



A Study of the Implications of Big Data Analytics on Business Intelligence

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ABSTRACT

Globally, social media has resulted in a revolution and compelled a paradigm shift in business operations. As a result, enormous volume of data has been collected from a variety of social media outlets, necessitating the use of this data for business intelligence reasons. Despite the importance, little study has been done on the consequences of using Big Data Analytics for Business Intelligence (BI). This research bridges a knowledge space by evaluating the function and implications of Big Data analytics on business intelligence for data obtained from India's social media networks. The study uses a qualitative technique to data collection due to the exploratory nature of the research. NVivo will be used to analyse the data in order to uncover issues that are crucial for creating revenue through Big Data analytics for business intelligence. The results have significant implications for both theory and practice in terms of developing plans and strategies to optimize the benefits of social media channels for commercial importance.

Keywords: Social Media, Big Data Analytics, Business Intelligence, N Vivo, Qualitative Technique.

INTRODUCTION

Business intelligence (BI) refers to a company's capacity to make effective use of data collected throughout normal business operations [5]. BI can help organizations improve their performance by finding new possibilities, highlighting potential dangers, disclosing new business insights, and improving decision-making processes, among other things [14] [6]. BI systems now focus mostly on structured and internal enterprise data. As a result, much useful information encoded in unstructured and external data remains hidden, potentially resulting in incomplete functionality. The approach of computing and web innovations have encouraged collection of an expansive volume



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of heterogeneous information from numerous sources on an progressing premise posturing unused challenges and openings for commerce intelligence. This knowledge involve each structured and unstructured, complicated and easy data. For instance, Wal-Mart will handle over one million transactions per hour. Twitter posts over five hundred million tweets on a daily basis [3]. Weibo is reported to own over 766 million active users per day in 2014 [12]. The increasing use of social media like YouTube, Twitter, and Weibo has contributed nearly ninetieth of the overall knowledge obtainable these days [11]. These unprecedented giant and complicated knowledge have born to the thought of "Big Data" [11]. Given its potential of making business worth, massive knowledge has gained vital attention in recent years. As per a TDWI survey in 2009, thirty eighth of the surveyed organizations have practiced advanced analytics and eighty fifth reportable that deployed it in 3 years [9]. By victimization advanced analytics, enterprises will analyze massive knowledge to be told, both, the present state of business and therefore the perpetually evolving processes like client behavior [9]. Massive knowledge analytics is predicted to handle several challenges that companies face nowadays [8].

However, the present analysis in use of huge information for business intelligence is principally focused on the advantages and challenges of business intelligence and massive information, whereas the sensible implications of mistreatment huge information analytics in enhancing business intelligence remain relatively under-researched. Some analysis exist typically targeted on the strategies, technical issues and its doable solutions in utilizing huge information analytics for business intelligence, however there's a lack of studies on the sensible implications of mistreatment huge information analytics for business intelligence generally and notably in Indian context particularly for information collected through social media. This analysis fills this gap in information by examining the sensible implication of huge information analytics for business intelligence by victimisation social media information in Asian nation and assess the long run developments. Therefore, the analysis queries are:

1. What are the implications of huge information analytics on business intelligence in Asian nation particularly for information collected from social media?
2. What are the long run directions for any developments in use of huge information analytics for business intelligence?

This study is critical because it investigates a problem in a very for the most part undiscovered analysis space. The results can facilitate managers and business homeowners to use huge knowledge analytics to know their business higher and improve their higher cognitive process and gain. The ever inflated use of Social Media in Republic of India provides a robust case for understanding however large knowledge collected from Social media may be used for furthering business productivity and client service enhancements in India.

Literature Review**Business Intelligence**

Business intelligence (BI) is that the ability of a corporation to create purposeful use of accessible knowledge. Business intelligence includes a variety of areas like competition intelligence, client intelligence, market intelligence, product intelligence, intelligence, technological intelligence and business intelligence. The author [14] cited a survey suggesting that the most important edges of BI are generating quicker and a lot of correct news (81%), improved business higher cognitive process (78%), improved client service (56%) and increasing company revenue (49%).

Big Data

Big knowledge is often characterized by three necessary attributes, particularly volume, selection and rate. The 3 Vs signify huge knowledge volume, knowledge kind selection and numerous knowledge generation rate. In terms of knowledge volume, as an example, Nielsen will generate around 300,000 rows of period knowledge per second from live viewing and yield quite one billion records per month to try and do huge knowledge analysis [5]. In terms of knowledge selection, huge knowledge analytics of, both, structured and unstructured knowledge will facilitate corporations generate insights from varied sources, together with shopper transactions, inventory observance, store-



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based video, advertizing and shopper relations, shopper preferences, sales management and money knowledge. For knowledge rate, huge knowledge analytics will alter period access and data sharing through native to national governments for improved higher cognitive process.

The Importance of Big Data in Business Intelligence

Big knowledge analytics will assist firms to higher exploit huge knowledge for up client satisfaction, managing provide chain risk, generating competitive intelligence, providing business time period insights to assist create necessary selections and optimizing evaluation if suitably used. In step with an investigation, a retail merchant which will use huge knowledge properly has the potential ability to extend hour of in operation margins by getting market share over its rivals and exploiting the elaborate client knowledge. Generally, there are five prime blessings of massive information analytics. First, it will increase visibility by creating connected information additional accessible. Second, it facilitates performance improvement and variability exposure by assembling correct performance information. Third, it helps in higher meeting the particular wants of shoppers by segmenting the population. Fourth, it enhances the choice creating with machine-driven algorithms by revealing valuable insights. Fifth, it yields new business models, principals, product and services. One in every of the foremost vital applications of massive information analytics is data creation, new management principles cultivation and also the economy supported this.

Big information analytics will improve the management of provide chain from numerous aspects, as well as provide chain potency, provide chain coming up with, internal control and risk management, market intelligence and period customized service. Meanwhile, massive information additionally support the availability chain to introduce new product and repair development ideas and also perceive however various sub-firms can collaborate along to optimize the operation method in an exceedingly value effective means. Big knowledge analytics can even facilitate to support the choice creating processes. The effective use of massive knowledge relies on an improved understanding of various call contexts and therefore the needed informatics mechanisms. Firms that shall implement massive knowledge analytics for the choice processes ought to attach nice importance on reducing equivocality and knowledge selection. Collaboration among call manufacturers and information analysts will enhance the effective utilization of massive information in higher cognitive process, however the choice processes ought to be rigorously managed so as to reduce the potential understanding gaps. So as to leverage the large quantity of heterogeneous information in unstructured text, audio and video formats, it's vital to develop correct and economical analytic strategies. Meanwhile, it's additionally important to utilize new tools to try to prophetic analytics for structured massive information.

Challenges of Big Data Analytics in the context of Business Intelligence

Although massive information will facilitate corporations deliver the goods competitive advantage over its rivals through several aspects, massive information analytics still face a spread of challenges. The main challenge of huge information analytics embrace lack of intelligent big information sources, lack of ascendible period analytics capabilities, the provision of enough network resources for running applications, the demand in necessary growth for peer-to-peer networks, the issues concerning information privacy and data security laws, the issues with information integration and fragmented information and lack of handiness of price effective storage scheme of high performance [6]. Also, the wants of costly software package and big machine infrastructure to try and do the analysis cause problems within the implementation of huge information analytics for metallic element.

Particularly, as massive knowledge involves storage of huge volumes of collective heterogeneous knowledge from a good vary of sources; it remains the target of hackers. The compliance to regulative necessities, particularly the information protection laws becomes a crucial issue. Since the large knowledge analytics remains in its infancy, there are not any clear rules for safeguarding and protective the privacy, and which can hurt the general public trust on massive knowledge storage and its analytics. The challenge is to ascertain protocols to line written agreement restrictions on exposing the information to unauthorized individuals and revealing of the information, proscribing



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the copy of the information, establishing personnel background check for people who are unit able to access to the information, and setting written agreement restriction of the employment of specific comes information[10]. Apart from the safety and privacy problems with massive information, the hardware-technology that supports massive information analytics poses challenges (computation, networking and storage technology). First, the technology is unable to supply one computing configuration to use on each period and ascendible analysis. Second, the networking technology cultivates growing void between information measure, that limits the network capability to support period applications. Third, there's no well-established rule to predict the expansion in storage capability of magnetic drives [15].

Methodology

Given the preliminary nature of the study, this study uses a semi-structured interview to knowledge assortment. This technique is employed in the main because of two reasons. First, the two-way communication throughout the interview can facilitate in seeking a lot of elaborated and in-depth data. Second, it will permit to raise queries outside the semi-structured form for seeking clarity and grouping sturdy knowledge and asking follow-up queries [3]. This flexibility in communication might facilitate in generating sudden insights. The whole analysis method is split into four main stages: form style, knowledge assortment, knowledge analysis and report writing. The data assortment can involve around fifty interviews with consultants from various backgrounds. The respondents are IT managers / administrators, Chief data Officers (CIOs), IT consultants, Senior managers with involvement in BI, and Business Development managers. Interviews are audio recorded with interviewees' permission so transcribed verbatim.

The data are analyzed mistreatment the NVivo ten code, that could be a helpful analysis tool for qualitative information. Two secret writing cycles are enclosed within the analysis method to permit for brand new findings from the info. The answers will first be set to completely different themes supported the main focus of the content. Then answers inside a similar themes are compared and contrasted to spot the similarities and variations across the themes. The respondents profile information such occupation, people and dealing expertise of respondents shall even be thought-about within the analysis method to justify their opinions. For instance, those that worked because it managers and IT Consultants could have completely different views on huge information or business intelligence. Therefore, these factors ought to be deliberated within the analysis method to induce deeper insights in regard to the planned analysis queries.

Questionnaire Development and Data Collection

To develop a semi-structured form, an in depth literature review has been administered to spot necessary problems which will facilitate answer the analysis queries. The literature analysis resulted in identification of variety of problems that are accustomed produce queries. These embody, however not restricted to, implications of huge knowledge analytics for: developing on-line selling methods, combining Social media knowledge with period sales knowledge to research the influence of selling campaign on shopper sentiment and buying behavior, characteristic key opinion leaders to line selling targets, analyzing social network to spot bottlenecks in company info flows, analyzing social network knowledge to find the reactions of various client segments and stakeholders to company's merchandise and actions, sentiment analysis of social media knowledge to watch the period response of shopper behavior and modify selling strategy consequently, the appliance of victimization huge knowledge analysis of social media knowledge to develop new merchandise and new models, victimization knowledge from social media to spot sales opportunities, and also the application of huge knowledge analytics in personalization.

The form consists of two components. The primary half collects interviewees' details like their title, organisation size, kind and business of the respondents' organisation. The second a part of the form includes twenty queries covering a range of problems to collect associate in nursing understanding of the implications of huge knowledge analytics on business intelligence. The data assortment is presently current and also the study is victimization multiple strategies together with face to face and on-line interviews over skype and different Social Media communication channels.



**Rekha Chouhan and Mahima Singh****Limitations and Future Scope**

The study has some limitations furthermore. First, despite the actual fact that qualitative knowledge assortment technique has its benefits, it will have some limitations. The quantity of individuals interviewed during this analysis is restricted and also the location of interviewees cannot cover all the regions of India. Therefore, the conclusions derived from this analysis could also be improved with additional knowledge collected in future study. Second, given the qualitative beta study, any generalisation of results shall be finished caution. The study exposes variety of recent directions for more analysis. Future analysis will be done by involving business specific respondents to unearth patterns from a selected business perspective. The results will be more enlarged by interviewing additional respondents and senior managers [7]. More analysis is secure in understanding patterns in huge knowledge from completely different Social Media channels and such patterns impact the business and call creating processes. However knowledge collected from completely different Social Media channels will be contrasted and combined in more practical ways that to assist enhance business price and productivity. Next set of studies can even take a longitudinal approach to hunt additional insights on the drivers and inhibitors of use of massive knowledge analytics and significantly from Social Media based mostly huge knowledge. The results of qualitative study will be increased by a follow-up quantitative cross- section survey-based studies to assist generalize the findings.

CONCLUSION

The Big information analytics offers multitude of opportunities to reinforce business price and productivity. One amongst the most applications of huge information analytics is for business intelligence to enhance deciding capabilities, quicker deciding, understanding of client desires, developing ways for launching new product and services, exploring new markets, rising inventory turnovers, reducing client complaints, and enhancing workers' productivity and potency. This study explores implications of huge information analytics of information collected from Social Media for increased business intelligence among the context of Indian businesses. Social Media in India and on-line business in India have mature exponentially over the last decade and however information collected from these channels will be usefully utilized for more business enhancements.

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Studies on Distribution and Diversity of True Mangroves at Vellikkeel, Kannur, Kerala

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ABSTRACT

Seven species of true mangroves belonging to six families are found at Vellikkeel. The true mangroves present in Vellikkeel are *Kandelia candel*, *Aegiceras corniculatum*, *Acanthus ilicifolius*, *Sonneratia caseolaris*, *Excoecaria agallocha*, *Rhizophora mucronata* and *Avicennia officinalis*. The distribution and diversity indices of mangroves are calculated and found out that *Kandelia candel* was the most dominant species in Vellikkeel. The presence of *Salvinia molesta* may cause threat to the mangrove ecosystem of Vellikkeel.

Keywords: Diversity Indices, Mangrove Distribution, True Mangroves, Vellikkeel.

INTRODUCTION

The mangrove ecosystem consists of woody vegetation inhabiting in intertidal marine and brackish environment [1],[2] found in between 30°N and 30°S latitude [3]. The mangrove biodiversity of India is unique in several aspects such as richness and spatial distribution [4]. Even though it plays a vital role in the maintenance of ecological balance and provide many ecological and economical services, mangroves are not yet conserved as they should [5]. The government of Kerala is planning to take over 12 sq.km areas of mangroves that are in private lands [6]. This is a great initiative for conservation of mangrove ecosystem because most mangroves that are destroyed for cultivation or construction lies in private land. The major threats of mangroves are aquaculture or agricultural expansion, cutting for mangroves for timber, fuel and charcoal, pollution, natural calamities, reduction of freshwater and tidal water flows, invasive species and climate change [7]. Mangroves are destroyed for the cultivation of paddy and coconut in the South Indian states of Karnataka, Goa and Andhra Pradesh [8],[9],[10]. Similar trend is seen Kerala





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where mangrove forests are destroyed and reclaimed as aquaculture and paddy fields. That is one of the many reasons why the status of mangroves is to be updated. It is reported that Kerala once held more than 700 sq.km of mangroves but at present it is reduced to 17 sq.km [11]. Kannur holds the richest floristic diversity of mangroves in Kerala. Many mangrove ecosystems were converted into ecotourism spots such as Thanal Eco Park in Perumba, Payyannur and Vellikkeel Eco Park in Thalipparamba. Even though the eco parks serves to protect mangroves for construction of building and other things many mangroves are destroyed. This should be avoided. Considering these facts, it is important to conserve the mangrove forests from further declination. In order to conserve the mangrove ecosystem, the distribution status and declination status should be constantly updated. For that, survey should be undertaken at every local area where mangroves grow. In this report, the current status of mangroves at the Vellikkeel Eco Park, Kannur district, Kerala is discussed.

MATERIALS AND METHOD

Study Area

Vellikkeel is located in Kannur district, Kerala. Vellikkel is one of the best ecotourism spots in the district. It comes under the Village Morazha and is located at 11.9996°N, 75.3401°E coordinates. The presence of Mangrove plants attracted the area and it is considered as an ecotourism center from 2014. Mangroves seedlings were planted during 2014 and 2015 in this area. Currently the place is one of the peaceful areas without much of traffic and one can enjoy the beauty of nature without much human interactions.

Diversity and Structural Analysis

The study was conducted by making seven plots of 10m x 10m quadrats non-randomly in the mangrove inhabiting areas. The girth measurements of all the plants inside the plots which have more than 10 cm girth were taken. Through the quadrant method, the frequency, relative frequency, density, relative density, abundance and relative dominance were calculated using standard phytosociological methods [12]. Important Value Index as the sum of the of relative frequency, relative density and relative dominance was calculated to find out the dominant species [13]. The data obtained from the plots were analyzed to calculate the diversity indices and species richness such as Shannon–Weiner diversity (H), Simpson index [14], species richness and evenness [15] were measured. Frequency, density, abundance, relative frequency, relative density and relative abundance were calculated using following formulae:

$$\text{Frequency (F)} = \frac{\text{Total no. of quadrats in which the species occurred}}{\text{Total number of quadrats studied}} \times 100$$

$$\text{Density (D)} = \frac{\text{Total no. of individuals of the species}}{\text{Total no. of quadrats studied}}$$

$$\text{Abundance (A)} = \frac{\text{Total no. of individuals of a species in all quadrats}}{\text{Total no. of quadrats in which the species occurred}}$$

$$\text{Relative Frequency (RF)} = \frac{\text{Frequency of an individual species}}{\text{Frequency of all the species}} \times 100$$

$$\text{Relative Density (RD)} = \frac{\text{No. of individuals of the species in all quadrats}}{\text{No. of individuals of all species in all quadrats}} \times 100$$

$$\text{Relative Dominance (RDO)} = \frac{\text{Total basal area of a species}}{\text{Basal area of all species in the area}} \times 100$$

$$\text{Importance Value Index} = \text{Relative Frequency} + \text{Relative Density} + \text{Relative Dominance}$$





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RESULTS AND DISCUSSION

A total of 7 species of true mangroves belonging to 6 families namely *Kandelia candel*, *Aegiceras corniculatum*, *Acanthus ilicifolius*, *Sonneratia caseolaris*, *Excoecaria agallocha*, *Rhizophora mucronata* and *Avicennia officinalis* are found at Vellikkeel (See Table 1). The distribution status of true mangroves of Vellikkeel is shown in Table 2, Figure 1 and Figure 2. *Kandelia candel* is the most dominant true mangrove species at Vellikkeel followed by *Acanthus ilicifolius*, *Excoecaria agallocha* and *Aegiceras corniculatum*. *Rhizophora mucronata* was the least dominant species followed by *Avicennia officinalis* and *Sonneratia caseolaris*. The presence of the invasive species *Salvinia molesta* is observed in the waters of Vellikkeel. Probably this taxon may pose a threat to the mangrove ecosystem of Vellikkeel. In the present study, 7 true mangroves namely *Kandelia candel*, *Aegiceras corniculatum*, *Acanthus ilicifolius*, *Sonneratia caseolaris*, *Excoecaria agallocha*, *Rhizophora mucronata* and *Avicennia officinalis* and the fern mangrove *Achrostichum aureum* are found at Vellikkeel of which *Kandelia candel* is the most dominant species. [16] reported the same results in their study in mangroves of Vellikkeel. [17] reported the occurrence of *Bruguiera cylindrica*, *Rhizophora apiculata* and *Sonneratia alba* in Vellikkeel. But these plants are not found in the current study. Also *Sonneratia caseolaris* found in the current study was not reported by them.

SUMMARY AND CONCLUSION

A total of 7 true mangroves are found at Vellikkeel along with the mangrove fern *Achrostichum aureum*. The true mangrove species found at Vellikkeel are *Kandelia candel*, *Aegiceras corniculatum*, *Acanthus ilicifolius*, *Sonneratia caseolaris*, *Excoecaria agallocha*, *Rhizophora mucronata* and *Avicennia officinalis*. Of these *Kandelia candel* is found to be most dominant species and *Rhizophora mucronata* is found to be least dominant species.

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Table 1: The true mangroves and their IUCN status of Vellikkeel.

SL. NO.	SPECIES	FAMILY	IUCN STATUS
1	<i>Kandelia candel</i> (L.) Druce	Rhizophoraceae	Least Concerned
2	<i>Aegiceras corniculatum</i> (L.) Blanco	Primulaceae	Least Concerned
3	<i>Acanthus ilicifolius</i> L.	Acanthaceae	Least Concerned
4	<i>Sonneratia caseolaris</i> (L.) Engl.	Lythraceae	Least Concerned
5	<i>Excoecaria agallocha</i> L.	Euphorbiaceae	Least Concerned
6	<i>Rhizophora mucronata</i> Lam.	Rhizophoraceae	Least Concerned
7	<i>Avicennia officinalis</i> L.	Avicenniaceae	Least Concerned

Table 2: Distribution of True Mangroves in Vellikkeel

SPECIES	FREQUENCY	DENSITY	ABUNDANCE	RELATIVE FREQUENCY	RELATIVE DENSITY	RELATIVE DOMINANCE	IMPORTANT VALUE INDEX
<i>Kandelia candel</i> (L.) Druce	57.33	1.13	1.58	41.03	43.79	40.63	125.45
<i>Aegiceras corniculatum</i> (L.) Blanco	17.33	0.25	0.95	12.4	9.3	8.21	29.91
<i>Acanthus ilicifolius</i> L.	22	0.6	2.45	19.48	24.73	17.68	61.89
<i>Sonneratia caseolaris</i> (L.) Engl.	8	0.09	0.35	8.91	6.26	4.08	19.25
<i>Excoecaria agallocha</i> L.	10	0.17	1.09	10.07	11.43	17.29	38.79
<i>Rhizophora mucronata</i> Lam.	4	0.04	0.17	4.07	1.56	0.3	5.93
<i>Avicennia officinalis</i> L.	6	0.08	0.22	3.95	3.03	11.81	18.79





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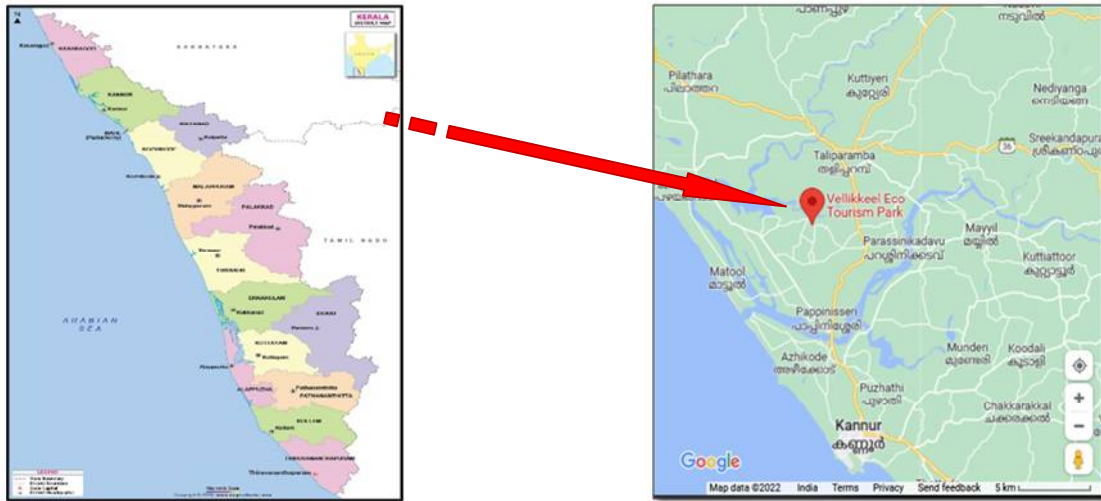


Figure 1: Study Area

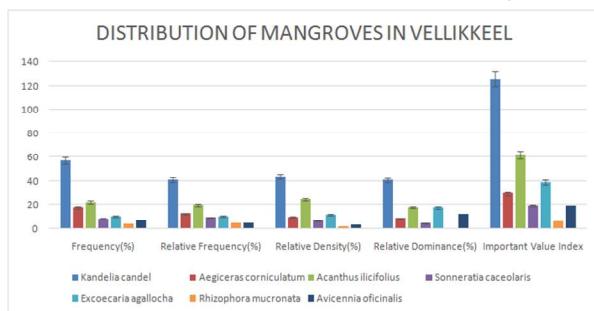


Figure 2: Distribution of true mangroves of Vellikkeeel

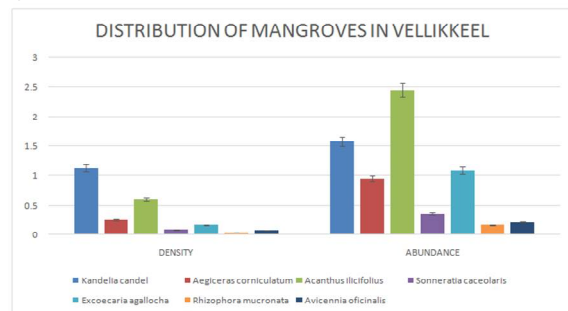


Figure 3: Density and Abundance of true mangroves of Vellikkeeel.

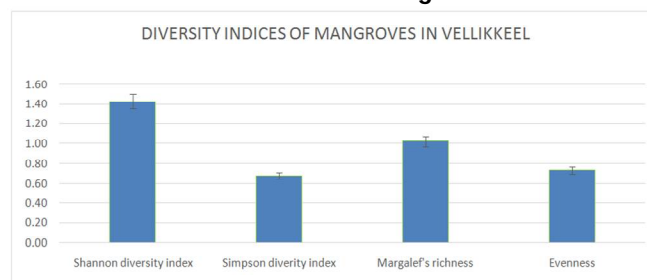


Figure 4: Diversity Indices of true mangroves of Vellikkeeel.





Prevalence of Adolescent Obesity in North East Indian (NEI) States- A Crises in Public Health

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ABSTRACT

The adolescents section of the society is the youth which generally comprises the future of a developing country like India. Researchers have shown a keen interest in examine the fitness level of school children of North-Eastern Indian (NEI) states and the risks associated with health. This study deals with analyzing the physiological parameters like Body Mass Index (BMI) and Waist-Hip Ratio (WHR) of 1200 boys & girls (each gender had 600 subjects) school children of Assam, Manipur, Tripura, and Arunachal Pradesh (NEI) with an age group of 10-19-year. In the present study 2 X 3 X 4 factorial design ANOVA was used to find out the trend in BMI and WHR, followed by leveraging of ANOVA to find out the interaction. Pearson correlation was used to examine the association between WHR and BMI in different age groups of Adolescent. Results of the study revealed that body mass index of boys & girls of NEI significantly influence by gender, age, states, interaction of age & states, gender & age & state at 0.01 level of significance. No significant influence of age, gender and states of North East India was observed on Waist Hip Ratio of school children. Overall, in 10-13 years age group of school children 01% are in underweight, 82.25% are in normal, 13.75% are in overweight, 03% are in obesity whereas in 13-16 years age group of school children 0.25% are in severely underweight, 01% are in underweight 84.75% are in



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normal, 11.25% are in overweight, 2.75% are in obesity. However, in 13-16 years age group of school children 0.25% are in severely underweight, 01% are in underweight, 84.75% are in normal, 11.25% are in overweight, 2.75% are in obesity. However, in 16-19 years age group of school children 2.25% are in underweight, 80.5% are in normal, 15.5% are in overweight, 1.75% are in obesity. Regardless of gender approximately 80% school children of states of North East India have normal body weight. Further it is observed from the results of correlation that a significant association is observed between BMI and WHR in age group of 13-16 years only. On the basis of finding of present study it can be concluded that more than 80% of boys and girls school children of NEI are having good health, better fitness and having positive attitude towards regular exercise.

Keywords: Obesity; Body Mass Index; Waist Hip Ratio; North-Eastern India.

INTRODUCTION

Health is most prestigious gift for everyone and people of north east have very active lifestyle. Family lifestyles have great impact on the health of adolescents and adolescents' poor health has negative influence on adult life. Approximately world population constitutes one sixth adolescents aged 10-19 years (Saikia & Debbarma, 2020). In India approximately 243 million people fall in group of adolescents which is highest in the world (Chaturvedi et al., 1997). Recent research stated that health of adolescents affected by under as well as over nutrition (Chaturvedi & Mahanta, 2004). Across the world among children and adolescents, rate of obesity and overweight significantly increased in last two decades (Lobstein et al., 2004). Adolescent's overweight is connected to instant and long-term risks on health such as type 2 diabetes, blood pressure, cholesterol and obesity (Lloyd et al., 2012). The major cause of a high mortality rate in India has always been Cardiovascular Diseases (CVDs). The proneness to such diseases increases with addiction to narcotics, alcohol consumption, smoking habits, obesity (high BMI), high Waist-Hip Ratio (WHR), and other associated reasons (Gupta et al., 2008). Indian data regarding obesity among school children shows that it is increasing very rapidly and a study was conducted in south India stated that percentage of overweight children improved from 4.94 per cent of the total students in 2003 to 6.57 per cent in 2005 demonstrating the time trend of this rapidly growing epidemic (Raj et al., 2007). Lifestyle and socio-economic status are two important factors responsible for adolescent's obesity and a study from northern India shows that higher socio-economic group have 5.59% greater obesity as compared to lower socio-economic strata (Marwaha et al., 2006). Obesity is associated with type -2 diabetes among the adolescents within age of 10 years (American Diabetes Association,2000). In India among urban children type-2 diabetes is increasing rapidly (Ramachandran et al., 2003).

In India obesity is increasing very rapidly especially in school going children which increased the risk of hypertension, type 2 diabetes, cardio vascular disease, premature death, anxiety, stress, depression low self-esteem, insomnia and poor performance in exams. Greater Body Mass Index in children is a major risk of musculo skeletal disorders, osteoarthritis, breast cancer and fatty liver. In India under the age of five 2% children are overweight (Lobstein and Jackson, 2016). In Indian adolescent prevalence of obesity has been increased 9.8% in 2006 to 11.7% in 2009 (Gupta et al., 2011). India by 2025 may be reached a figure of 17 million obese children and this trend is common for both urban and rural area (Lobstein and Jackson, 2016). In 5 -19 years children prevalence of overweight ranged between 6.1 and 25.2% while obesity between 3.6 and 11.7% (Gupta et al., 2012). Obesity in Indian adolescents is a serious concern and to tackle this menace a well-planned strategy is need to implement at school level. National Family Health Survey shows that prevalence of obesity of Arunachal Pradesh(10.6% for male and12.5%, for female), Assam (6.7% for male and 7.8%, for female), Manipur (13.4% for male and 17.1% for female), Meghalaya (8.2% for male and 8.9% for female), Mizoram (16.9% for male and 20.3% for female), Nagaland (8.4% for male and 10.2% or female), Sikkim (17.3% for male and 21.0% for female), and Tripura (5.2% for male and 5.3% for female) respectively. {Ava i la blefrom <http://en.wikipedia.org> I wikil Obesity-in India. (Last accessed on 04-08-



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201.21. } The national survey revealed that undernutrition is common health issues in rural areas where as overweight and obesity was found higher in urban areas. To fill this gap of knowledge researchers of present study think there is need of hour to investigate the health status of adolescents of North-East Indian (NEI) States. Therefore, present study is undertaken to examine prevalence of Adolescent Obesity in North-East Indian (NEI) States.

METHODOLOGY

Present study was conducted on adolescents of North-East Indian and purposive sampling was used to select 1200 respondents (600 each of Boys and Girls) having equal and normal distribution for 3 continuous intervals of age groups, precisely 10-13 years, 13-16 years and 16-19 years (lower limits included in the scale) separately for both Boys and Girls, making the study reliable and accurate in every segment. Literature reviews related to background of study was done and on the basis of reviews following Physiological Parameters like Body Mass Index (BMI) and Waist Hip Ratio (WHR) were studied to know the obesity and lifestyle among the different age group school children of North-East Indian. The flow has been illustrated in Figure 1 below.

Ethical Consideration

A verbal consent was taken from each subject involved in this study.

Criteria for Obesity

WHO (Z-Score) classification was applied for the appraisal of various classes of obesity among the adolescents. Severely Underweight whose z-score is below (-3 SD), Underweight whose z-score is between (-3 to -2 SD), Normal Body weight whose z-score is between (-2 to 1 SD), Overweight whose z-score is between (1 to 2 SD) and Obese whose z-score is above (2 SD) applied for both boys and girls (WHO,2007).

Statistical Analysis

For the analysis of acquired data IBM SPSS (version 20.0.0) was used and Shapiro –Wilk coefficients test shows normality of data for BMI and WHR separately for boys and girls of three age groups (10-13 years, 13-16 years, and 16-19 years) of Assam, Manipur, Arunachal Pradesh and Tripura states of northeast states of India. Levene's test (1960) was used to meet the assumptions of homogeneity of variance. 2 X 3 X 4 Factorial Design ANOVA was applied to examine the difference with in age, gender and sates of North East India. Further Duncan's Multiple Range Test was also used to measure specific differences between pairs of means. The alpha level was at 0.05 level.

RESULTS

Results of the Shapiro –Wilk coefficients test stated that normality assumptions were met in case of BMI except 10-13-year age group of Assam, Manipur, Arunachal Pradesh in boys and 10-13years age group of Arunachal Pradesh in girls. Whereas normality assumptions were also met in case of WHR except 10-13years age group of Assam, 16-19 years in Arunachal Pradesh in boys and 13-16-year age group of Tripura and 16-19-year age group in Manipur in girls. The level of significance for all tests was set at 0.05. The F-test from Levene's test is significant of Body Mass Index, $F(23, 1176) = 5.56, p = 0.00$, Waist Hip Ratio, $F(23, 1176) = 4.08, p = 0.00$ and the assumption of the homogeneity was violated. F-test is valid to use if unequal variance exists among the identical sample sizes. Results have shown in Table 1 below. Descriptive statistics were applied and results are given in Table 1.

Table -1 clearly revealed that in age groups of 10-13 years lowest average body mass index was found in Tripura & Arunachal Pradesh in boys & girls respectively. Whereas in 13-16 years age groups lowest average body mass index was found in Tripura in both boys and girls. However, in age groups of 16-19 years lowest average body mass index was found in Arunachal Pradesh in both boys & girls. On the whole it may be observed that girls have greater Body Mass Index as compared to boys of sates of North East India. For girls, in the age range of 16-19 years, Assam has



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shown a slightly exceeding mean (by 0.01) of WHR value, which is negligible. For all other sections, the mean values of WHR for boys is less than 0.89 and for girls less than 0.85 which is within the normal range.

The first objective was to study the influence of Gender, Age, States, and their various interactions on the Body Mass Index of Schoolchildren. From Table 2, showed that the F-Value for Gender, Age, States, interaction between Age & States and interaction among Gender, Age & States were found significant at the level of 0.01. Whereas no significant difference was found in interaction between Gender & Age and Gender & states. From Table 3, revealed that Body Mass Index of school children of 10-13 years & 13 -16 years of age and 10-13 years & 16-19 years of age differ significantly at the level 0.01. School children of 10-13 years of age had a lower Body Mass Index as compared to school children of 13 -16 years and 16-19 years of age. When comparing Body Mass Index among the States of North East India, results showed significant difference between Assam & Manipur, Assam & Tripura, Manipur & Tripura, Tripura & Arunachal Pradesh at the 0.01level whereas between Manipur & Arunachal Pradesh at the 0.05level. On the whole, it may be said that Tripura school children were found to have the lowest obesity as compared to Assam, Manipur, and Arunachal Pradesh school children (Table 4).

From Graph 1, it is evident that with an increase in Age the Body Mass Index was found to increase sharply in the case of Schoolchildren from Tripura State. On the other hand, Body Mass Index was found to increase sharply as the Age increased from 10 to 16 Years of Schoolchildren from Manipur, Assam & Arunachal Pradesh states but Body Mass Index decreased sharply as Age increases from 13 to 19 years of Schoolchildren from Arunachal Pradesh. Further, Body Mass Index increased as Age increases from 13 to 19 years of Schoolchildren from Manipur and Assam. Body Mass Index was the highest in Age group of 13 to16 Years School children from Arunachal Pradesh but School children from Manipur, Assam, and the Tripura States were found to have higher obesity at the Age lies between 16 to 19 Years. In the increasing order of Body Mass Index, the School children in the Age range of 16 to 19 Years were from Arunachal Pradesh, Tripura, Manipur, and Assam.

From Graph 2, it is evident that with an increase in Age the Body Mass Index was found to increase sharply in the case of School Boys from Tripura State. On the other hand, Body Mass Index was found to increase sharply as the Age increased from 10 to 16 Years of School Boys from Manipur, Assam & Arunachal Pradesh states but obesity decreased sharply as Age increases from 13 to 19 years of School Boys from Arunachal Pradesh. Further, the Body Mass Index increased as Age increased from 13 to 19 years of School Boys from Manipur and Assam. Body Mass Index was the highest in Age group of 13 to16 Years of School Boys from Arunachal Pradesh but School Boys from Manipur, Assam, and the Tripura States were found to have higher Body Mass Index at the Age lies between 16 to 19 Years. In the increasing order of Body Mass Index, the School Boys in the Age range of 16 to 19 Years were from Arunachal Pradesh, Tripura, Manipur, and Assam.

From Graph 3, it is evident that Body Mass Index among School Girls between ages 10 to 13 from the states of Assam, Manipur, Tripura, and Arunachal Pradesh was almost the same and the lowest. As Age increased from 10 to 16 Years, the Body Mass Index was found to increase among School Girls from Assam, Manipur, Tripura, and the Arunachal Pradesh States but it increases sharply among School Girls from Assam and the Arunachal Pradesh States. School Girls between ages 13 to 16 Years from Assam and Arunachal Pradesh were found to have the highest Body Mass Index. As Age increased from 13 to 19 years, the Body Mass Index among School Girls from Arunachal Pradesh decreased sharply. Further, as Age increased from 13 to 19 years, the Body Mass Index increased among School Girls from Tripura and Manipur. At Ages between 16 and 19 Years, School Girls from Assam were found to have the highest Body Mass Index but School Girls from Manipur, Tripura, and Arunachal Pradesh were found to have almost the same Body Mass Index.

The second objective was to study the influence of Gender, Age, States, and their various interactions on the Waist Hip Ratio of Schoolchildren. From Table 5, showed that the F-Value for Gender, Age, States, interaction between Gender & Age, Interaction between Gender & Sates, interaction between Age & States and interaction among Gender, Age & States were found insignificant.



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DISCUSSIONS AND CONCLUSION

The above study comprised of collection of sample data of 1200 students which included three age groups i.e., 10-13 years, 13-16 years and 16-19 years, followed by normalization of data using Shapiro Wilk test. Lastly ANOVA test was conducted to find out the interrelationship among several parameters the results of which are discussed below.

From the findings of present study, it is evident that on the basis of Z-score (WHO, 2007) in Assam 10-13 years age group of boys 80% are in normal body weight, 16% are in overweight and 04% are in obesity whereas girls of the same age group 84% are in normal, 12% are in overweight and 04% are in obesity. In 13-16 years age group of boys 82% are in normal body weight, 18% are in overweight whereas girls of the same age group 04% are in underweight, 88% are in normal, 06% are in overweight and 02% are in obesity. In 16-19 years age group of boys 02% are underweight, 80% are in normal body weight, 18% are in overweight whereas girls of the same age group 04% are in underweight, 80% are in normal, 14% are in overweight and 02% are in obesity. However, in Arunachal Pradesh 10-13 years age group of boys 88% are in normal body weight, 08% are in overweight and 04% are in obesity whereas girls of the same age group 04% are in underweight, 78% are in normal, 18% are in overweight. In 13-16 years age group of boys 02% are in severely underweight, 86% are in normal body weight, 12% are in overweight whereas girls of the same age group 82% are in normal, 16% are in overweight and 02% are in obesity.

In 16-19 years age group of boys 84% are in normal body weight, 12% are in overweight, 04% are in obesity whereas girls of the same age group 02% are in underweight, 84% are in normal, 14% are in overweight. Similarly in Manipur 10-13 years age group of boys 82% are in normal body weight, 14% are in overweight and 04% are in obesity whereas girls of the same age group 86% are in normal, 10% are in overweight, 04% are in obesity. In 13-16 years age group of boys 86% are in normal body weight, 10% are in overweight, 04% are in obesity whereas girls of the same age group 84% are in normal, 12% are in overweight and 04% are in obesity. In 16-19 years age group of boys 80% are in normal body weight, 14% are in overweight, 04% are in obesity whereas girls of the same age group 02% are in underweight, 84% are in normal, 14% are in overweight. In Tripura 10-13 years age group of boys 02% are in underweight, 80% are in normal body weight, 16% are in overweight and 02% are in obesity whereas girls of the same age group 02% are in underweight, 80% are in normal, 16% are in overweight, 02% are in obesity. In 13-16 years age group of boys 02% are in underweight, 84% are in normal body weight, 08% are in overweight, 06% are in obesity whereas girls of the same age group 02% are in underweight, 86% are in normal, 08% are in overweight and 04% are in obesity. In 16-19 years age group of boys 02% are in underweight, 78% are in normal body weight, 18% are in overweight, 02% are in obesity whereas girls of the same age group 04% are in underweight, 74% are in normal, 20% are in overweight and 2% are in obesity. On the overall in 10-13 years age group of school children 01% are in underweight, 82.25% are in normal, 13.75% are in overweight, 03% are in obesity whereas in 13-16 years age group of school children 0.25% are in severely underweight, 01% are in underweight 84.75% are in normal, 11.25% are in overweight, 2.75% are in obesity. However, in 13-16 years age group of school children 0.25% are in severely underweight, 01% are in underweight, 84.75% are in normal, 11.25% are in overweight, 2.75% are in obesity. However, in 16-19 years age group of school children 2.25% are in underweight, 80.5% are in normal, 15.5% are in overweight, 1.75% are in obesity.

Regardless of gender approximately 80% school children of states of North East India have normal body weight. It may be attributed due to the fact that most of the subject appeared in the study were from rural areas of states of North East India. Adolescents from rural areas engage more in physical activities and for attending school they use bicycle or walk and also eat less spicy & oily food. The people of North East states are indigenous and live-in inhabiting contrasting environments, hills as a result they participate more in strenuous activities which help them to be more fit and active. Other significant reasons may be large ethnic variation socio-economic disparities, demographic situations, socio-cultural diversity and healthcare practices among the people of states of North East India. Another significant inference of study was girls have greater body mass index as compared to boys. It may be due the reasons that girls have more restriction and involved in less physical activities as compared to boys. Qiu, Guo, Duan, Yang, and Sakamoto (2013) conducted a study and showed that body mass index for 6 to 18 years



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children vary for boys and girls. The patterns of overweight/obesity differ by age, sex, rural or urban residence, and socioeconomic position and vary between and within countries (Matijasevich, 2009). Kapil et al. (2009) said girls are more overweight than boys. This higher prevalence of overweight among girls may be related to the adolescent growth spurt and the effects of hormonal surge that occurs earlier in girls (Chhatwal,2002). Further finding of study show that Body Mass Index significantly vary with increasing age of boys and girls. Result of present study are in consonance with study conducted by (Swati et al. 2017) stated that body mass index varies with age group in school boys and girls. No significant influence of age, gender and states of North East India was observed on Waist Hip Ratio of school children.

Obesity in Indian school children is a cause of concern. To tackle this menace, a sustained multi-pronged approach is required, where all stake holders join hands. The strategy starts at the pre-conception time, continues during pregnancy, infancy and childhood. Apart from promoting healthy eating and an active lifestyle, it also includes active case finding among overweight and obese children and aggressive management of diabetes, hypertension and dyslipidaemia apart from weight loss. Legislations targeting infant feeds, HFSS, artificially sweetened soft drinks, nutrient labelling and food advertisements are important. Government have to be serious about implementing these legislations and they should also formulate imaginative programmes to target childhood nutrition and lifestyle.

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Table 1: Descriptive Statistics (Mean & SD) of BMI and WHR of Respondents in North-Eastern India (NEI)

States	BMI						WHR					
	10-13		13-16		16-19		10-13		13-16		16-19	
	M	F	M	F	M	F	M	F	M	F	M	F
Assam	17.25 ± 1.47	17.93 ±1.45	21.1 ±1.36	22.08 ±1.71	21.97 ±2.23	21.78 ±2.35	0.81 ±.04	0.83 ±.06	0.85 ±.05	0.85 ±.05	0.88 ±.05	0.86 ±.05
Manipur	17.56 ±2.01	18.2 ±2.00	19.67 ±2.65	20.38 ±2.55	21.25 ±2.64	20.8 ±1.8	0.84 ±.05	0.82 ±.06	0.81 ±.05	0.80 ±.05	0.79 ±.04	0.81 ±.05
Arunachal Pradesh	17.84 ±2.72	17.67 ±1.28	22.75 ±1.67	21.79 ±1.97	20.00 ±1.55	20.58 ±1.89	0.77 ±.05	0.76 ±.05	0.89 ±.02	0.80 ±.04	0.86 ±.04	0.85 ±.04
Tripura	16.35 ±1.23	17.74 ±1.26	18.94 ±1.60	18.77 ±1.66	20.48 ±2.08	20.95 ±2.87	0.76 ±.07	0.79 ±.03	0.84 ±.05	0.84 ±.06	0.87 ±.05	0.84 ±.06

M- Boys F- Girls

Table 2: Summary of 2 X 3 X 4 Factorial Design ANOVA of Body Mass Index of School Children

Source of Variance	df	SS	MSS	F-Value	Sig.
Gender	1	25.30	25.30	6.33	0.01
Age	2	2854.29	1427.15	356.86	0.00
States	3	381.28	127.09	31.78	0.00





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Gender * Age	2	17.54	8.77	2.19	0.11
Gender * States	3	25.22	8.41	2.10	0.09
Age * States	6	506.24	84.37	21.10	0.00
Gender * Age * States	6	81.97	13.66	3.42	0.00
Error	1176	4703.04	4.00		
Total	1199	8594.89			

Table 3: Age-wise Mean, SE, and Significance of difference among mean scores of Body Mass Index of School Children

Age	Mean	SE	13- 16 Years	16 -19 Years
10-13 Years	17.57	0.1	**	**
13- 16 Years	20.68	0.1		Not Significant
16 -19 Years	20.98	0.1		

**Significant at 0.01 level.

Table 4: States-wise Mean, SE, and Significance of Difference among mean scores of Body Mass Index of School Children

States	Mean	SE	Manipur	Tripura	Arunachal Pradesh
Assam	20.35	0.16	**	**	Not Significant
Manipur	19.64	0.16		**	*
Tripura	18.87	0.16			**
Arunachal Pradesh	20.10	0.16			

*Significant at 0.05 level **Significant at 0.01 level

Table 5: Summary of 2 X 3 X 4 Factorial Design ANOVA of Waist Hip Ratio of School Children

Source of Variance	df	SS	MSS	F-Value	Sig.
Gender	1	7.80	7.80	1.17	.28
Age	2	17.15	8.58	1.29	.28
States	3	19.37	6.46	.97	.41
Gender * Age	2	13.29	6.64	1.00	.37
Gender * States	3	22.60	7.53	1.13	.34
Age * State	6	42.93	7.16	1.07	.38
Gender * Age * States	6	38.07	6.34	.95	.46
Error	1176	7829.70	6.66		
Total	1199	7990.91			

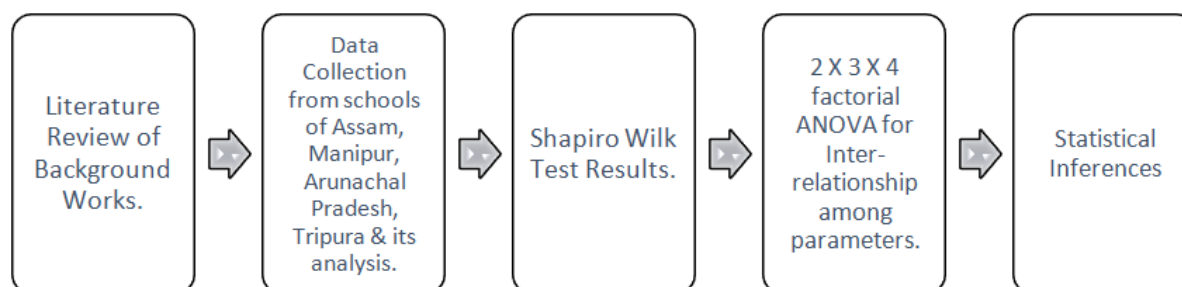
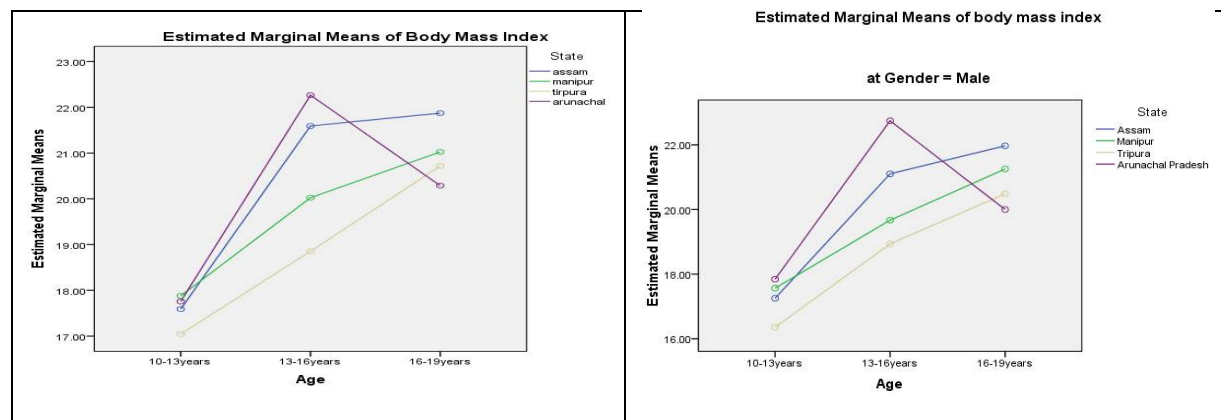


Figure 1: Research Methodology Block Diagram



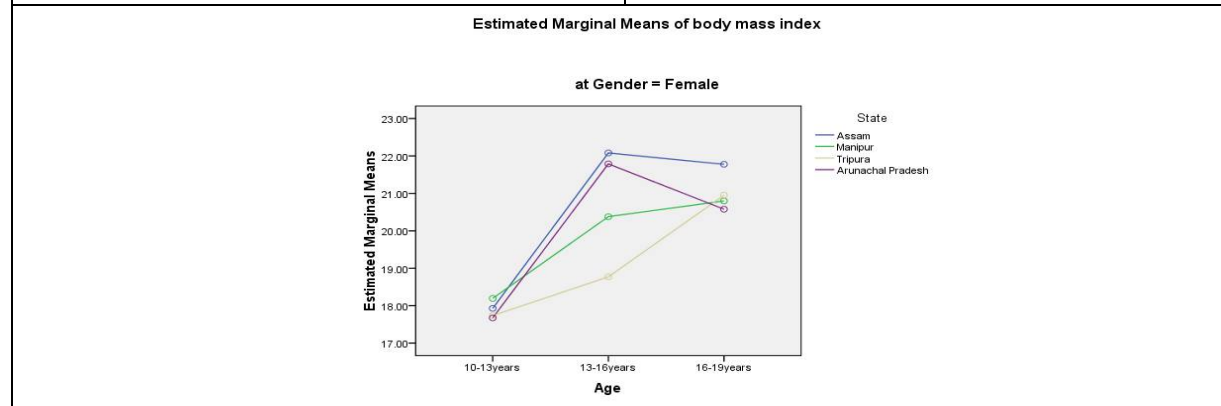


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Graph-1: Trend of Influence of interaction between Age and States on Body Mass Index of School Children

Graph-2: Trend of influence of interaction between Age and States on Body Mass Index of School Boys



Graph-3: Trend of influence of interaction between Age and States on Body Mass Index of School Girls





A Survey on Different Data Mining Methods for Categorization of Chronic Kidney Disease

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ABSTRACT

Kidney Damage is also known as chronic kidney disease (CKD) which is a common term for various heterogeneous diseases in the kidneys. There are many cases with an imprecise diagnosis and extensively organized medical procedures may lead to many difficulties in the patient health. Hence, it is advisable to go for early diagnosis and prediction of kidney disease. The main aim of this work is to review the state-of-the-art methods which are utilized to predict whether the patient is affected with CKD or not. The patient with CKD and non-CKD status can be predicted using various classification algorithms. This survey has discussed about various ML algorithms which utilized to diagnose kidney disease as well as the significant issues are explained briefly. Hence, this review about current study of ML applications in kidney disease is well recognized by clinicians and greatly enhances the clinical practice in future.

Keywords: Chronic Kidney Disease, Heterogeneous, early diagnosis and classification algorithms.

INTRODUCTION

Chronic kidney Disease (CKD) means your kidneys are damaged and not filtering your blood the way it should. The primary role of kidneys is to filter extra water and waste from your blood to produce urine and if the person has suffered from CKD, it means that wastes are collected in the body [1,2,3,4,5]. This disease is chronic because of the damage gradually over a long period. It is flatterer a common disease worldwide. Chronic kidney diseases have become a major public health problem. Chronic diseases are a leading cause of morbidity and mortality in India. Chronic kidney diseases account for 60% of all deaths worldwide. Eighty percentage of chronic disease deaths worldwide occur in low- and middle-income countries (National Kidney Foundation, 2002) [6,7,8,9,10]. The National

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Kidney foundation determines the different stages of chronic kidney disease based on the presence of kidney damage and Glomerular Filtration Rate (GFR), which is measure a level of kidney function. Due to CKD may have some health troubles [11,12,13,14,15].. There are many causes for CKD like diabetes, high blood pressure, heart disease. Along with these critical diseases, CKD also depends on age and gender.

If your kidney is not working, then you may notice one or more symptoms like abdominal pain, back pain, diarrhea, fever, nosebleeds, rash, vomiting. There are two main diseases of CKD: (i) diabetes and (ii) high blood pressure. So that controlling of these two diseases is the prevention of CKD. Usually, CKD does not give any sign till kidney is damaged badly [16,17,18,19,20]. CKD is being increased rapidly as per the studies hospitalization cases increase 6.23 per cent per year but the global mortality rate remains fixed. There are few diagnostic tests to check the condition of CKD: (i) estimated glomerular filtration rate (eGFR) (ii) urine test (iii) blood pressure. High risk groups are classified as person with diabetes, hypertension, and hereditary. It is possible to get rid of chronic kidney disease through early detection and proper treatment once the progress of the disease is observed it may greatly leads to kidney failure [21,22,23,24,25]. The main aim of this work is to review the state of the art methods which are utilized to predict whether the patient is affected with CKD or not. The patient with CKD and non-CKD status can be predicted using various classification algorithms. This survey has discussed about various ML algorithms which utilized to diagnose kidney disease as well as the significant issues are explained briefly. Hence, this review about current study of ML applications in kidney disease is well recognized by clinicians and greatly enhances the clinical practice in future.

Literature Review

Ogunleye and Wang [2018][26] proposed a better technique based on Extreme Gradient Boosting (XGBoost) model with a combination of three feature selection technique for a fast and accurate diagnosis of CKD with relevant symptoms. The CKD model developed in this work has an accuracy of 0.976, which is better than the baseline models currently existing. Also, the sensitivity and specificity of the CKD model for 36 patients is 1.0 and 0.917 respectively. False diagnosis of CKD patients using this model is reduced greatly. The proposed model will reduce the cost of diagnosing CKD and it can be easily embedded in a CDSS. Salekin and Stankovic [2016][27] considered 24 predictive parameters and create a machine learning classifier to detect CKD. Evaluate approach on a dataset of 400 individuals, where 250 of them have CKD. Using approach achieve a detection accuracy of 0.993 according to the F1-measure with 0.1084 root mean square error. This is a 56% reduction of mean square error compared to the state of the art (i.e., the CKD-EPI equation: a glomerular filtration rate estimator).Also perform feature selection to determine the most relevant attributes for detecting CKD and rank them according to their predictability. Identify new predictive attributes which have not been used by any previous GFR estimator equations. Finally, perform a cost-accuracy tradeoff analysis to identify a new CKD detection approach with high accuracy and low cost.

[Chatterjee et al, Kriplani et al, Shanmugarajeshwari and Ilayaraja, Rubini and Perumal, Chakraborty et al][28, 29, 30, 31,32] proposed a modified Cuckoo Search (MCS) trained Neural Network (NN) or NN-MCS based model to detect CKD. The NN-MCS model has been proposed to overcome the problem of using local search based learning algorithms to train the NNs. The NN weight vector is optimized by applying MCS for NN training. A comparative study with eminent classifiers, namely the Multilayer Perceptron Feed-forward Network (MLP-FFN) and NN based on Particle Swarm Optimization (PSO-NN). The classifiers performance is measured in terms of different performance metrics. The experimental results depicted that the NN-MCS has the ability to detect CKD more efficiently compared to any other existing model. Chatterjee et al [2017][33] presented a Cuckoo Search (CS) trained Neural Network (NN) or NN-CS based model has been proposed to detect Chronic Kidney Disease (CKD) which has become one of the newest threats to the developing and undeveloped countries. Studies and surveys in different parts of India have suggested that CKD is becoming a major concern day by day. The financial burden of the treatment and future consequences of CKD could be unaffordable to many if not detected at an earlier stage. Motivated by this, the NN-CS model has been proposed which significantly overcomes the problem of using local search based learning algorithms to train NNs. The input weight vector of the NN is gradually optimized by using CS to train the NN. The model has been compared with well-known classifiers like Multilayer Perceptron Feed



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forward Network (MLP-FFN) (trained with scaled conjugate gradient descent) and also with NN supported by Genetic Algorithm (NN-GA). The performance of the classifiers has been measured in terms of accuracy, precision, recall and F-Measure. The experimental results suggest that NN-CS based model is capable of detecting CKD more efficiently than any other existing model.

Basar, and Akan[2017][34]applied Adaboost, Bagging and Random Subspaces ensemble learning algorithms for the diagnosis of chronic kidney diseases. Decision tree based classifiers are used in the decision stage. The classification performances are evaluated with kappa and accuracy criteria. Considering the performance analyses of the proposed systems, it is observed that ensemble learning classifiers provide better classification performance than individual classifiers. [Wibawa et al][35] developed machine learning method using ensemble learning and feature selection to improve the quality of CKD diagnosis. The used data in this study is 24 attributes including signs, symptoms and risk factors that may appear due to CKD. The number of features are selected using a Correlation-based Feature Selection (CFS) and AdaBoost is using for ensemble learning to improve the detection of CKD. K-Nearest Neighbour algorithm (KNN) [Charleonnan et al , Tazin et al, Alasker et al, Sobrinho et al, Shamrat et al], [36,37,38,39,40]Naive Bayes and Support Vector Machine (SVM) is used as base classifier. Based on the evaluation parameters, CFS and AdaBoost was able to improve the CKD classification. Dulhare and Ayesha [2016][41]proposed work, are not only extracting action rules based on stages but also predicting CKD by using naïve bayes with OneR attribute selector which helps to prevent the advancing of chronic renal disease to further stages.

Bhaskar and Suchetha [2021][42] proposed a computationally efficient Correlational Neural Network (CorrNN) learning model and an automated diagnosis system for detecting Chronic Kidney Disease (CKD). A Support Vector Machine (SVM) classifier is integrated with the CorrNN model for improving the prediction accuracy.

Borisagar et al [2017][43]using neural network based Chronic kidney disease detection system. This system of neural network accepts disease-symptoms as input and it is trained according to various training algorithms. Levenberg, Bayesian regularization, Scaled Conjugate and resilient back propagation algorithm are discussed here. After neural network is trained using back propagation algorithms, this trained neural network system is used for detection of kidney disease in the human body. The back propagation algorithms presented here have capacity for distinguishing amongst infected patients or non-infected person.

Chetty, et al [2015][44]built classification models with different classification algorithms, Wrapper subset attribute evaluator and best first search method to predict and classify the CKD and non CKD patients. These models have applied on recently collected CKD dataset downloaded from the TICI repository. The models have shown better performance in classifying CKD and non CKD cases. Results of different models are compared. From the comparison it has been observed that classifiers performed better on reduced dataset than the original dataset. Vashisth et al, Arulanthu and Perumal, Zhang et al , Hosseinzadeh et al , Ma et al , Alshakrani, et al , Boukenze et al[45,46,47,48,49,50,51]proposed a Multi-Layer Perceptron Classifier that uses a fully connected Deep Neural Network to predict whether a patient suffers from the problem of CKD or not. The model is trained on a dataset of around 400 patients and considers various symptoms like blood pressure, age, sugar level, red blood cell count, etc. that assist the model in performing accurate classification. Experimental results show that the proposed model can perform classification with the testing accuracy of 92.5%, surpassing the scores achieved by SVM and Naïve Bayes Classifier.

Hore et al [2018][52] proposed a genetic algorithm (GA) trained neural network (NN)-based model to detect chronic kidney disease (CKD) which has become one of the newest threats to the developing and undeveloped countries. Studies and surveys in different parts of India have suggested that CKD is becoming a major concern day by day. The financial burden of the treatment and future consequences of CKD could be unaffordable to many, if not detected at an earlier stage. Motivated by this, the NN-GA model has been proposed which significantly overcomes the problem of using local search-based learning algorithms to train NNs. The input weight vector of the NN is gradually optimized by using GA to train the NN. The model has been compared with well-known classifiers like Random Forest, Multilayer Perception Feed forward Network (MLP-FFN), and also with NN. The performance of the classifiers has been measured in terms of accuracy, precision, recall, and F-Measure. The





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experimental results suggest that NN-GA-based model is capable of detecting CKD more efficiently than any other existing model. Arasu and Thirumalaiselvi[2017][53] proposed Weighted Average Ensemble Learning Imputation (WAELI). In this proposed work the single value imputation model used expectation-maximization (EM) and Random Forest (RF) which predict the missing values effectively in small dataset. For huge dataset the multiple value imputation model predict the missing values with the help of RF, Classification And Regression Tree, C4.5 are used to estimate the missing value. Hence the accuracy of kidney disease prediction will be improved by using WAELI. Then introducing priority assigning algorithm to assign priority for each features in the dataset then higher priority features are carried over for classification process. This makes classification process more efficient and time consumption for classification will be reduced

Polat, et al, Ahmad et al, Almansour et al, Tazin et al , Ahmad et al, Tazin et al,[54,55,56,57,58,59] used a Support Vector Machine classification algorithm to diagnose Chronic Kidney Disease. To diagnose the Chronic Kidney Disease, two essential types of feature selection methods namely, wrapper and filter approaches were chosen to reduce the dimension of Chronic Kidney Disease dataset. In wrapper approach, classifier subset evaluator with greedy stepwise search engine and wrapper subset evaluator with the Best First search engine were used. In filter approach, correlation feature selection subset evaluator with greedy stepwise search engine and filtered subset evaluator with the Best First search engine were used. The results showed that the Support Vector Machine classifier by using filtered subset evaluator with the Best First search engine feature selection method has higher accuracy rate (98.5%) in the diagnosis of Chronic Kidney Disease compared to other selected methods. Chaudhuri, et al [2021][60]proposed a method to distinguish between chronic and non-chronic kidney disease, identify its crucial features without reducing the accuracy of prediction, and a prediction algorithm to eliminate the possibility of under or overfitting. This study uses the recursive feature elimination (RFE) method that selects an optimal subset of features and an ensemble algorithm, the enhanced decision tree (EDT), to predict the disease. The results obtained in this work show that the accuracy level of EDT is not changed with the removal of less significant features, thus enabling the decision-makers to concentrate on few features to reduce time and error of treatment. EDT establishes substantially high consistency in predicting, with or without feature selection, the disease.

Inferences from the Existing Work

As Chronic Kidney Disease progresses slowly, early detection and effective treatment are the only cure to reduce the mortality rate. Machine learning techniques are gaining significance in medical diagnosis because of their classification ability with high accuracy rates. The accuracy of classification algorithms depend on the use of correct feature selection algorithms to reduce the dimension of datasets. But existing works does not used any feature selection models. And also existing classifiers provides lesser accuracy results with the large volume dataset.

Solution

Future work in this area focuses on the idea of improving the classifiers for the detection and classification of Chronic Kidney Disease. And initially, optimization algorithm will be employed to choose the finest features from the available set of features. The selected features from the medical dataset are processed and provided to the Enhanced classifiers for medical data classification purposes.

Performance Metrics

Precision: It refers to the percentage of the appropriate outcomes,

$$\text{Precision} = \frac{\text{Truepositive}}{\text{truepositive} + \text{falsepositive}} \quad (1)$$

Recall: It refers to the percentage of total relevant outcomes correctly classified by the suggested technique,

$$\text{Recall} = \frac{\text{Truepositive}}{\text{truepositive} + \text{FalseNegative}}$$





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Accuracy: It is the fraction of predictions this technique got right.

$$\text{Accuracy} = \frac{\text{TruePositive} + \text{TrueNegative}}{\text{Total}} \quad (3)$$

CONCLUSION AND FUTURE WORK

Chronic kidney disease (CKD) is a world public health problem characterized by permanent kidney damage. The high incidence and prevalence of chronic kidney disease (CKD), often caused by late diagnoses, is a critical public health problem, especially in developing countries such as Brazil. This work reviews the existing methods of Chronic kidney disease detection and how they have been implemented for classification. It has been studied that among the number of techniques discussed, each technique has its own strength and weaknesses and there is no proper Chronic kidney disease detection technique. Finally, by analyzing the pros and cons of existing techniques, the open research challenges in the Chronic kidney disease detection area are studied. By which it is concluded that the future work in this area focuses on idea of improving the classifiers for the detection and classification of Chronic Kidney Disease. And to develop, optimization algorithm to choose the finest features from the available set of features.

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A Stemmer for Malayalam Language in Context of Agricultural Domain

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ABSTRACT

Stemming is the first and most important process in Natural Language Processing, and it involves extracting the root word from the supplied input word. The stemming process produces root word extraction, which is useful in language translation, natural language processing (NLP), and a variety of other applications. The stemmer presented in this research is based on the Malayalam language. Other Indian languages, such as Marathi, Hindi, and Telugu, can be used to create it. Many stemmers have been developed to date, and there is still amount of change. Malayalam stemmers have been created, but on a smaller scale than other languages because Malayalam has more alphabets than other languages. Our stemmer was built using a rule-based methodology. The rule-based method simply employs a set of rules that, when applied to an input word, aid in the discovery of the root word. By removing the prefix or suffix, the root word can be extracted. Overall, our system was 77% accurate. The proposed stemmer's outputs are cost-effective, adaptable, and ideal for natural language processing, information retrieval, and language translation, among other applications.

Keywords : Information Retrieval, Natural Language Processing (NLP), Rule based approach, Stemmer and Malayalam.



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INTRODUCTION

A human being can readily grasp and interpret languages, but it is far more difficult for a machine to do so. Many times, we use a computer to search for something or to recognize our voice and then provide us with the necessary results, therefore teaching a computer to understand human language is advantageous. We live in a bilingual society, and our country is divided into many areas, each of which has its own set of regional languages. There are 22 constitutional languages in total. Morphological analysis is used to examine or learn the structure of these languages. Stemming is a part of morphological analysis and plays an important function. Many words have inflectional variants, but they all refer to the same root word in the end. For instance, in the English language, the words "enjoyment," "enjoys," and "enjoyed" all have the same root word "enjoy." If we look at the Malayalam language examples in table 1, we can get the root terms for each one.

The priority is to extract root words, i.e. the stem, because the stem can have a meaning or be meaningless. There are a lot of farmers in India, and not everyone speaks the same language. Because there are so many regional languages, we will concentrate on the agricultural area in this research. The necessity for stemming emerges as a result of the replacement of manual labour by modern language tools; as a result, we must teach computers about the languages we speak as well as their structure. The issue we confront during the stemming process is that we must first learn the grammatical structure of words, as only then will we be able to do stemming correctly. The methods we utilized were rule-based. We must manually establish the rules for stripping the suffix or prefix when utilizing this method. The first stemming algorithm, known as the Lovins stemming algorithm, was introduced by Lovins JB [10] in 1968. When it comes to stemming in Indian languages, we have done a lot less work than in English because English is a less inflectional language. The Malayalam language belongs to the Dravidian language family and is spoken by around 38 million people. Malayalam writing comprises both alphabetic and syllabic elements; additionally, the language has 15 vowels and 36 consonant letters, as well as a few symbols. STHREE (Stemmer for Malayalam Using Three Pass Technique), a stemmer for Malayalam [9] based on the three pass algorithm provided by Pragisha et al., 2013 [1], and LALITHA, [2], a light weight Malayalam stemmer based on the suffix stripping approach. Information retrieval, question answering systems, speech recognition, and many other aspects of language processing benefit greatly from the stemming process. The literature review is in section 2, our proposed study is in section 3, the evaluation is in section 4, and the conclusion is in section 5.

LITERATURE SURVEY

Many studies and effort have been done in the subject of stemming since it is a popular topic in natural language processing [14][15][16][17][18]. Ram R et al. suggested a Malayalam stemmer based on the repetition principle [1], and were able to create a Finite State Automata of suffixes as a result. They also employed the Sandhi analyzer, which consisted of Sandhi rules and assisted in the extraction of the root word. In 2010, the accuracy obtained was 94.76 percent. In 2013, U.Prajita et al. developed LALITHA [2], a light-weight stemmer that relied on the suffix stripping method. They created a stemmer that was domain agnostic and reasonably priced. Urdu is a morphologically rich language, making it difficult to develop a stemmer for it. Khan, Sajjad, and colleagues [3] used a rule-based technique to construct an Urdu-based stemmer. They also used stop word lists, prefix and suffix lists, a global prefix exceptional list, and a global suffix exceptional list. They devised a longest match method. They compared the stemmer to the prior only available Urdu stemmer, which had a precision of 73.55 percent (Asass-band). Mishra Upendra and Chandra Prakash [4] suggested MAULIK: An effective Hindi language stemmer in 2012. The method used was a hybrid strategy that used brute force and suffix stripping. The brute force approach is a method of searching for all viable solutions in a methodical manner. So, whenever a user enters a word, the brute force approach is used to search the database for all possible solutions; if the word is found, the corresponding root word is returned; if not, the suffix stripping approach is used, in which all the rules are defined, and the corresponding output is returned. This stemmer has a 91.59 % accuracy rate. In 2018, Majumder, P et al. developed YASS (Yet Another Suffix Stripper), a Bengali stemmer [5]. They employed the clustering lexicon method algorithm.



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They claimed that the stemmer has a stronger recall while utilising Bengali language, and that the stemmer's performance is comparable to that of other rule-based stemmers. To construct complete text databases, Alkula R. [6] used morphological analysis tools. Because of the high inflections found in Finnish, she chose it as her language of choice. In addition, she used Boolean searches and inverted files to generate meaningful words in a compounding language. Traditionally, the establishment of a rule-based stemmer has been on the rise. The goal of a rule-based stemmer is to create a suffix list and a set of rules. This section explains some of the rule-based stemmers. Ramanathan et al. [7] presented a lightweight stemmer for Hindi, based on a suffix list and observations of overstemming and under stemming in the words. The number of unique words was also 35977. The corpus was taken from a Hindi news magazine, and the accuracy rate was 88 percent. In comparison to other language stemmers, Ameta et al [8] proposed a Gujarati stemmer that is less produced. They employed a rule-based stemming technique, and as a result, they were able to develop a stemmer with a 167-suffix list. This Gujarati stemmer was created because there are relatively few Gujarati tools available nowadays. Their algorithm attained a 91.5 percent accuracy with this rule-based Gujarati stemmer. Gupta et al. developed an Urdu stemmer ('Usal') based on inflectional and derivational rules [11]. They began by doing a morphological analysis of Urdu word structure. Those words that do not have inflection are classified as exception words and saved in a database. They also used a longest suffix stripping technique and a database of exception and stop words to handle the problem of over stemming and under stemming. Usal attained an accuracy of 89.66 percent. Gupta, Vaishali, and colleagues suggested a rule-based stemmer [12] for one of the more difficult languages, Urdu. This stemmer strips away the affixes, revealing the base word. Affixes are eliminated in order of how long they are. They also dealt with the issue of over stemming. They achieved an accuracy of 86.5 percent after examination. Gupta et al. created an Urdu lemmatizer [13] that was based on rules. They introduced criteria to aid in the creation of meaningful roots, as well as a database of exception words (words that don't need to be removed). The lemmatizer achieves a total accuracy of 90.3 percent.

PROPOSED WORK FOR MALAYALAM STEMMER

We proposed a stemmer for the Malayalam language for the agricultural area, thus we begin by gathering corpora from agricultural sources. The corpus included English sentences that needed to be translated into Malayalam. Our stemmer takes the input word and creates a stem that can be meaningful or meaningless. The following architecture shows the work we've done in a phase-appropriate manner. The first part is the construction of a corpus of 2000 sentences before going on to the second phase, which entails the elimination of prefixes and suffixes using a length-based technique. The third phase entails uniquely identifying suffixes and prefixes, and the last part entails formulating rules based on the prefixes and suffixes studied. The stemmed word is the needed output when the four processes are completed.

Corpus Creation

The collecting of corpus was the first step in building the Malayalam stemmer. The corpus was primarily in the agriculture field. Many farmers identify with regional languages, which is why this domain was chosen. There were 2,000 sentences in our corpus. The corpus was gathered from agricultural websites that were written in English. After that, the sentences were translated into Malayalam. One of the most well-known translators assisted with the translation (Google Translate). We also completed hand translation of each sentence because no translator can guarantee 100% accuracy.

Tokenization

The phrases were then broken down into tokens, with any suffixes and prefixes separated. The corpus contained a mix of words, numbers, and punctuation marks, among other things. We had a total of 20,000 words after tokenization.





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Rules Generation

Following that, rules were established based on the analysis of tokenized words, which led to the removal of the suffix from the root word and the creation of a stemmed term that might be meaningful or meaningless. We came up with a total of 80 suffixes. The following are some of the rules:

Word = root + suffix

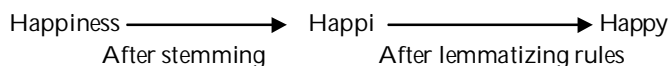
1) പൂക്കൾ = പൂ + കൾ
(pukkal) = (pu) + (kka)

2) സഹ ഓദരിമാർ = സഹ ഓദരി + മാർ
(sahodarimar) = (sahodari) + (mar)

3) ശവൻമാർ = ശവൻ + മാർ
(devanmar) = (devan) + (mar)

For the words in the collected corpus, several of these rules are implemented. For the stemmer, a total of 80 regulations were devised. We must apply lemmatization rules to the input words in order for the stemmed words to be meaningful. Stemming is followed by the process of lemmatization. Both stemming and lemmatization aid in the extraction of base or root words, but stemming has the potential to produce meaningless roots. The process of extracting meaningful roots, also known as lemma, is known as lemmatization. In the dictionary, a lemma can always be discovered.

For example



In the example above, we have the word 'happiness,' and we may stem it by extracting the root word 'happi' from the suffix 'ness.' 'Happi' has no inherent significance. Because the stemming process is unconcerned about morphology, the outcome is 'happi.' With lemmatization, this is not the case. After applying lemmatization rules- (Happi) -i + y $\xrightarrow{\hspace{1cm}}$ Happy

According to the criteria, the letter 'i' is removed and the letter 'y' is inserted to create a meaningful word, 'Happy.' As a result, lemmatization guarantees that the word is meaningful rather than merely removing the suffix or prefix. Lemmatization can only be done perfectly if we have a thorough understanding of the language's grammatical structure.

ALGORITHM

We began by generating prefix and suffix rules, which allowed us to stem the input word. Figures 2 and 3 show the entire procedure in the form of an algorithm and a flowchart, respectively.

- Step1: Input the text from user.
- Step2: Apply the rules to remove suffix or prefix.
- Step3: If match is found, then remove the suffix or prefix, otherwise return the input word.
- Step4: Extract the root word.
- Step5: Display the root word as an output.





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Generated stemmed outputs are shown in below table III.

RESULTS AND DISCUSSION

The entire stemming phenomena begins with the words gathered from the corpus. We collected a total of 20,000 words, but we only assessed 500 of them for the goal of determining how well our stemmer works. We acquired a total of 460 words from these words, which were created using the proposed stemming engine. We ended up with roughly 385 accurate words after filtering and cleaning. The formula is used to calculate the total accuracy of the suggested stemmer-

$$\text{Accuracy (\%)} = \frac{\text{Accurate stemmed}}{\text{Total no of given word}} \times 100 \quad (1)$$

As a result of the word collection, we have the following information in terms of total word, machine generated words, and correct stemmed words. Table IV provides more information, and figure 4 depicts a pi-chart.

We can calculate the correctness of this system in terms of Precision, Recall, and F-measure using the data in table IV. The following are the formulae for these-

$$\text{Precision} = \frac{\text{Correct stemmed output}}{\text{Machine Generated output}} \quad (2)$$

$$\text{Recall} = \frac{\text{Machine Generated output}}{\text{Total number of Words}} \quad (3)$$

$$F - \text{measure} = \frac{2 * P * R}{P + R} \quad (4)$$

Calculated results of test data are shown in table V.

CONCLUSION AND FUTURE SCOPE

The stemming process is the first step in the translation process, and it aims to remove the suffix or prefix from a given input word. It comes in handy when we wish to eliminate variations within a single term. We worked on the agricultural domain in this paper to construct a Malayalam rule-based stemmer. Malayalam belongs to the Dravidian language family, and it is spoken by nearly 38 million people in Kerala alone. We were able to develop a stemmer with a 77 percent accuracy by examining the morphology of the Malayalam language. Under-stemming and over-stemming are two main limitations in our system, both of which result in a reduction in system accuracy. In the future, we'll concentrate on adding more rules to our Malayalam stemmer and improving its accuracy.

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Table I: Words Having Suffixes/Prefixes

Malayalam words	Transliterated words	suffixes	prefixes
ശേഷം	Shesham	ംം (am)	–
നമസ്കരം	Namaskaram	ംം (am)	–
വിഷയം	Vishayam	ം (am)	–
അന്യേതി	Aneethi	–	അ (a)





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Table 2: List of Some Malayalam Rules

Prefix/ Suffix	Transliterated Form
കകല്	Kkal
ഉടെ	ude
ഇല	il
ങങള്	angal
അതീ	ati

Table 3: Stemmed Output of Input Words

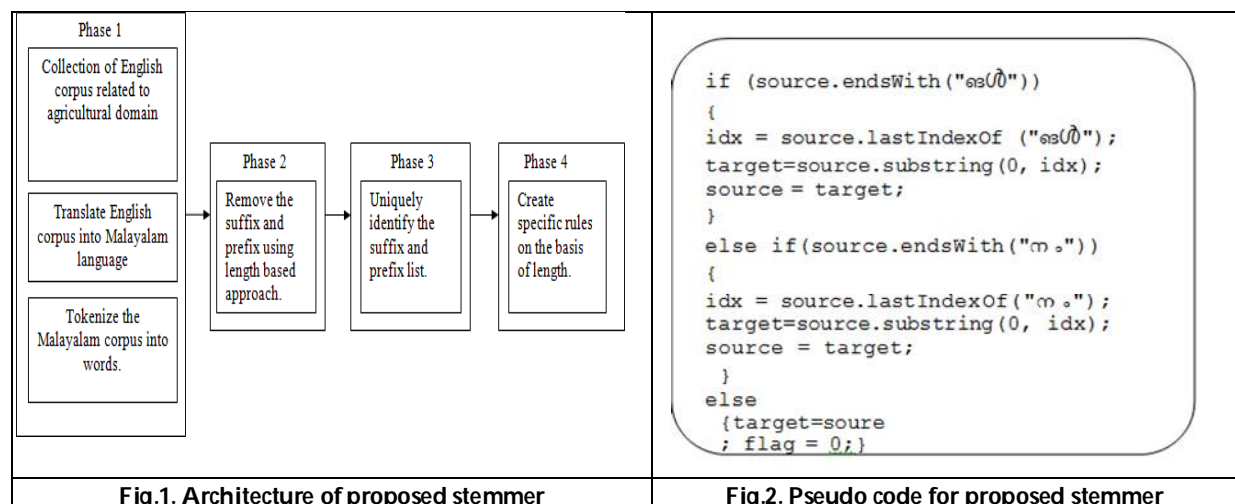
Word	Stemmed Output
ജോലിയിൽ (joliyil)	ജോലി (joli)
പറക്കുക (parakkuka)	പറക്കു (parakku)
മടിയൻ (matiyān)	മടി (mati)
പറിക്കുക (patikkuka)	പറിക്ക (patikka)
നന്മയുടെ (nanmayude)	നന്മ (nanma)

Table 4: Test Data For Evaluation

Stemming data attribute	Total number of words
Total words as test data	500
Machine generated output	460
Correct stemmed output	385

Table 5: Evaluation Parameters of Test Data

Evaluation Parameters	Accuracy in %
Precision (%)	83.6
Recall (%)	92.0
F-measure (%)	87.5
Total Accuracy (%)	77.0





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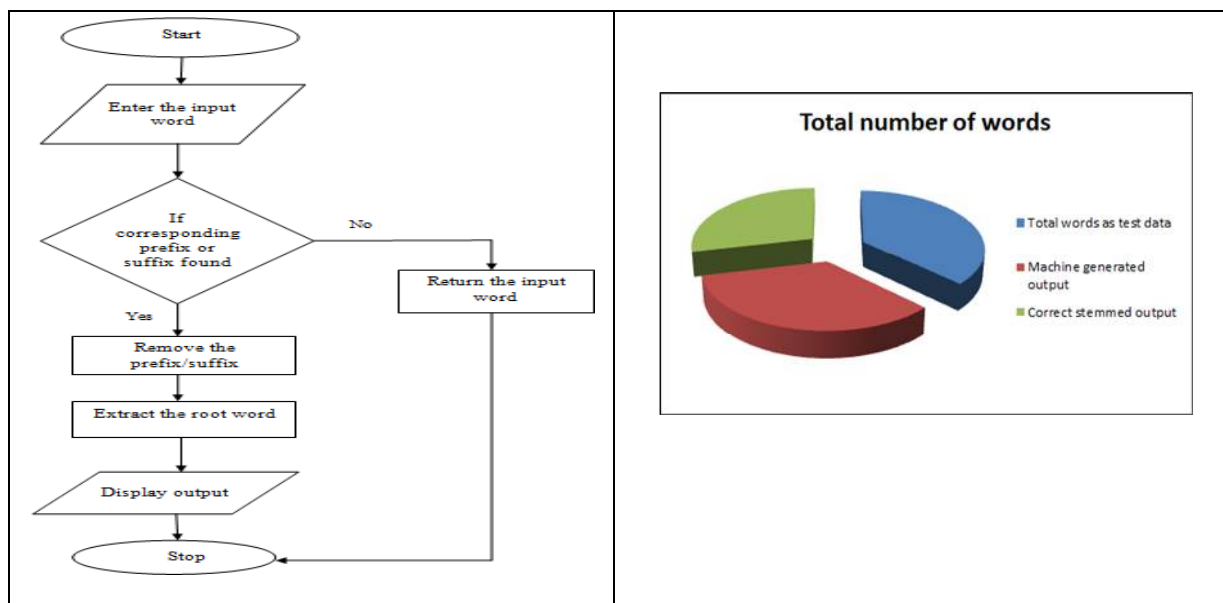


Fig.3. Flowchart for the proposed Malayalam stemmer

Fig.4. Test Data Evaluation

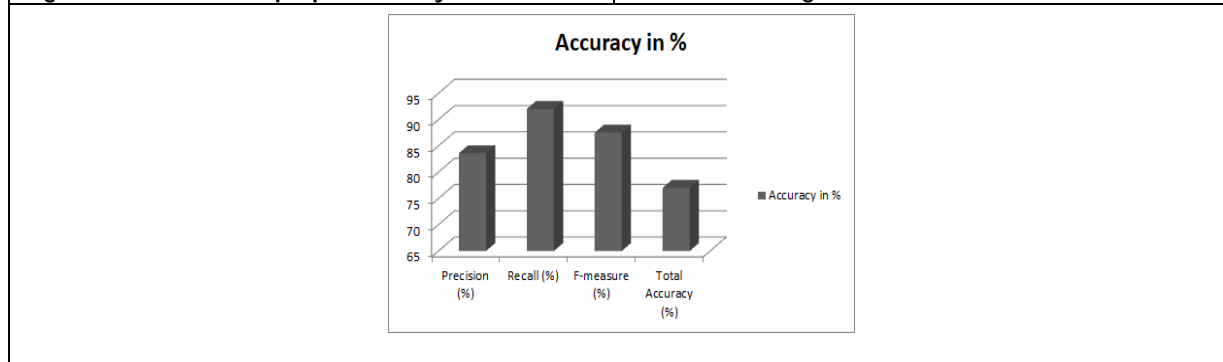


Fig.5. Evaluation parameters of test data

APPENDIX A: Glossary

Table 6: Glossary of Some Malayalam Words

Malayalam Words	Translated into English
Aneethi	Injustice
Devanmar	Lords
Joli	Job
Mati	Lazy
Namaskaram	Hello
Nanma	Kindness
Parakku	Fly
Patikku	Study
Pukkal	Flowers
Sahodarimar	Sisters
Vishayam	Subject





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Appendix B: Morphological Structure of Malayalam

Malayalam falls under the category of Dravidian languages. It is also one of the 22 constitutional languages and is majorly spoken by the people of South India, specifically Kerala.

Malayalam is derived from the Sanskrit language which is also one of the oldest languages. The Malayalam grammar is a bit tedious to understand. It has overall 52 letters which is divided as 36 consonants and 16 vowels. Parts of speech typically define the grammatical features of a word. The common ones are noun, pronoun, adjective, verb, adverb, conjunction, preposition etc.

Noun: Noun is simply defined as a naming word. It identifies any name, place, animal etc. nouns are further categorized as collective nouns, proper nouns, and common nouns etc. Noun is the most important part of speech.

For Example: പാൽ (pal) → milk

Pronoun: Pronoun is something that is used in place of a noun. Its work is same as that of a noun. For

Example: ഞാൻ (njan) → I

Verb: Verb is basically an action word. It represents all the words that is doing something like see, do, go etc.

For Example: കാണുക (kanuka) → see

Adjective: Adjectives helps in making words more descriptive and enhances the word. They come before a noun or a pronoun. For Example: ധീരതയുള്ള (dheerathayulla) ● courageous.

Table VII Categories of Malayalam Words

Malayalam words	Category of words
കാപ്പി (kaapi) (Coffee)	Noun
ഉള്ളി (ulleli) (Onion)	
അവർ (avar) (They)	Pronoun
നിങ്ങൾ (ningal) (you)	
ചെയ്യുക (cheyuka) (Do)	Verb
ശപാകൂ (poku) (Go)	
നല്ല (nalla) (Good)	Adjective
ചവളത്ത് (velutthu) (White)	
വളരെ (valare) (Too)	Adverb
ഇവിടെ (ivide) (Here)	
പക്ഷേ (pakshe) (But)	Conjunction
കാരണം (karanam) (Because)	
കീഴെ (kizhe) (Below)	Preposition
മുകളിൽ (mukalil) (Above)	





Paradigms of Knowledge Engineering for Smart Education and Learning Systems

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ABSTRACT

Artificial intelligence (AI) has recently received increased attention in the field of developing smart digital education. Researchers used computational intelligence (CI) and machine learning techniques to create intelligent tutoring systems (STSs). On the other hand, the convergence of artificial intelligence (AI), data science, and the Internet of Things (IoT) is enabling the development of a new generation of web-based smart systems for all educational and learning tasks. The CI and knowledge engineering paradigms are discussed in this paper for just beginning smart educational and learning systems

Keywords: Artificial intelligence, Classroom, Smart Education, Managements

INTRODUCTION

A Novel Smart Education Model for the Development of a Smart University System

Smart pedagogy, smart learning environments, smart technologies, and smart learners are among the components that individually contribute to the development of smart education system projects. This article's contributions are summarised as follows: First, a more complete and dynamic vision definition of smart education than previous views and definitions. The proposed smart education model is based on a perspective and definition that demonstrates how each component contributes to the advancement of the smart education endeavour. The rest of this paper will proceed in the following manner. The background and related works were addressed in Section 2. In section 3, a smart education approach was proposed. The smart education as "creating an intelligent environment through the use of smart technologies so that smart pedagogies can be facilitated so that personalised learning services can be provided and learners can be empowered, and thus wisdom talents with better value orientation, higher thinking quality, and stronger conduct ability can be fostered. The proposed a framework for a smart education system that includes four components: smart campus (Wi-Fi, cloud, mobile, Internet of things, and security); smart classroom (smart classroom & eLearning); Smart assessment (personalised learning objects, collaborative learning objects, and learning management); and Smart bags (personalised learning objects,

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collaborative learning objects, and learning management) (laptops and other personal learning devices). Based on the overall definition and goal of the smart education system, this framework only considered a sub-component of smart education. Smart learners and a smart learning environment that can accommodate both online and in-class students are both lacking. Furthermore, the function of smart technologies in the development of smart education is not sufficiently addressed. The essences of smart education, according to the report, "is to create an intelligent environment by using smart technologies so that smart pedagogies can be facilitated in order to provide personalised learning services and empower learners, and thus wisdom talents with better value orientation, higher thinking quality, and stronger conduct ability can be fostered." Smart education ideology, smart pedagogies, smart learners, and a smart learning environment make up the frame work. While this paradigm is more extensive and capable of capturing the fundamental components of smart education, it is limited to the functions of smart technologies as both learning devices and development tools.

Smart Education Model Proposed

Each of the three study works discussed above lacks smart pedagogies, smart digital learning devices, and smart campus, and each lacks smart pedagogies, smart digital learning devices, and smart campus, respectively. There is a need to incorporate the components absent in the prior views and definitions in order to create a comprehensive description and views. As a result, smart education is defined in this paper as "a student centric intelligent learning environment enriched with digital learning resources to provide smart pedagogies that support smart learners' personalised learning experiences anywhere, at any time, using a smart portable device and linked across educational institutions or training workforce through the advancement and superiority of smart and wireless technologies." They use smart portable learning devices to learn anywhere and at any time, are connected with smart learners throughout their domain, and are always interested in acquiring the most up-to-date information on their subject. To be relevant and up to date, they prefer to try new things and explore new chances. Smart learners help to explore and use digital learning resources in a smart learning environment utilising smart portable devices based on smart pedagogy in this paradigm. Their assessment will result in a conclusion on the success of smart education projects, as well as improvements to the smart learning environment and smart pedagogy to facilitate further deployment.

Implications of the Model

The smart learning environment can be designed to handle some of the key issues of providing smart education, such as providing updated learning resources, facilitators, and infrastructures, as well as educating individuals without regard to time or space constraints. Internet penetration and the potential for a 5G network, as well as the growing use of smart mobile devices among smart learners and their affordability, can all be utilised to deliver a smart education. The smart education system brings with it new challenges and policies to take advantage The educational institution bears the cost of investing in smart technology and digital equipment. It was necessary to design new security and safeguarding rules. New educational frameworks must be established to satisfy the requirements and learning styles of students. Better pedagogical framework and policies are required for a new educational policy of bringing your device to class. All of these concerns arise as a result of the new smart educational model's challenges.

Multiple Intelligence-Based e-Learning Recommendation Model

eLearning has a number of advantages, including consistency, cost effectiveness, flexibility, remote operability, simplicity, and others. Smart technology and solutions successfully promote convenient and uncomplicated instruction without regard to time or space constraints. The goals of this research are to 1) build a collaborative e-Learning conceptual framework for learners with multiple intelligences, and 2) develop e-Learning activities based on the mathematical/logical intelligence part of multiple intelligences in order to foster critical thinking. Students' data analysis provides the rules that are used to create rule-based activities that lead learners. The research studies are carried out using four chapters from the subject of Secondary I Education (S1) at any university's Demonstration School. The findings show that eLearning activities can successfully develop the critical thinking intellect, which is one of the multiple intelligences.



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Teachers determine the ambience of all lessons and instructional approaches in traditional classroom education. The current teaching and learning systems, such as the e-learning system, remote learning, and so on, evolved from the previous system. The educational scenario nowadays provides learners with the opportunity to self-learn, with instructors serving solely as guides. Every learner, in general, has unique and individual abilities and aptitudes. As a result, when students' skill levels differ in the sessions, their academic achievement will vary, and some students may not be able to learn as rapidly as others. Previous research has used a variety of educational strategies, such as brainstorming for teaching and learning, which means that students would be active in problem-solving throughout class. When pupils brainstorm, they have better chances to solve difficulties. This form of education has the advantage of teaching groups of students to solve issues more effectively than traditional ways of learning and teaching, but it has the disadvantage of not providing students with learning materials that are tailored to their specific capacities. Project-Based Learning and teaching methods with a focus on each student are employed in this study. As a result of this strategy, students can learn at their own pace from the project.

The project is organised into appropriate student groups and instructional materials. The limitation occurs, however, when pupils are exposed with content that is inappropriate for their level of ability. Aruan et al. proposed the use of Problem-Based Learning in education. [1]By creating and solving challenges, this instructional style focuses on the students. This instructional approach is best suited for pupils who are skilled at assessing problems and circumstances. When pupils do not receive lessons that are tailored to their specific talents, however, the same limitation applies. Arroyo et al. [2] focused on teaching and learning, with an emphasis on Multiple Intelligences-based learning activities. Their research focused on learning activities, but it was constrained by the fact that individual aptitudes were not taken into account. [3] also recommended using learning activities incorporating different intelligences in the context of e-learning. This study, on the other hand, solely looked at learning activities and ignored students who were experiencing difficulty with their studies. Furthermore, a group of researchers used this technology to construct multimedia games with the goal of boosting teaching and learning [4] presented educational techniques that employ games to provide learning materials. This instructional strategy is appropriate for kids who enjoy playing games because they are learning and enjoying games at the same time.

Teaching and learning using various types of project-based learning, problem-based learning, activity-based learning, game-based learning, and student-centered learning were shown to have limitations in the above-mentioned research. Students are given educational materials that are inappropriate for their unique aptitudes in all of these strategies. As a result, the development of e-Learning activities based on the notion of many intelligences for the strengthening of critical thinking is proposed in this work. The rules that emerge from the data analysis of learners result in rule-based activities that can be used to guide students. The research studies were conducted in one subject of Secondary I education (S1) at any university's Demonstration School. The findings show that e-Learning activities can successfully develop the critical thinking intelligence, which is one of the multiple intelligences. The research is divided into five sections, the first of which is an overview of past work. The backdrop for this study is presented in the second section. Third section, describes the concept of proposed framework. The fourth section contains the proposed design of the rule foundation for learner suggestion. Lastly, conclusion is presented.

e-Learning is one of the first things that comes to mind. Essentially, e-Learning refers to any educational activity that involves the use of the internet, networks, or a personal computer, and is becoming increasingly popular in today's digital environment. It incorporates learning activities available on electronic devices everywhere [8], at any time for anyone with a smart device linked to the internet [9], [10].e-Learning is usually connected with activities that include both computers and interactive networks at the same time. The computer does not have to be the major component of the activity or deliver learning content. Nonetheless, computers and networks should be at the centre of instructional activity. There are several sorts of eLearning activities, such as web-based, online, and distance learning activities.



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- Web-based learning is focused on learning materials that are accessible via a web browser, such as CD-ROMs or other types of media. Online learning makes use of content that is easily accessible on a computer or other electronic device. The content could be stored on a website or on a CD-ROM or a computer's hard drive.
- Distance learning is concerned with contact between the instructor and learners who are separated from one another, allowing the instructor to respond quickly to the students, yet it does not simply entail the teacher uploading or transmitting educational materials to the students. Instructors must participate in receiving and providing comments on students' assignments. Multiple Intelligences (Multiple Intelligences) There are nine different types of multiple intelligences that have been recognised.

Multiple intelligences refers to the level at which learners have different sorts of brains and, as a result, learn, remember, perform, and understand in different ways [11], [12]. The Multiple Intelligences idea [13] divides people into three groups: 1) The Analytic group, which is divided into three groups and focuses on the processes of analysis and thought; 2) the Introspective group, which emphasises comprehension and imagination and is divided into three parts: Intrapersonal intelligence, Spatial intelligence, and Existential intelligence; 3) The Interactive group, which is divided into three parts: Linguistic intelligence, Interpersonal intelligence, and Kinesthetic intelligence, and is focused on communication and interactive components. The multiple intelligences model.

e-Learning Activities Based on Multiple Intelligences Gardner and Hatch [14] claim that there are three primary factors that go into determining someone's intelligence: 1) The ability to create a product or service that is valued in that person's society or culture; 2) A skill set that enables a person to address challenges that they encounter in their daily lives; 3) The ability to come up with new ways to solve issues or to apply current solutions in novel ways. This frequently necessitates the acquisition of more knowledge. The theory of multiple intelligences can be applied to e-Learning that is based on the nine intelligences.

The following are the categories and activities based on multiple intelligences that can be undertaken during instructional design in order to build the most successful e-Learning lessons for students

1. Musical (or Rhythmic) Intelligence is defined as the ability to learn and think in terms of rhythm and music, as well as the ability to perceive and recognise sound patterns. A lesson including music or sound, such as a multimedia presentation, is one activity that this intelligence would like. Making an effort to select music that reinforces the subject matter might help learners immerse themselves in the experience. Musical occupations, such as playing a musical instrument and producing musical compositions, may be acceptable for learners with a high level of musical intelligence.
2. Linguistic Intelligence is focused with using language to communicate. These people have the ability to express themselves well and comprehend what others are saying. Writers and presenters frequently demonstrate a high level of this intelligence. Discussion-based activities, such as online forums and group-based settings, are ideal for persons who have a proclivity for linguistic intelligence.
3. Mathematical (or Logical) Intelligence is linked to the capacity to discern principles and patterns in systems, and it typically involves the use of logic and numbers. Charts, diagrams, figures, and tables are common activities for this intellect. Critical thinking scenarios are also beneficial to this group. Accountants and researchers are known for having high levels of mathematical intelligence.
4. Kinesthetic (or Bodily) Intelligence is the ability to use one's entire body to find solutions or achieve results. Those with a high level of kinesthetic intelligence are well-suited to employment in the performing arts, such as dancing, or other occupations that need a natural knowledge with the human body, such as being an athlete or a doctor. This type of intelligence thrives in activities that need high hand-eye coordination, such as games and sports, as well as interactive scenarios involving physical movement. It's worth noting that when muscular motions are involved, this group learns the most successfully. As a result, bodily reflexes and movement should be included in the exercises.
5. Spatial Intelligence is concerned with a keen awareness of space and how those spaces can be traversed. This intelligence group will be interested in activities that include flow charts and graphics, as well as visually





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stimulating games and multimedia. Architects, pilots, and sailors are among the vocations that have a high level of spatial intelligence.

6. Intrapersonal Intelligence entails a thorough understanding of one's own personality, such as what they are capable of and how they behave in various situations. As a result, persons with high levels of intrapersonal intelligence frequently have strong feelings about what they should avoid and what they should include in their life. Professors and philosophers frequently have high levels of intrapersonal intelligence. Intrapersonal intelligence individuals can help others and share their ideas and experiences through collaborative learning activities such as online forums and chat programmes. The tasks that require introspection are the most beneficial for this intellect.
7. Interpersonal intelligence is defined as the ability to understand and learn from others. Those with a high level of intrapersonal intelligence are often well-suited to careers in the service industry, such as teaching and politics. This intelligence type may like activities like group discussions and comprehensive questions that allow them to completely study a topic of interest. It's worth noting that, in terms of interpersonal intelligence, people in this category are sensitive to other people's sentiments and moods. They may typically work better with others and learn more successfully in collaborations and group situations.
8. Naturalist Intelligence is concerned with the ability to detect the connections between all living things and to distinguish amongst them. Individuals that fall into the category of naturalist intelligence usually have a close relationship with nature. Botany and biology are two subjects closely related with this sort of intellect, and enticing tasks for these people require classifying and organising details.
9. Because it is primarily focused on philosophical and spiritual aspects, Existential Intelligence was added later by Gardner [13] and is hence not typically viewed as a part of learning settings. A philosophical individual who has a tendency to explore concerns about the purpose of existence and the meaning of death is an example of someone with advanced existentialist intelligence.
10. Multiple Intelligences Methodology In E-Learning: This study proposes the creation of e-Learning activities that are based on multiple intelligences and are meant to enhance critical thinking. As a result, the research focuses on the notion of mathematical/logical intelligence as a component of multiple intelligences with the goal of developing rule-based activities for an e learning recommendation system. Critical thinking is defined as the ability to think clearly and rationally, as well as the comprehension of the logical stages that connect concepts.

In the system of many intelligences, this capability is the most important feature of mathematical/logical intelligence, and it is the intelligence that most learners should cultivate. displays the e-Learning design framework that is based on many intelligences ideas. Module 1: Critical Thinking The critical thinking module is the one that maintains track of learners' learning reasoning and styles based on their critical thinking ability in mathematical/logical intelligence. Module B: Recommendation The recommendation module introduces learners to the several types of learning content they should learn, such as interactive, introspective, and analytical content. C. Learning Management System (LMS) Module The Learning Management System (LMS) module serves as a bridge between e-Learning systems and learners. The LMS module is connected to the majority of the other modules, allowing it to be used in learning and teaching. D. The Learning Content Module is a module that holds learning materials from nine multiple intelligences, which are grouped into three categories: 1) Analytic content, which is utilised with learners who have analytical, logical, and mathematical aptitude. These learning materials also feature the Critical Thinking Module's critical thinking analysis for aiding critical thinking.2) Introspective content is employed with students who are creative and inventive.3) Interactive content is employed with students who are capable of interacting with others and communicating with them.

CONCLUSION

The theory of multiple intelligences is concerned with categorising and conceptualising human intelligence. The multiple Intelligence theory gives an in-depth pluralistic conception of human intelligence with the goal of building an effective e-learning paradigm. This study presents a variety of e-learning methodologies as well as a variety of communication modes. The goal of this project was to use multiple intelligences as a foundation for building e-



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Learning activities that encourage critical thinking. There are four parts in the development of the activities that are rule based. The first step is to identify the variables that influence critical thinking intelligence capabilities. The second stage is to create examination activities to categorise the data collected from the sample group.

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Renewable Energy Systems based on the Weighed Quantum Particle Swarm Optimization for Cost Reduction

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ABSTRACT

This article describes a method for optimizing the power output of a hybrid renewable energy system (HRES) system to meet the demands of a typical household load, which is an example of the need for cargo. The Weighed Quantum Particle Swarm Optimization (WQPSO) is utilized as an optimization search algorithm because of its benefits over other technologies in terms of lowering the leveling energy cost (LCE) while maintaining an acceptable production range when misfortunes between the creation and request sides are thought about. Utilizing the roulette wheel idea, an issue is characterized and a target work is thought about in the proposed calculation. The pheromone distribution throughout the search area is defined by a Gaussian distribution, and probabilistic route selection is performed based on the deposit value of pheromones. Recent interests have been captured among renewable energy sources, wind, and photovoltaic energy conversion technologies. Since the input to these two types of energy conversion processes is extremely unpredictable, it becomes essential to include a power storage device for an unabated power supply. However, taking into consideration hybrid production of renewable power to satisfy load demand, random mixing between participating producing units may provide unprofitable results to power suppliers. The framework of the algorithm was created using the MATLAB program.

Keywords: HRES, WQPSO, LCE, Photovoltaic Energy, Gaussian distribution.



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INTRODUCTION

As independent power systems for supplying electricity in distant locations, hybrid renewable energy systems have become popular with the advancement in renewable energy technology and consequent increase in oil costs. A hybrid energy framework or a half-breed energy framework regularly involves at least two sustainable power sources used together to further develop both framework productivity and energy supply balance. The Hybrid Renewable Energy System (HRES) [1] comprises an inexhaustible and an ordinary wellspring of energy or a sustainable, either independent or matrix connected, with or without customary wellsprings of energy. Various mixes of environmentally friendly power frameworks might be shaped into HRES [2].

As the advantages of sunlight-based and wind energy frameworks were very much perceived, framework fashioners started to look for their mix. The design of the implementation of a hybrid energy system is an uphill job since the sources examined change arbitrarily with time and also regardless of the configurations of the load needs, the selection of criteria, the size, control methods, and energy management technologies. Various mathematical analyses and simulation models for different system components are explored. The complexity of the hybrid systems' component models relies largely on the kind of application. The problems associated with the penetration of alternative energy systems are emphasized within the current distribution network. The optimum balance between power dependability and system costs must be found in HRES [3]. The intermittent nature of hybrid power increases the overall cost over the size of the individual units. Many additional factors, such as power quality, system stability, efficient use of surplus energy, and others, have to be regulated for improved system performance. Net Present Cost (NPC), life cycle emission (LCE), dumped/excess energy (EE), loss of expected load (LOLE), loss of power supply probability (LPSP), loss of load probability (LLSP), system performance levels (SPL), load hours of loss (LOLH), load risk loss (LOLR) and autonomy level are different parameters considered in the literature to optimize cost and reliability (LA)[4].

This technique compares the results with other traditional methods of artificial intelligence and optimization and has been shown to outperform them in terms of achieving optimum solution and speed. The goal function is the overall design costs, which is the sum of the total capital costs and the total maintenance costs [5]. Demand Side Management (DSM) will modify the entire consumption table - consumption profile, contract supply parameters (contract supply and network connection characteristics) to save money on electricity bills. Network operators in many countries are facing growing network instability and service interruptions due to the high penetration of renewable energy sources and the decentralisation of production. Managers can now use generation and consumption systems that give so-called grid services in exchange for payment to reduce these consequences and ensure a balance between energy use and the quantity of electricity put into the grid, hence increasing the prices for the electrical system.

An optimum size algorithm for a hybrid renewable energy system based on available generation, utilizing an intelligent grid load management tool. This algorithm attempts to optimize the production of system energy and satisfy load demand with the lowest cost and maximum dependability. This algorithm uses swarm optimization to find the optimal size of the system components. The HRES is a multi-generation combination with a storage module [6]. The generating module includes a wind turbine, a solar system, a fuel cell, and a generator for diesel engines. The battery energy storage system and the flywheel energy storage system are part of the energy storage module. Aqua electrolyzes are also included in the HRES [7] study to provide hydrogen to the FC as a fuel. The power produced by the generator and the photovoltaic system of wind turbines is considered constant. In comparison to traditional controllers, the simulation responsiveness of the HRES is superior for WQPSO optimized controllers.

The use of stochastic components in micro grids is unique: EE on the production side and flex active loads on the consumption side. Micro-grids, compared to large grids, are able to produce and provide electricity to users independently, but only at the local level. To ensure the micro grid's reliable and optimal operation, such grids



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employ an energy management system that can automatically switch between energy sources, exchange energy with an external network, and even perform load shedding if necessary, all in accordance with the developed policy (management strategy). At the same time, the possibility of user activity and the availability of EE give the optimization problem a stochastic nature, and the goal for off-grid operation necessitates the use of online optimization concepts. A stochastic optimisation application that studies sequential decision making is known as online optimisation. The NPC, which is a definition of the sequential decision-making problem for a fully observable environment with a Markov transition model and additional rewards, is one of the usual modelling approaches in this context.

Related Works

This article describes a method for optimizing the energy created by the HRES to satisfy the average residential load demand, which is used as an example of load demand in this article. As an optimization search algorithm, the particle swarm optimization technique (PSO) is utilized due for its potential benefits over other energy cost decrease strategies LCE[8], which consider the misfortunes among creation and request; the issue is characterized, and a target work is presented, thinking about the wellness esteems. The calculation's structure was made with the assistance of the MATLAB programming language [15]. As a result of sustainable power innovation and the subsequent ascent in the cost of oil-based goods, HRES have become more appealing for remote-producing applications. The economic characteristics of such technologies are sufficiently promising to warrant their incorporation into the power generation capacity of the emerging countries[9]. Innovative work exercises in sun-oriented, wind and other sustainable power advances should proceed, fully intent on working on their presentation, creating techniques for precisely determining their creation, and incorporating them into other regular fuel sources in a protected and solid way. Because of the significant disparity between intermittent power output and energy consumption, hybrid systems combining one or more main sources with a storage component is being used for the production of renewable energy sources [10]. Optimal system size for a hybrid system with no loss of power supply (LPS) for the duration of its life cycle is critical while thinking about the LCE. In particular, a pursuit calculation improvement strategy is created in this examination to track down the most reduced LCE conceivable with regards to a server farm application. A framework model is worked by incorporating essential subsystem models to accomplish this objective[11]. Besides that, the framework model is utilized in the examination of two diverse burden cases: (1) where request can't be controlled, such as in residential network power demand; and (2) where demand can be controlled, but only to a certain extent, such as in power demand within a data center or data center network. In addition, the system model considers two distinct loading scenarios. It has been investigated how different types of scenarios with regulated power demand may be created. If the electricity demand is regulated[12], the results reveal a significant reduction in system life cycle costs, which is especially important in regions where wind and solar resources are limited or non-existent.

In terms of sustainability, it has been shown that using a single criterion to choose the most suitable HRES does not provide adequate results. Using a multi-criteria approach, this study proposes a technique for choosing HRES for a typical family with low earnings to close this gap. Energy-efficient equipment (EET) and buyer energy interest without the utilization of energy proficiency [13]. The HRES optimization is accomplished via hybrid optimization of multiple renewable energy sources (HOMER), and the multi-criteria analysis is accomplished through the use of entering criteria correlation (CRITIC) and order-preference method in a manner that is comparable to the ideal solution (TOPSIS). According to the findings, the PV/GEN/BAT system is the most cost-effective alternative that can be returned to HRES based on both energy demand scenarios. According to the findings of the study, a 44.6 percent reduction in energy demand through EET results in a 51.38 percent reduction in total net current costs, an 11.90 percent reduction in energy costs, a 96.61 percent reduction in CO₂ emissions, and an increase of 193.94 percent in renewable energies.

A hybrid power system is a novel technology for power generation that combines a variety of energy systems, mostly renewable, to provide the best possible output at the lowest possible cost. As part of the current pursuit of renewable energy (RE) development, it is believed that optimum conditions for the generation and use of energy





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systems are an important component of profitably transporting loads. This is a real reality given the rising cost of energy, which harms socio-economic development. As a result, this article analyses important issues about the drivers of renewable hybrid energy systems as well as their unique benefits of HRES. Aside from that, this article covers the many renewable sources of energy that should be explored for use in the execution of the HRES program [14]. In a conclusion, the framework offers a comprehensive review of issues for the design and execution of high-reliability environmental studies in general, including software packages for modeling and optimization of the results of such studies.

METHODOLOGY

Weighed Quantum Swarm Optimization (WQPSO)

It is a stochastic optimization method based on population. The best fitness value of every, P best, and the best fitness value of the whole swarm, G best, is recorded. We compute the bird's fitness value at each iteration and then compare it with Global P best and G best to update it if necessary. By reducing objective function, the swarm is moving towards optimal solutions. First, renewable energy is utilized. Excess renewable energy in the battery is stored. Conversely, pulling power out of the battery constitutes shortages. Any residual demand must be supplied either by thermal generators or imports of energy. The grid status, market pricing, and remaining local demand are input into the Unit Commitment PSO algorithm, which produces the closest generator schedules possible.

The generator schedules are put into an economic dispatch solving algorithm. The objective of this algorithm is to balance the load across all online producers to maximize profit. The algorithm produces the best production curves for the generator it can find. The production curves of generators are used to calculate the completeness of the micro grid, total calculation costs, and energy exchange. The WQPSO algorithm is based on the idea that a few basic principles are based on complex behavior. The basic thought of WQPSO is to speed up each particle to its best and best positions, utilizing an arbitrary, weighted speed increase, as illustrated in Figure 1.

Where, If the current search point is, S_{i+1} refers to the changed search point, V_i refers to the current speed, V_{i+1} is modified velocity, V_{pbest} indicates pbest based velocity and V_{gbest} refers to Gbest based velocity. Generators can change their power output by any amount instantaneously, as long as they are already on. The minimal power output is 0 in all generations. Prices are known throughout the day, yet the purchase and sale is as if in a real-time market. This is like working on a 24-hour forecast based on a real time market. Instantly and with a granularity of one minute to buy and sell. Real time markets really have offers and the exchange must be continuous over a longer period of time. Considerations of reactive power are neglected. Excess renewable power is disregarded as if renewable energy sources could decrease their production or dump it immediately.

Parts move across a multidimensional search area to get the best solution. Each is stored in the memory of the s (pbest) for the greatest experience and the best world outcome is called the best global (gbest). The current position and speed of every i are changed throughout the whole flight according to the experiences of the surrounding s in these equations 1 and 2:

$$v_i^{(i+1)} = nv_i^{(i)} + c_1a_1(pbest_i - x_i^{(i)}) + c_2a_2(gbest - x_i^{(i)}) \dots\dots\dots (1)$$

$$x_i^{(i+1)} = x_i^{(i)} + v_i^{(i+1)} \dots\dots\dots (2)$$

Where g is the counter of generation and within [0.5, 1] a total weight factor inertia and almost one encourages global search. Inside [0, 4], the C_1 and c_2 are positive acceleration constants, which are referred to be the factor of swarm confidence and self-confidence.





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Proposed Algorithm Steps

- Let, $P = \{1, 2, \dots, n\}$ are the coordinate in swarm and $V = \{1, 2, \dots, n\}$ be the corresponding velocities of swarm s.
- The iteration for the given velocity using Pbest and Gbest as given in equation 3, $V_n(i+1) = X V_n(i) + \text{rand}(). (P_{\text{best}}(p) - p(i)) + \text{rand}(). G_{\text{best}}(i) - p(i)) \dots \dots \dots (3)$
- The current velocity with new position is denoted in equation 4,
 $P(i+1) = p(i) + V(i+1) \dots \dots \dots (4)$
- It employs a certain number of agents (s) in the search area that form a swarm in search of the optimal answer.
- Each particle is viewed as a point in a n-dimensional space which adjusts its "flying" to its own flight insight just as different s.
- Each particle tracks its co-orders in the arrangement space related with the best wellness arrangement got by that particle up until this point. This is viewed as the best close to home estimation (pbest).
- Another best worth that WQPSO tracks is the best worth that any particle in the neighborhood of that particle have accomplished to date. This is termed as (gbest).

The life cycle of Energy production is calculated in Equations 5 and 6:

$$LCE = LCC / LTEP \dots \dots \dots (5)$$

(LCC is Life Cycle Cost, LTEP is Life Time Energy Production)

$$LCE = (CF \times IC) + (AE) / NAEP \dots \dots \dots (6)$$

Where:

NCE: Normalized Cost of Energy (€/kW), **CF:** Capital Factor (%), **IC:** Installed Cost (€/kW), **AE:** Annual Expenses (€/kW/yr), **NAEP :** Net Annual Energy Production (kW)

An annualized cost for maintenance is given in Equaiton 7,

$$LCE = \frac{\left(\left[\frac{r(1+r)^t}{(1+r)^t - 1} \right] \times ICC \right) + (AN + [OM \times t])}{8760 \times CF_{\text{net}}} \dots \dots \dots (7)$$

Where r is interest rate (%), t is operational life (years), **AN:** the annualized costs (insurance, other expenses), **OM:** Operation & Maintenance Cost (€/kW), **CF net:** net capacity factor, **8760:** hours per year. The proposed method of the primary aim of is to minimize cost fitness from various sources to identify the appropriate power produced.

Cost Estimation and Reduction

The rapid production of energy in the globe was driven by ease of installation, reducing technical cost and supportive government legislation. Management and planning engineers conducted a significant deal of research utilizing several formulas to reduce expenses, which explained this. However, power prices provide their own insights into the accounting of all methods in a number of ways. This allows the analysis to be closer monitored with the underlying facts and assumptions, the analysis to improve transparency and trust and to allow national or local pricing comparisons for the same technologies to identify the primary reasons for any difference. The goal function is 'Min. NCE {Pgen (source, application)}'

The hybrid PV-wind generator system is capable of supplying 1.5 kW of continuous power and has the following features:

- Detects and tracks the point of greatest power produced by the PV panels or the wind generator, maximizing the electric power produced.
- For a stable repeater operation, the electric energy is stored in lead-acid batteries.
- Manages the charging and discharging of the batteries.
- By connecting a dummy load to the wind generator's output, it is protected from over speeding.
- When renewable energy sources fail to supply enough electric energy, starts a diesel generator or connects the system to the electric grid (if one is available).





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- Provides a 1.5-kW TV repeater with continuous and uninterruptible electric power (220 V, 50 Hz).

Figure 2 shows stream graph of the applied enhancement calculation. WQPSO emerges in its core and looks for the optimal produced power. This procedure is developed using the software MATLAB.

Experimental Result

WQPSO is straightforward to implement and may be customized by adjusting a few parameters. It can also deal with complex cost functions that have a large number of local minimum criteria. The first random swarm that was put on the cost surface is shown in Figure 3 as a block diagram of the system that has been proposed for this problem. When enough generations have passed, the swarming of s becomes apparent. The best gathering of s reaches a conclusion around the worldwide least, while the following biggest gathering is situated around the absolute bottom. There is some additional s that meander about the expense surface a good way off from the two gatherings of s . Figure 4,5 and 6 displays the finest and best local and worldwide parts as well as the average population depending on generation. The finest worldwide is the same as the elite chromosome in GA. It is most effortless to exhibit the turbulent amassing measure by following the excursion of one particle until it accomplishes the worldwide least. The s often bounces off the borders with this approach.

As a result, the MATLAB script was used to create a simple one-diode mathematical model. The solar cell's output properties are influenced by the surrounding environment. The parameters of any solar cell model are determined by the irradiance and temperature values of the site where the panel is installed. The programme generates numerical values for the corresponding circuit parameters in this article. Furthermore, the effect of varying degrees of irradiance and temperature on the electrical characteristics of the cells is investigated. The cell characteristics, shunt resistance, and series resistance were determined using a range of intensity and temperature levels. In the single diode model, the results reveal that solar cell efficiency has an inverse relationship with temperature, and that irradiance levels are controlled by changes in the photo-generation current and the series resistance. Figure 7 depicts that the random swarm particles of 10s initially and fig 8 shows the comparison of proposed WQPSO algorithm with existing algorithms. Figure 9 depicts a path taken for WQPSO of the whole system, which incorporates advancement, control, and assembling, and which will be completely integrated into and really implemented in

Matlab Simulink after being developed in a separate program and economic parameters are shown in table 1. The problem of optimal sizing of hybrid solar wind system with battery storage as a multiobjective optimization problem solved using Genetic Algorithms. The system was designed on its principal aims were to minimize the annualized cost of the system and to minimize the loss of power supply probability (LPSP) in Ant Bee Colony (ABC). In this work, the influence of load profile on design, they chose three load profiles with the same daily energy. Achieved results clearly indicated that the cost of the optimal configuration was strongly dependent on the load profile.

To get the most from the PV matrix and control the engine in the rotor reference frame. When the pump is first started, the soft start function is used. A scalable incremental conductance approach is used to extract maximum power. For a correct estimate of the maximum power point, the tangent of the power curve from the voltage is followed. The proposed methodology was tested using empirical data collected from an off-grid micro grid system that included 10 kW of PV panels, 24 kWh of two battery storages, and a 10 kW generator. Three loads (each 10 kW), a PV module, a steerable generator (Biomass Gassifier with an internal combustion engine running in only producer gas and dual-fuel mode), and storage devices were all part of the micro grid setup.

Boost converters are used as front-end converters for battery sources, solar PV systems and fuel cells, as their output voltage exceeds the input voltage. Because boost converters display poor voltage regulation and unsatisfactory dynamic response when used in open loop mode, they are generally equipped with a closed loop control to regulate the output voltage. The mode of operation of the converter depends on whether the switch is turned on or off, and tiny signal linearization techniques have always been used for controller design. Electric energy is converted into appropriate forms of energy at the end of use. An interface between the available electrical power and the operating





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equipment is required. The available energy source and the state in which the charge wants energy are incompatible in most situations.

The figures above clearly indicate that demand for peak loads have decreased, resulting in overall costs. In industrial load DSM, the profit was higher than commercial and residential load. This is because of big industry rating devices. So even the relocation of a single controlled device from the top may result in shifting the high load and making cost savings more efficient. When the end time data and the start time were included. Therefore, it increases the time restrictions. Because of these constraints and the implementation of the appliance, several high peaks were noticed on the load profile after DSM. In this instance, less cost decrease was seen.

CONCLUSION

A simplified success factor for optimizing power generated in the HRES multi-source to decrease levelling energy costs (LCE) is discussed in this work, which employs the technique of optimized weighed-quantum swarm to achieve this goal. In the end, the proposed algorithm was implemented using the WQPSO optimization technique and yielded a minimum LCE level of 0,0030277€/kW with wind turbine power generated at 1,0185 kW, whereas though the force produced by the PV module was 0,23153 kW with load request found the middle value of at around 1 kW, and misfortunes and capacity were accomplished.

Using a Quantum Swarm Optimization method, this research presents a straightforward generic approach for optimizing the production of energy in HRES, with the goal of lowering the prices of conventional energy. When it comes to dealing with different optimization issues, the WQPSO has shown its great intensity and sensitivity. It is essential, in addition to the availability of the method for regulating the electricity produced, to utilize the load for both the total power loss system and the energy stored only in batteries.

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Table 1: Nomenclature

HRES	Hybrid Renewable Energy System
WQPSO	Weighed Quantum Particle Swarm Optimization
LEC	Leveling Energy Cost
LCE	Life Cycle Emission
NPC	Net Present Cost
EE	Excess Energy
LOLE	Loss of Expected Load
LPSP	Loss of Power Supply Probability





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LLSP	Loss of Load Probability
SPL	System Performance Levels
LOLH	Load Hours of Loss
LOLR	Load Risk Loss
PSO	Particle Swarm Optimization
LPS	Loss of Power Supply
EET	Energy-Efficient Equipment
HOMER	Hybrid Optimization of Multiple Renewable Energy Sources
CRITIC	Criteria Correlation
RE	Renewable Energy
CF	Capital Factor
NCE	Normalized Cost of Energy
IC	Installed Cost
AE	Annual Expenses
NAEP	Net Annual Energy Production
OM	Operation & Maintenance Cost
CFnet	net Capacity Factor
AN	Annualized Costs
DSM	Demand Side Management

Table1. Economic Parameters

Technology	Units	Photovoltaic	Wind turbine	Diesel Generator	Lead-acid battery
Investment Cost	€ / kw (€ / kWh for battery)	2,835.00	5,832.00	596.00	148.00
Lifespan	Years	20	20	20	20
Interest rate	%	10	10	10	10
CRF	-	0.1185	0.1185	0.1185	0.1185
Annualized Investment Cost	€ / kw (€ / kWh for battery)	333.00	685.02	70.01	39.04
Maintenance and Operation Cost	% of investment cost	2	2	6.4	2
Maintenance and Operation Cost	(€ / kWh for battery)	56.70	116.64	38.08	2.96
STMGC	€ / kWh _{electr}	0	0	0.26 (India) 0.19 (Colombia)	0





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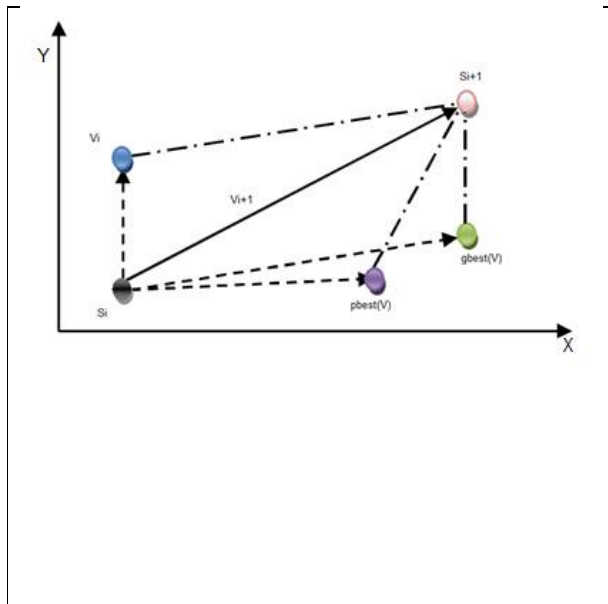


Figure 1: Searching point of WQPSO

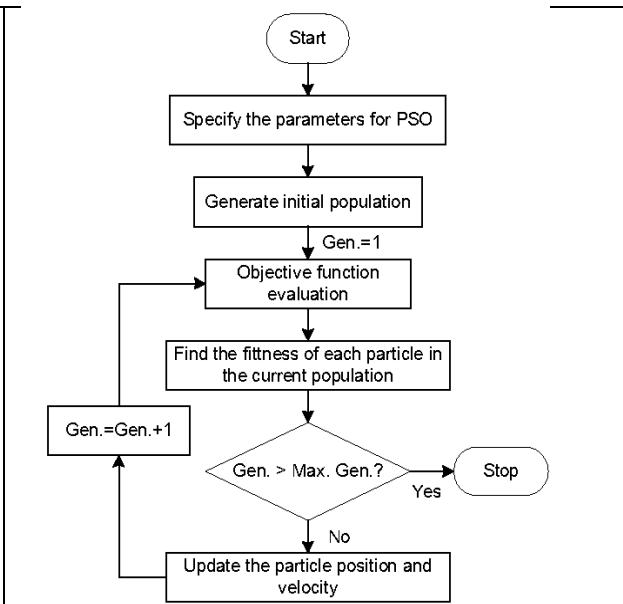


Figure 2: Flow Chart

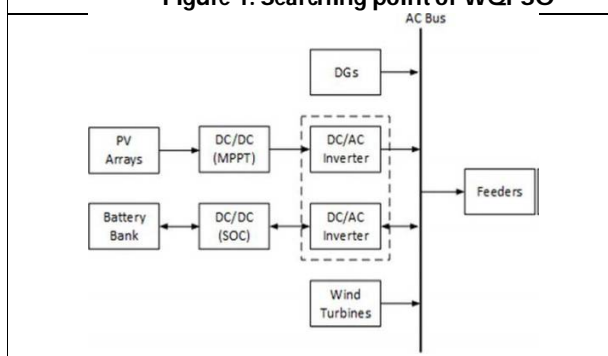


Figure 3: Block Diagram of Proposed System

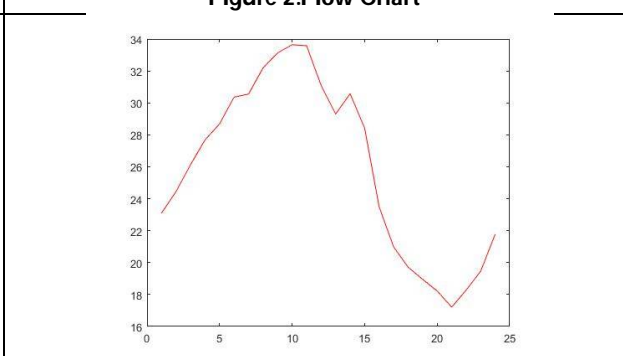


Figure 4: Day ahead load price

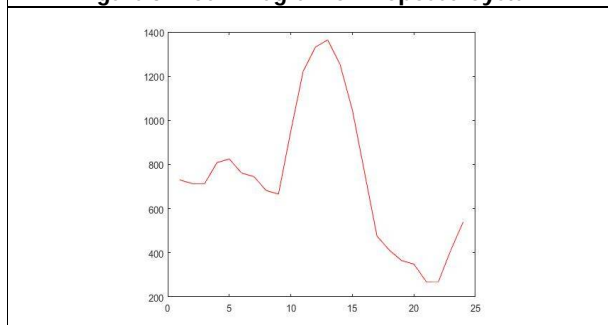


Figure 5: Forecasted Load data

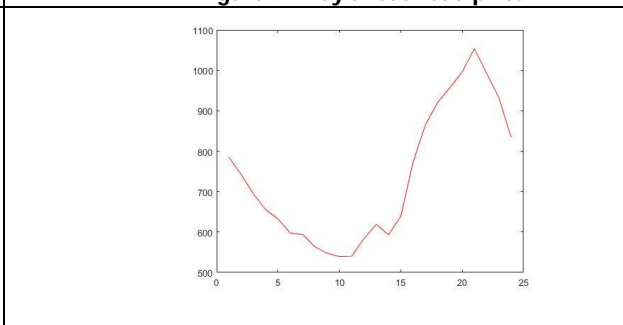


Figure 6: Optimization Function





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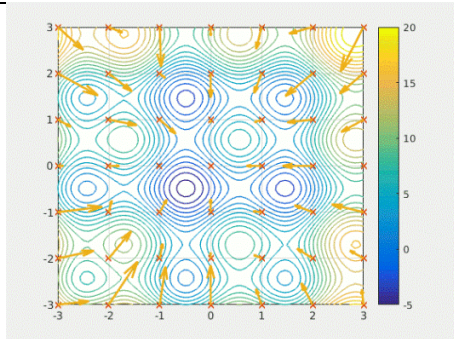


Figure 7. Initial random swarm of 10 s.

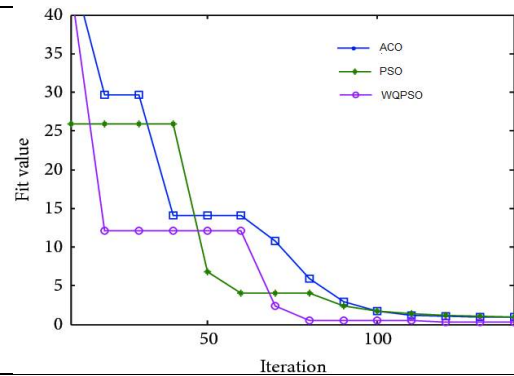


Figure 8. WQPSO algorithm vs Existing System

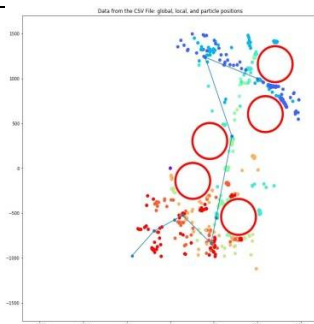


Figure 9. WQPSO path obtained iteration

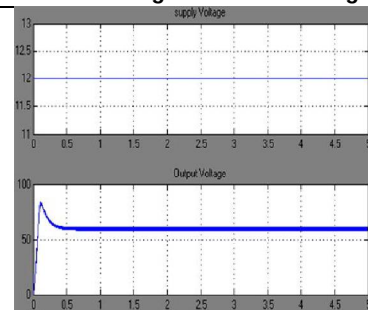


Figure 10. For PV array

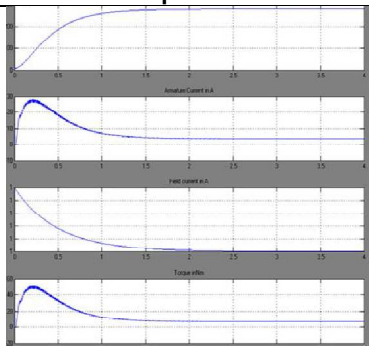


Figure 11. PV array current and torque

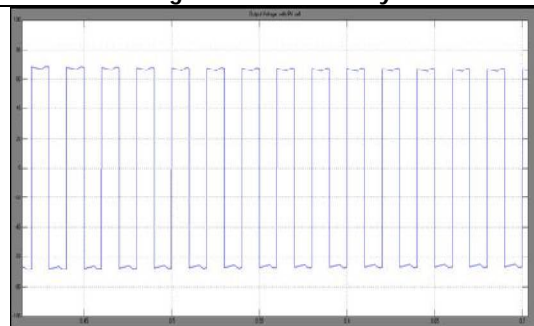


Figure 12 Simulation of boost converter with PV inverter.

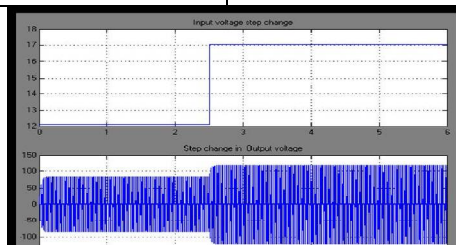


Figure 13 Simulation output of boost converter and inverter with step change.





Analysis of PNCC and Artificial Neural Network Voice Speech Recognition based Machine Learning

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ABSTRACT

Restricting the ability to breach security & encompassing is critical. The security features of the standard system, such as passcodes, finger scanning, palm scanning, and identity verification, are easily broken. In the biological sciences, voice recognition is divided into two categories: text-dependent and text-independent. For recording and identifying sessions in text-based solutions, the user should say the same phrases each time. This example in non-text systems involves a recording and evaluation session, which are two very different things. Every person's voice is highly recognisable, and they will even recognise one another on the phone.

Keywords: security, system, scanning, phone.

INTRODUCTION

Process of Speech Recognition

The speech recognition method [1-5] is a difficult and time-consuming task. The steps involved in the voice recognition approach are depicted in the diagram below. The two primary arms of voice recognition are Audio Categorization Prediction, Extraction And classification, and Storage. The feature extraction technique collects a significant amount of information from a certain vocal modality, resulting in the display of the specified authorised speaker. Because the Feature Extraction approach [6-12] is used in this project, MFCC is utilised.

The procedures are commonly believed of being a very current and cost-effective strategies for avoiding unauthorised connections in any common location or machine usage. Alternatively, the substitution in the devices





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makes it acceptable for use as speaker verification for security. Some of the most well-known systems, such as Voice Search, Cortana, Siri, Alexa, and others, make extensive utilisation ASR (Artificial Speech Recognition) engines at their front end. This ASR technology precisely converts spoken utterances into their matching text. There are numerous advantages to having a good ASR system. Instead of wasting time typing, an individual can save a lot of time by giving speech cues that are then transformed to the appropriate text. Technology nowadays has a lot of interfaces, so most people can't keep up with it.

As a result, there is a greater demand for a well-developed and well-built ASR system that can be utilised by both illiterate and better educated users to better engage with evolving technology. The Convolution Neural Network (CNN) is a type of neural network that uses convolutional (CNN). The rationale behind solving the speech recognition problem is the contribution of CNN in object identification from image; an image in CNN displays its design. As a result, our solution includes image-based sound encoding. CNN is made up of three layers: convolution, pooling, and tightly coupled layers. Internal structure is created by combining convolution and pooling layers, whereas class probability is generated by completely linked layers. Convolutional Layer Neural networks have neurons that are linked to the receptive field of the prior layer. The weights of the neurons in the same prospective map are the same. CL is made up of a set of filters that can be learned.

The following is the format of this paper: Introductions to voice comparison, speech synthesis, and speaker verification are included in Section II. A generic pipeline enabling voice comparison is also covered, as well as classical and deep learning approaches to speaker recognition including voice comparison. Emotions have an important part in everyday communication This is crucial since it aids in the making of informed and tactical judgments. It assists us in analysing a speaker's emotions by intercommunicating them with our own emotions and reporting back to others. Emotion has a crucial part in human social interaction, according to several psychologists. Speech is one of the mediums used in human-machine interaction, which is now widely used in a variety of applications. Emotion Recognition from Speech is one of the most difficult problems in human-machine communication. When two people speak with each other, the nature of their speech makes it straightforward to determine their emotions[13-16].

The major goal of this endeavour is to use their speech systems to recognise emotion. It is critical to build a technique that appropriately senses emotion. The relevant features from the speech can be collected to achieve emotion recognition. The sequential model functions similarly to a layer stack[17]. It's used to create encoder decoder and classification network models. In this approach, each layer is treated as an item that leads to the next layer. A functional model has multiple inputs and outputs. In this approach, each complicated node is separated into two or more branches.

Speech Signals Database Creation and Analysis for Multiple Emotion Recognition

One of the most recent challenges in human-computer interaction is speech emotion recognition (SER). In traditional SER classification approaches, the estimation outcome is a single emotion label per phrase. This is due to the fact that traditional speech emotional databases used to train SER models only feature one emotion label per utterance. In human speech, however, many emotions are frequently articulated at the same time with varying intensities. The presence of multiple emotions in a one phrase should be taken into account in order to achieve more natural SER than ever before. As a result, we constructed an emotional speech database that includes numerous emotions as well as descriptors for their intensity. The investigation was carried out by collecting speaking utterance fragments from existing video works that contained emotions. In addition, we used statistical analysis to examine the database that was developed. As a consequence, a total of 2,025 samples were collected, with 1,525 of them including various emotions.

Human communication

Non-linguistic information is incorporated in human communication in addition to linguistic information. What is thought to be particularly essential among non-linguistic information is the emotion that the speakers have when





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they are speaking. Speech recognition systems created in recent years can understand what the speaker is saying, but they can't tell you what emotions they're expressing. It is critical to evaluate the sentiment of the speakers in order to have a natural communication between humans and computers. Speech emotion recognition (SER) has gotten a lot of attention as a result of this, and it's one of the most recent challenges in human-computer interaction. For SER, there are two representative techniques.

The necessity to know English is becoming increasingly crucial as science and technology advance. English, as an international language, has been ingrained in people's daily lives. As a result, learning has been applied to English from an early age. There are three competences in learning English: writing, listening, and reading. Currently, the most common method of learning to read is to repeat words or sentences from textbooks. As a result, pupils will be more focused on the material delivered and will be less likely to engage in direct dialogue. Furthermore, English learning time is usually limited and expensive.

CONCLUSION

As a result, a learning medium that can deliver a direct simulation of conversational English must be developed. It may be accessible from anywhere at any time, saving money. Learning using the internet is an option. Students were taught to be active speakers rather than passive readers using web-based English learning tools with speech recognition technology and artificial intelligence. English is a language that is necessary in today's world of globalisation. Everyone of all ages is required to study English, regardless of their educational background or vocation. Currently, the goal of English teaching and learning is for students to achieve the functional stage. Students can solve challenges in everyday life by communicating in English vocally and in writing [1]. It differs from what is used in Indonesian educational institutions, which mostly use grammar translation approaches that prioritise grammar rules and tend to trump oral abilities in English learning and teaching activities.

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Artificial Intelligence-based Financial Creativity and Computer Software Security Management

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ABSTRACT

Artificial intelligence's ongoing innovation and development has resulted in significant changes in a variety of high-tech businesses. Illustration, as a technologically driven art form, is confronted with new obstacles and opportunities. Future illustration technology will continue to enhance intelligence in the new era of technical innovation and application, indicating that the industry will enter a new period of transition and upgrading. Simultaneously, the quality of graphics in India and possibly the rest of the globe, will improve in the direction of high quality and efficiency.

Keywords: Artificial intelligence, Cloud computing, Financial Management ,Security

INTRODUCTION

Big data, cloud computing, and other innovations have become widely employed in business and life in recent years, thanks to the ongoing development of numerous new Internet technologies. The advancement of artificial intelligence technologies has been aided by the expansion of data scale and processing capabilities. The classification and generalisation of financial scientific and technological has an impact on traditional financial operations, but it also raises the bar for commercial banks to operate in the economic science and technology sector. Artificial intelligence adds a new dimension to financial services it encourages customers to stay longer. Artificial intelligence technology aids banking industry standards, modelling, and intelligence, as well as credit decision-making, risk early warning, and supervision.

This article initially explores the impact of artificial intelligence upon financial innovation before proposing methods for bank financial technology and science innovation and development. Finally, in the age of artificial intelligence, it discusses the challenge of computer security management in commercial bank development.



**Mohamed Imran and Habeebur Rahman****Financial System**

The foundation of the global financial system is commercial banks. Commercial banks' business development and risk management are linked not only to the employment of a significant number of people, but also to whether or not the entire banking system generates systemic dangers.[1].The significance of financial information in promoting and leading banks has never been clearer, with the complete deployment of cloud technology, big data, block chain, artificial intelligence, and other developing technologies in banking and their daily operations. Computer data is either related to financial funds or financial secret data for banks. Its safety is inextricably linked to that of the national financial system. And the economic order's stability, and it's linked to the country's overall economic security and social stability [2].How banks use science and technology to stay up with the times is an important challenge that needs to be solved right now, given the overall trend of traditional banking embracing financial science and technology. This paper explains the fundamental prerequisites for using artificial intelligence technology to India financial innovation, summarises the impacts, evaluates the problems, and makes acceptable recommendations for India financial innovation.

Artificial Intelligence's Impact on Financial Innovation

Great transformations in relations of production and lifestyle have occurred in the contemporary era of mobile Internet with cloud computing. Artificial intelligence will have a significant impact on future economic and social growth. Risk control, as a crucial component of financial scientific knowledge, necessitates not only the development of more precise risk control regulations, but also the establishment of a systematic control environment. The influence of artificial intelligence upon commercial banks is depicted in Figure 1.

Enhance the consumer experience

Financial services must urgently improve customer experience in light of the expansion of client groups and changes in consumer needs. Artificial intelligence technology can assist in the virtualisation and automated realisation of the banking business, allowing consumers to open accounts & complete transactions on their mobile phones. Increased scientific research investment creates a business innovation platform for commercial banks to use artificial intelligence, big data mining, and cloud computing, thereby continuously enhancing data processing capability.[3] The customer's reliance on bank employees has gradually deepened, and the consumer's stickiness has been enhanced, thanks to person-to-person connection. Financial science and engineering not only integrates capital market with both the Internet, but also represents a wave of technical innovation in accounting systems that goes far beyond Digital banking. It hastened the trend of economic disintermediation, altered payment and credit systems, and altered the relationship among banks and clients, as well as breaking the old financial industry's dominant position. As a result, computer information systems are rapidly becoming the foundation of financial innovation, and they are one of the most essential ways for banks to enhance asset income, diversify their sources of income, lower operating expenses, and improve profitability.

Extend the range of services

The channel component of understanding consumers' style preferences can also be enhanced through intelligent investment. It can leverage unstructured data to estimate investors' risk - adjusted performance more objectively, in addition to counting their age, assets, and investment length through traditional surveys. Under the data platform, financial research and innovation credit risks are commonly employed in unlawful acts such as accounting scandals. The essential criterion to reflect the attitudes of customers in getting financial technology services is a credit risk assessment.

Client stickiness has diminished as a result of the passive increase of customer financial expertise. Commercial banks, on the other hand, lack the ability to innovate when compared to their counterparts and Internet financial organisations. Financial managers' personal judgment is hampered by their lack of experience. Commercial banks' traditional methods of retaining client relationships are also failing and it is difficult to predict which clients will be lost. It can predict customers' thoughts, answer thousands of customers' inquiries, swiftly guide them to the functional pages they need, and speed up the operation process when combined with technologies like voice



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recognition, semantic comprehension, and artificial intelligence reasoning. Financial technology combines two types of businesses, finance and technology, that were previously separate but are now highly intertwined, igniting new opportunities for the youth.

To improve the banking industry's management level.

The integration of AI technologies with commercial banks will boost the banking industry's management efficiency and cost, as well as its overall management level. Financial science and technology activities can be combined and formed into a systematic system using financial cloud computing services. Artificial intelligence plays a critical role in resolving the pain points of traditional wind control operations and successfully increases pre-warning, in-process processing, and post-supervision capabilities. Reduce the strain of manual service and lower the enterprise's running costs by accurately understanding client wants, providing complete remote customer care, providing business counselling and handling, and so on. It could be a well-established large corporation or a brand-new start-up.

Thirdly, financial science have a larger and more substantial impact on traditional finance than Internet finance. Financial technology and science innovation is revolutionary, and its application breadth can encompass nearly all financial industries. As a result, computer information systems are rapidly becoming the foundation of bank financial invention, and they are one of the most essential ways for banks to enhance asset income, diversify their sources of income, lower operating expenses, and improve profitability.

Measures to Promote Financial Innovation and Development by Banks III.**Improve regulatory policies and strengthen advice.**

The unpredictability of financial science and technology has had a significant impact on India financial system, making risk monitoring more complex. In this context, the government supervision departments should evaluate how to deal with the risks posed by digital finance and how to reorganise the domestic financial order. The most pressing worry in the financial industry is how to combine technology to fully exploit enterprises' competitive advantages.

While promoting fast and reliable business, it also extends the chain of data applications while also bringing external customers with internal systems closer together, effectively breaking the barrier between internal and external networks. Financial Risk Prevention Can Be Made Easier With Big Data Technology [6]. However, as computer networks have grown in popularity, as well as a huge number of security flaws and other risk occurrences, financial experts have acknowledged that network interconnection and centralised data storage will bring hazards that cannot be disregarded. Computer information security is directly linked to banking financial innovation depending on the use of current information technology. They are mutually necessary, interconnected, and promote each other. Then there will be no bank 's financial development, no bank computer - based information system security, and no bank financial innovation even without bank computer information system.

Achieve strategic transformation through altering one's mindset.

We will accelerate financial sector by utilising Internet technology to build online financial services, such as e-commerce and online payment, throughout time. The problem of limited regulatory manpower may be efficiently solved by collaboration between financial technology and research businesses and regulatory authorities, and the integration and comprehension of regulatory agencies and technologies can be increased. It is required to further combine the interconnections of work in related areas and the vague areas of operations, clarify features, establish a team full and effective coordination, and actively promote the development of corresponding fields, knows how to deal with the black industry . in this regard and internal fraud. Large data text mining is carried out on the annual reports of thousands of publicly traded corporations, and a machine learning algorithm is used to create a relatively accurate and fast prediction of a company's credit rating. The outcomes serve as key reference points. As a result, in order to achieve financial innovation goals, banks must fully address the security of computer information, employ mature and stable technology in the system implementation process, and implement the appropriate security measures and technical methods.



**Mohamed Imran and Habeebur Rahman****Management of Computer Information Security in Banking**

Exploration of fake transactions and risk control of commercial banks in the Artificial Intelligence Era. Commercial banks can first increase the data sources of traditional commercial banks' risk management using Internet big data technology and analyse semi-structured and unstructured data in the era of Internet big data and artificial intelligence [7]. Banks should anticipate new information security risks coming from the adoption of new technologies, such as artificial intelligence, in order to avoid consumer information leakage and capital losses caused by new technology.

Overall goal setting, organisational structure modification, business operational efficiencies, IT implementation plan, and regulatory mechanism measures are all examples of top-level artificial intelligence innovation design. The technical security risks caused by possible loopholes in network systems and storage centres, as well as the access to information risks of massive customer information and personal privacy, are the two major risks in the data security of commercial banks in the era of Internet big data, once commercial banks use artificial intelligence techniques to make business innovations [8]. The basic module [9] shown in fig. 2 can be used by commercial banks to offer security for classified data based on data type or sensitivity level.

This means that when financial institutions produce a greater products and services, companies should first foresee and identify the risks that will be associated with them, and then adapt to the risks' pre-existing features. The module response of the system of customer engagement channels can be achieved with voice recognition technology, simple problems can be managed to answer at the same time, and also the efficiency of meeting customer needs can be increased with man-machine combination. Regularly scan and analyse the network connection between various successful cyber attack detection applications to identify and address potential security concerns. Financial science and technology quality - improvement systems and safety management procedures, regulatory authorities doing an excellent work in quantitative management, improving performance appraisal rewards and recognition mechanisms, and strengthening risk management training and assessment

Promote the adoption of a standard system and the use of financial information technology. Not only can standardisation meet application requirements at different periods of time, decrease system redundancy, and save resources, but it can also reduce system complexity, management difficulty, and simplify operation. To assure the validity, legality, and accuracy of information, the validity of collected data, the validity of input data, and the correctness of business operations must all be properly checked. The core of financial business rivalry is no longer restricted to brand and product advantages and disadvantages, but rather to the customer's recognition of the degree of integration of financial business and life scenes, thanks to advances in financial science and technology.

This will drastically alter the embarrassment of security management and installation in the growth of banking financial technology. To process enormous heterogeneous data, natural language processing employs the two technologies of machine learning and natural language creation. News and transaction analysis reports are prepared automatically when the data has been analysed. The business's security needs must be considered while implementing a computer application system. Its security measures focuses on the network and system's security monitoring, administration, and emergency treatment, and eventually completes the application system's security transformation.

Improving the risk management norms of financial information and communication technologies for commercial banks' internal control Commercial banks should develop internal management rules and standards based on financial innovation and entrepreneurship business they conduct, which will be part of the commercial bank's internal control system. The financial industry can completely employ both structured and unstructured data, such as customer fundamental information and social network information, to create more three-dimensional personal portraits and properly analyse customer preferences. The connection between data protection and data, algorithms, and services is explored on the basis of incorporating artificial intelligence to ensure that the application system has appropriate security analysis and security testing from the defined needs to the launch. procedure, and to avoid



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rushing the system's development in order to implement it quickly. Commercial banks can develop long-term partnerships with big data businesses to collect information about their clients' travel, trading, and other activities at a low cost. When it comes to scoring consumers' credit, using a machine learning categorization method can help you make a more accurate decision on whether or not to approve their application. Commercial banks can emphasis on the development and practice of four types of artificial intelligence technologies in the future, according to current artificial intelligence research and application: voice recognition system processing, intelligent robotics, computer vision, and in-depth learning.

Continually improve the basic construction and administration of safety. Architecture strengthening, access control, application security, and other topics are covered in depth in basic security. The plan for building bank computer security should take into account all of the additional security requirements that the protected system's future development will bring. The security architecture of a bank computer system is unique in the industry. The system requirements for building a computer security unit differ from those for ordinary units. The security items employed should be diverse and specially customised, with similar social products.

When establishing a financial innovation and engineering ecology, banks should take advantage of this to create tailored goods and services to banks that rely on the digitalization of creative financial scientific research firms. The IT and banking services provider industries are highly developed in developed countries. This has given them a technical and production foundation on which to work together. Future network system security will encompass all levels of the mainframe, but in the coming years, the protective technology surrounding the bank's computerized information security will take centre stage. Access control, authorisation, authentication protocols, firewall, protected storage and processing, content restriction, and other precautions are among the most important to employ. Attract and train personnel in the fields of information security and scientific and technology management. Without human resources, no modern technology can be realised. As a result, assembling a team of skilled and strong technological personnel is a sure-fire way to ensure data security.

CONCLUSION

Information security has reached a fork in the road with the arrival of the business technology revolution. For banking information security managers, living in a digital world guided by financial scientific and technological is both a challenge and an opportunity. Commercial banks should improve their adoption and training for artificial intelligence professionals, expand their collaboration with research institutes, and actively request new professional talent. We can combine the issues and difficulties to create a risk management system that is close to flawless in terms of financial science and technology. As a result, whether or not commercial banks can comprehend and implement the latest big data technologies to some extent affects their future development chances. Furthermore, the accounting profession should recognise artificial intelligence's catalytic effect on the new round anyway economic growth, encourage the modernization of developed economies through investment, pique the interest of emerging markets, set an example, and improve the utilisation rate of society's resources.

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Nomophobia among School Students (10-18 Years)

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ABSTRACT

Our lives have been drastically altered by smart phones. Nowadays, we can't do anything without our phones. We must analyze ourselves or think clearly in order to determine whether a cell phone is a boon or a curse. Quasi-experimental one group pretest and post-test research among school students aged 10-18 years of both gender were chosen by Systematic sampling technique. The data were collected by using demographic performa and Nomophobia questionnaire. The result showed that 42 (28%), 15(10%) of them had mild nomophobia, 70(47%), 7(5%) of the school students were had moderate nomophobia, 11 (7%), 0% of them had severe nomophobia and 27(18%), 128(85%) of them were normal users in pre teat and posttest respectively. Regarding Knowledge on Nomophobia among school students is that 73(49%), 0 (0%) of them had inadequate knowledge, 36 (24%), 52 (35%) of them had moderately adequate knowledge and 41 (27%), 98 (65%) of them had adequate knowledge in pretest, post test respectively. The pretest means score was 11.46 ± 4.41 (SD) whereas in post-test, the mean score was 18.4 ± 1.79 (SD) which means the mean differences was 6.94. The calculated paired't' value 13.2 ($P < 0.05$) states that highly significant difference between the pre-test and post-test. It proved that the Educational programme was highly effective in improving the knowledge and helps to reduce the Nomophobia among school students.

Keywords: Assess, Nomophobia, School students.



**Venkatesan and Kamala****INTRODUCTION**

We are all a part of techno culture. Schoolchildren have also been immersed in this aspect of techno-culture during the previous two years. We must properly prepare technology because each technology has both positive and negative elements. Overuse of mobile phones is extremely dangerous to one's health. Smart phone has become the basic necessity of school children daily life and students are slowly coping with this new method of technology for their academic progress. Over usage of mobile phone leads to such an extent that children comes across a situation where they cannot live without the use of mobile phone. Such a situation when students start to have fear when they cannot access their smart phones is known as nomophobia [1]. The increasing utilization and pervasion of the mobile phone, the new smart technology, and virtual communication tools including computers, tablets, and smart phones have influenced peoples' daily routines. A huge revolution in mobile phone technology is smart phones that allow individuals to do more than just communication with others. A variety of daily tasks are now easily performed by smart phones including calling, texting, sending e-mails, scheduling appointments, communicating socially, surfing the internet, and gaming [2, 3]. China is the world's largest mobile phone using nation and India is the second largest with 884 million cell phone connections. China has 963 million potential Nomophobics. China and India accounts for more than 30% of global cell phone usage [4].

Nomophobia is a new term, defined as the fear of being out of mobile phone contact. People, especially teenagers get very anxious when they lose their mobile phone, run out of battery or credit or due to less network coverage. The ignorance of the disadvantage among adolescents has led to a long way of health hazards. So, it is best to sensitize and alert them regarding the ill effects of Nomophobia, which prevents them from further risks [5]. Nomophobia refers to discomfort, anxiety, nervousness or anguish caused by being out of contact with a mobile phone. For many, the smart phone has become an extension of their ear, from the moment they wake up to the moment they fall asleep. Individuals with nomophobia, especially teenagers, get very anxious when they lose their mobile phone, run out of battery or credit or due to less network coverage. They never switch off their mobile phone, carry their phones to bed and never stay away from their phone even for a second [6]. Joe B *et al.*, (2020) revealed that 52.58% of the participants had a moderate level of Nomophobia, 32.58% had a mild level of Nomophobia, 14.40% had a severe level of Nomophobia, and only 0.44% had no signs of Nomophobia. They concluded that the present scenario, due to online classes, students are more and more involved with smart phone technologies for online classes. Nomophobia is very prevalent among school-going children and it's affecting their health. [1]

Saraswathi K N (2019) revealed in her study that the majority 35 (58.4%) of nursing students had average knowledge, 22 (36.6%) had poor knowledge and only 3 (5%) had good knowledge regarding Nomophobia. The mean knowledge score regarding Nomophobia is 7.5 with the SD of ± 1.4 .[7] As a situation-specific phobia, Nomophobia has recently been suggested to lead to strong perceptions of anxiety and distress. In fact, some suggested that Nomophobia could be so stressful that it warrants to be considered a psychopathology. Nurse as health team member may want to assess the prevalence of Nomophobia, knowledge regarding smart phone use and the effect of using smart phones among school students. Hence the researched intended to assess the level of knowledge and the effectiveness of educational programme on Nomophobia among school students.

Statement of the problem

Identify the level of nomophobia and evaluate the effect of planned educational strategy on Nomophobia among school students of 10-18 years in selected school at Karaikal.

Objective

- To identify the level of nomophobia among school students
- To assess the level of knowledge on nomophobia among school students
- To evaluate the effect of health education on level of nomophobia among school students
- To find the correlation between the level of knowledge and level of nomophobia
- To associate the level of nomophobia with selected demographic variables



**Venkatesan and Kamala**

MATERIAL AND METHODS

Quantitative Quasi experimental one group pretest and post test research design was adopted for this study. A total of 150 school students who aged between 10-18 years of both gender are participating in the study. The samples who met inclusion criteria were selected by using probability systematic sampling technique. Willing and eligible participants were included in the study. The study was conducted at selected schools at Karaikal. Informed assent was obtained from all the children who have accepted to participate in the study. Data was collected with the use of demographic and Nomophobia questionnaire to identify the level of nomophobia and semi structured knowledge questionnaire to evaluate the level of knowledge.

RESULTS

The table 1 showed that in pretest the majority 70(47%) of them had moderate nomophobia,42(28%) of them school students were mild Nomophobia, 27 (18%) of them had no Nomophobia and 11(7%) of them had severe Nomophobia ,where as in post test majority 128(85%) of the school students were had no nomophobia,15(10 %) of them had mild Nomophobia, 7 (5%) of them had moderate Nomophobia and none of them had severe Nomophobia. According to table 2 the level of knowledge on Nomophobia among school students was that 73(49%), 0(0%) of them had inadequate knowledge, 36(24%), 52(35%) of them had moderately adequate knowledge and 41(27%), 98(65%) of them had adequate knowledge in pretest, post test respectively. Table 3 showed that the comparison of overall mean, SD and mean differences of knowledge scores. The pretest means score was 11.46 ± 4.41 (SD) whereas in post-test, the mean score was 18.4 ± 1.79 (SD) which means the mean differences was 6.94. The calculated paired't' value 13.2; $P < 0.05$, states that highly significant difference between the pre-test and post-test. It proved that the Educational programme was highly effective in improving the knowledge and helps reduce the Nomophobia among school students. Table 4 illustrates that the present study result found that the negative correlation knowledge and levels of Nomophobia among school students. Table 5 revealed that there was a significant association with the pre test level of Nomophobia among school students with their selected demographic variables like age, duration of using mobile phone, Previous source of information regarding Nomophobia and not found statistically significant with other variables like gender, Standard studying.

DISCUSSION

The present study result showed that in pretest majority of the school students had inadequate knowledge on Nomophobia and some of them affected by severe Nomophobia. After the Educational programme the knowledge was improved and its positively correlate with Nomophobia among school students. So this study proved that significant difference was there between pre test, post test level of knowledge and Nomophobia and also found that Educational programme was effective in improving the knowledge and decrease the level of nomophobia among school students. The above findings were supported by Vaishali, Mandonca et al., (2021) revealed that majority, 140 (56.0 %) of samples have moderate levels of Nomophobia. 203 (81.2 %) samples have good knowledge level regarding smart phone. Majority, 188 (75.2 %) of samples had moderate level of effect on their life due to smart phone use [8] Veerapu, N. et al. (2019) reported that out of 364 students, 62 have mild, 234 have moderate and 68 have severe Nomophobia. [9] Anshari, M. et al. (2019) examined the prevalence of Nomophobia among youth and found that impact of nomophobia on personal habits and behaviors amongst the youngsters [10]. Durak, H.Y. (2018) reported that social media addiction is positively correlated with nomophobic behavior levels. [11]

Gezgin, D.M. et al. (2018) investigated nomophobia prevalence among 818 pre-service teachers in Turkey and the results showed that pre-service teacher's nomophobia levels are higher and they feel anxious about not being able to communicate and not being able to access information [12]. Manrique, G.A. et al. (2018) analyzed the relationship between the levels of nomophobia and the distraction associated with smartphone usage among nursing students



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during their clinical practicum. A positive correlation was found between the use of smartphones and the total score of nomophobia. [13] Kar, S., Sarma, et al., (2017) reported that Nomophobia is found to be vital in medical students and individual and group counseling should be given to regulate it. [14] Salloju, V. et al. (2017) assessed the pattern of mobile phone usage and prevalence of nomophobia and the data suggested nomophobia as an emerging problem of the 21st century. [15]

CONCLUSION

Nomophobia is a common type of problem seen among youths. Tele communications has been revealed as one of the rapidly spreading media on the planet, encouraging an emergent “mobile culture” in younger generation. The present study result insisted the necessities of strategies to overcome the nomophobia among school children.

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Conflicts of interest

There are no conflicts of interest

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Table: 1 Frequency and percentage wise Distribution of level of Nomophobia among school students

n=150

Level of knowledge	Pre test		Post test	
	Frequency	Percentage	Frequency	Percentage
Normal (20)	27	18%	128	85%
Mild ($\leq 21 < 60$)	42	28%	15	10%
Moderate ($\leq 60 < 100\%$)	70	47%	7	5%
Severe ($\leq 100 < 140\%$)	11	7%	0	0

Table: 2 Frequency and percentage wise Distribution of level of knowledge on Nomophobia among school students

n=150

Level of knowledge	Pre test		Post test	
	Frequency	Percentage	Frequency	Percentage
Inadequate	73	49%	0	0%
Moderately adequate	36	24%	52	35%
Adequate	41	27%	98	65%

Table. 3 Comparison of Mean, SD, and mean percentage of pre-test and post- test knowledge on Nomophobia among school students

Area	Max score	Pre test scores		Post test score		Mean diff (%)	t' test
		Mean	SD	Mean	SD		
Level of knowledge on Nomophobia	20	11.46	4.41	18.4	1.79	6.94	13.2* (S)

Table.4 Correlation between knowledge and levels of Nomophobia among school students

Area	pretest
knowledge and levels of Nomophobia	-0.67 Negative correlation

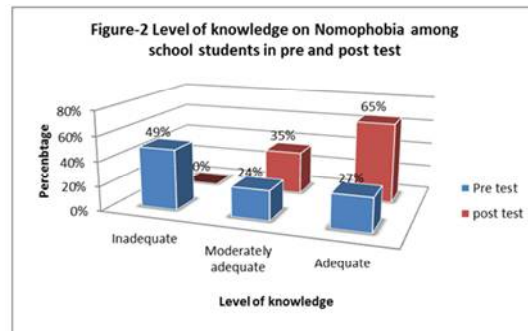
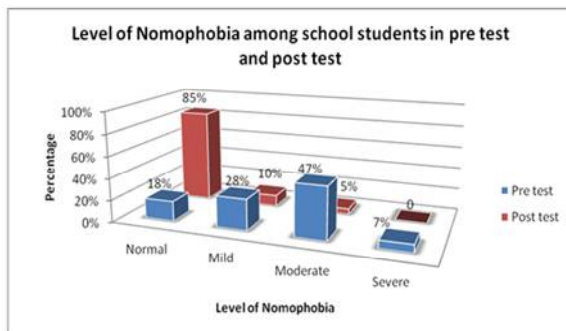




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Table.5 Association between pre-test levels of Nomophobia among school students with their selected demographic variables

S.no	Demographic Variables	X ² value	Significance
1.	Age in years	6.81	S*
2.	Gender	2.34	NS
3.	Standard studying	1.24	NS
4.	Duration of mobile phone using	6.47	S*
5.	Previous source of information regarding Nomophobia	8.24	S*





An Intelligent Deep Learning Enabled Content based Image Retrieval and Classification Model for Plant Disease Images

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ABSTRACT

In agricultural sector, plants suffer from various diseases at any stage of their development. It necessitates effective diagnosis and preventive measures to manage quality and reduce crop loss. The utilization of Computer Vision (CV) based image analysis approaches has turned out to an efficient technique to continuously monitor the plant health conditional and earlier identification of plant diseases. On the other hand, Content-Based Image Retrieval (CBIR) approaches can be used for the automated indexing and retrieval of plant disease images. Several CBIR approaches have been reported in the literature during the last decade, and other CBIR applications have been proposed recently. With this motivation, this paper presents an intelligent deep learning enabled CBIR and classification model for plant disease (DLCBIR-PD) images. The proposed DLCBIR-PD model aims to retrieve the related images based on the query plant disease image and then classify the retrieved plant disease images.

The performance validation of the proposed model is carried out using the New Plant Diseases Dataset, which encompasses 87K color images of normal and infected crop leaves under 38 distinct class labels. The experimental results indicated that the proposed method not only achieved better retrieval results but also satisfactory classification results. The proposed model involves two major phases namely image retrieval and image classification. During the retrieval process, Super Pixel Guided - Graph-Cut (SPG-GC) based image segmentation, Inception with Residual Network (ResNet) v2 model, and Euclidean distance-based similarity measurement processes are involved. Next to the retrieval process, the



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classification of retrieved plant disease images is classified by the use of Gradient Boosting Tree (GBT) model.

Keywords: Plant disease, CBIR, Deep learning, Image classification, Feature vectors, Similarity Measurement.

INTRODUCTION

Many developments in computer vision (CV) have occurred in recent years, mainly because of advances in computer speed, new communication technology, inexpensive storage devices and multimedia. An updated collection of photos from many application areas. Today, image is a vital component of human life, including everything from politics to business to crime prevention to hospitals to engineering to surveillance to media. It is tough to find the photographs you need from these massive libraries [1]. The major aim of CBIR scheme is to retrieve images which are comparative to QI from the database images Alsmadi, MK. (2018) and Carneiro, G. et al., (2007). It uses the method of "query by example" that retrieves related images to the input image by a depiction regarding query image inputted with the client, the CBIR scheme operates using query image extraction features, thereafter the scheme seeks for the extracted features. Agriculture is one of the fields where the researchers have an opportunity to employ CBIR for identifying fruit, leave and stem diseases. The economy of agricultural countries has main part of agricultural production that is influenced by crop diseases. Predictive and Preventive actions at proper stage of crop cultivation could enhance efficiency with disease management. Professionals such as agricultural advisers and experienced farmers identify the disease. Extended cultivation skill could enhance capability in farmers since their visual sense get established for catching modifications in the crop affected by disease. Over the part of these 2 experts are restricted by inconsistency and subjectivity Patil. et al (2014). Computer based system could conquer this limitation. This system is established as mobile application/special disease.

Several DL-based plant disease and pest detection Wechat applets and photo detection APP software have been developed by a few domestic and foreign enterprises in actual agricultural practice. Because of its vast market potential, the plant disease detection method that relies on deep learning (DL) has a substantial amount of study value. This paper presents an intelligent deep learning enabled CBIR and classification model for plant disease (IDLCBIR-PD) images. The proposed IDLCBIR-PD model focuses on the retrieval and classification of plant disease images. The proposed model involves super pixel guided graph-cut (SPG-GC) based image segmentation, Inception with Residual Network (Reset) v2 model, and Euclidean distance-based similarity measurement processes for effective plant disease image retrieval. Besides, the classification of retrieved plant disease images is classified by the use of gradient boosting tree (GBT) model. The experimental examination of the IDLCBIR-PD model takes place on the benchmark New Plant Diseases dataset comprising normal and infected crop leaves. In Atila et al., Efficient Net DL framework has been presented in plant leave disease classification and the efficiency of these models is related to other advanced DL modules. The Plant Village dataset has been utilized for training modules. Every module has been trained with augmented and original datasets containing 55,448 and 61,486 images, correspondingly. This framework and other DL modules have been trained by TL method. In TL, each layer of the modules has been fixed to be trainable. Patil and Kumar proposed a CBIR scheme to retrieve diseased leaves of soybean. They utilize texture, colour, and shape features of leaves. Colour feature is extracted by HSV colour histogram. The SIFT provides shape feature by matching key points. The Gabor filter and LBP are broadly utilized for texture features. A new texture feature called LGGP is presented with the combination of Gabor and LBP. The efficiency of these entire features regarding retrieval accuracy is verified to 3 soybean leave diseases.

Later, segmented images are depending upon the outcomes of RPN technique that have the features of symptom via Chan Vese technique. Singh and Yogi emphasize on CNN, IP, AI, DL, and SVM technique complete descriptions of the detection of various kinds of diseases in potato and tomato plants depending upon CBIR system. Also, it includes different kinds of diseases that usually present in potatoes and tomatoes. CV architecture was proposed by Aziz et





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al., for the classification and identification of plant diseases. LTriDP may be extracted from a variety of plant leaf pictures using the approaches shown below. Through dimension reduction and effective extraction of discriminative data, the LTriDP feature is a powerful tool. Multi-class SVMs are used for classification. Research is conducted on a dataset of Tomato leaves that includes five unique varieties. Classifying and retrieving photos of non-infected and infected vegetables is proposed by Belsha and Hariprasad. In order to overcome the difficulty of searching through such a large database for a vegetable image for use in quality analyses, the CBIR scheme is being introduced. Vegetable photos are processed using a new CBIR approach that incorporates feature extraction. Classification and feature extraction are used to create the diseased vegetable categories.

The Proposed Plant Disease Image Retrieval and Classification Model

As seen in Figure 1, the suggested IDLCBIR-PD model has two key stages of operation: retrieval and classification. To enhance the quality of the photos, a histogram equalization-based pre-processing technique is used. An image segmentation approach known as the super pixel guided graph cut is used to find unhealthy areas in the plant disease images. It is then used to extract feature vectors from the Inception with Residual Network (ResNet) v2. Then, using the Euclidean-based similarity measurement technique, related plant disease images are retrieved based on the query plant disease photos. The gradient boosting tree (GBT) model is used to classify plant disease photos after they have been retrieved. The next sections go into great depth about how to use each of these modules.

Pre-processing

At the initial stage, the input plant disease images are converted into grayscale versions to reduce the execution time of the technique. Besides, for the images with background and foreground with bright/dark regions, histogram equalization approach is applied to enhance the contrast level by the adjustment of image intensity.

Image Segmentation

During image segmentation process, the preprocessed plant disease image is inputted to the SPG-GC technique to detect the infected portions from the plant image. In this study, they introduce an effective super pixel guided interactive image segmentation method is depending upon graph concept. The presented technique is finished in 2 phases. In initial phase, they utilize Mean Shift technique for pre segmenting the image to extract super pixel. The super pixels are later captured as nodes to create a fixed graph. In the next phase, to resolve the boundary leakage problem affected by Mean Shift method, the presented technique makes a mask image that is named Trimap, with expansion operation and morphological erosion depending upon initial phase segmentation result. When Trimap Background and Foreground modules are developed, they create similar background and foreground modules for the narrow band region as well. Finally, the pixel-level image segmentation is completed using the maximal flow minimal cut technique.

To measure the similarity among superpixels, the similarity of every superpixel regarding the background and foreground is estimated by,

$$\begin{cases} \rho(i, F) = \sum_{k=1}^Z \sqrt{H_i(k)H^F(k)} \\ \rho(i, B) = \sum_{k=1}^Z \sqrt{H_i(k)H^B(k)} \end{cases} \quad (1)$$

However, the initial portion of the term is the regional term that quantifies the similarity between each superpixel and the background and foreground interactions data. The edge data, which measures the similarity among surrounding superpixels, is the next part of the analysis. regional and edge terms are described in accordance with

$$E(i) = \sum_{i \in V} R(t_i) + \sum_{(i,j) \in E} |t_i - t_j| \cdot B(t_i t_j) \quad (2)$$

$$\begin{cases} R(t_i = 1) = \gamma & R(t_i = 0) = 0 & \forall i \in F \\ R(t_i = 1) = 0 & R(t_i = 0) = Y & \forall i \in B \\ R(t_i = 1) = \rho(i, F) & R(t_i = 0) = \rho(i, B) & \forall i \in U \end{cases} \quad (3)$$





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$$B(t_i, t_j) = \lambda \cdot \rho(i, j) \tag{4}$$

Where $\gamma = 1 + \max_{i \in V} \sum_{j: \{i, j\} \in N} \rho(i, j)$, N denotes pixels neighborhood, and λ represents balance control variable. The entire procedure of the next phase is mainly related to the Grab Cut technique. The area size of the defined narrow band from the initial phase is smaller, the defined background and foreground areas nearly have entire background and foreground information instantaneously. Thus, the background and foreground modules developed in the presented technique are very precise. In the next phase, they utilize similar energy function as Eq. (2) in the initial phase, however, the equivalent 2 energy terms are predetermined by,

$$\begin{cases} R(t_i = 1) = \gamma & R(t_i = 0) = 0 & \forall i \in \text{TrimapForeground} \\ R(t_i = 1) = 0 & R(t_i = 0) = Y & \forall i \in \text{TrimapBackground} \\ R(t_i = 1) = D_B(i) & R(t_i = 0) = D_F(i) & \forall i \in \text{TrimapUnknown} \end{cases} \tag{5}$$

$$B(t_i, t_j) = \frac{\lambda}{\text{dist}(i, j)} \exp\left(-\frac{\|I_i - I_j\|^2}{2\sigma^2}\right) \tag{6}$$

Where, I_i denotes color data of pixel i and $\gamma = 1 + \max_{i \in V} \sum_{j: \{i, j\} \in N} B(t_i, t_j)$.

Inception with ResNet v2 based Feature Extraction

At the time of feature extraction, the segmented images are fed as input to derive a useful set of feature vectors. A comprehensive CNN comprises activation, convolutional and downsampling layers. The aim is for mapping a pixel to the likelihood distribution/ output label depending upon extracted descriptive feature. The input contains 1D, 2D, and 3D. The CNN with 1D inputs straightaway categorizes the image in the spectral field; for 2D input extracts feature from adjacent pixels and utilize to be categorized as input, and with 3D input extracts complex feature from spatial and spectral fields. CNN considers spatial data to attain an optimum efficacy based on classification accurateness. In this study, 2 CNNs are created in terms of DAG Lenc (2015) framework whereas the fundamental layers are defined.

Assume x denotes vector of pixel of input image X of layer, and a separate neuron executes an operation on x and generates an output a . The neuron function is determined by:

$$a = \sigma(fx + b) \tag{8}$$

Weight filter f is represented by f , bias filter b is represented by b , and activation function $\sigma(\cdot)$ is often a nonlinear function represented by $()$. In most cases, each neuron is linked to a specific location (i, j) and dimension (d) . To put it another way, it indicates that the convolutional block is applied to the entire area, spanning all wavelengths of light. Assuming the DAG has a multidimensional filter $f \in \square^{H' \times W' \times D \times D'}$ and a bias, the output $a \in \square^{H'' \times W'' \times D''}$ is defined as follows for the input feature $x \in \square^{H \times W \times D}$ at the location (i, j, d) :

$$a_{i'' j'' d''} = \sigma\left(b_{d''} + \sum_{i'=1}^{H'} \sum_{j'=1}^{W'} \sum_{d'=1}^D f_{i' j' d'} \times x_{i''+i'-1, j''+j'-1, d'+d''}\right) \tag{9}$$

Assume that the activation function usually operates with square image in several image processing challenges, however, it operates with random filters and inputs. When the top bottom left right paddings $(P_{\square}^-, P_{\square}^+, P_w^-, P_w^+)$ and down sampling strides (S_{\square}, S_w) are indicated, Eq. (9):

$$a_{i'' j'' d''} = \sigma\left(b_{d''} + \sum_{i'=1}^{H'} \sum_{j'=1}^{W'} \sum_{d'=1}^D f_{i' j' d'} \times x_{S_{\square}(i''-1)+i'-P_{\square}^-, S_{\square}(j''-1)+j'-P_w^-, d'+d''}\right) \tag{10}$$

The size of output of every convolution layer in DAG framework is $H'' = 1 + \left\lfloor \frac{H-H'+P_{\square}^-+P_{\square}^+}{S_{\square}} \right\rfloor$. It must be stated that a similar filter is employed in every spatial position for guarantying the translation invariance. For every layer, one or





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more activation functions are employed. The sigmoid function and ReLU Gao and Lim (2015) are often utilized as activation functions. ReLU defined by Eq. (11) is employed in this research.

$$\sigma(x) = \max(0, x) \tag{11}$$

It is general to arrange the output of the prior layer and feed them to the following layer. Additionally, in the convolutional layer, few downsampling functions are generally included layers for increasing receptive neuron fields. Downsampling is determined by involving pooling layer or employing stride for skipping few convolutions. Usual pooling functions are accepted in CNN are mean-pooling and max-pooling.

The major part of CNNs in image classification for predicting the class label of test pixels with minimum loss function \square . A generally utilized log-loss function is employed all over this study:

$$\square(x, c) = -\log x \tag{12}$$

Whereas x_c represents true label values. During this study, a SoftMax function is employed to the top layer for producing output with a likelihood distribution viz., $x_k = p(k), k = 1, \dots, C$. When \square is employed, weight is executed by a descent technique. The initial derivatives of the loss function regarding every weight are upgraded by a learning rate λ in all iterations by

$$f_i = f_i + \lambda(\partial \square / \partial f_i) \tag{13}$$

The initial derivatives $\partial \square / \partial f_i$ are attained with BP by a chain rule

Inception-ResNet-V2 is utilized as an advanced module for classifying the plant disease images. It is mostly an integration of Google Net (Inception) and ResNet It is a usual network with a similar layer structure which is initially employed in Google Net. It comprises similar relations of filters with distinct sizes of $1 \times 1, 3 \times 3$, and 5×5 . Small size affects the convolution kernel for extracting image features greatly and efficiently decreases the module variables. The major concept of ResNet is to include a straight connection to the architecture that is discussed to the concept of Highway Network. The prior network structure is a non-linear conversion of efficiency input when Highway Network permits a specific proportion of output of the preceding network layer that exists maintained. It permits the original input data to be transferred straight to the following layer. While ResNet could secure the reliability of data by straight transferring the input data to output. The entire network should learn the variance among input and output that simplifies the learning difficulties and objectives. In Residual Inception network (Figure. 2), the Inception model was utilized since it includes lesser computation difficulty compared to the original Inception model. Fig. 2a–c denotes layers of Inception ResNet, viz., Inception-ResNet-A, Inception-ResNet-B, and Inception-ResNet-C. The number of layers in the overall architecture for every module are 5, 10, and 5, correspondingly. Every Inception block is linked to filter layer (1×1 convolution with no activation function) for dimension conversion to attain the input match. These systems reward for reduction dimension in Inception block.

Similarity Measurement

The feature vector of the query image (QI) is denoted by $F_q = [F_q(1), F_q(2) \dots \dots F_q(n)]$ and database image feature vector is denoted by $FV_{db} = [FV_{db}(1), FV_{db}(2) \dots \dots FV_{db}(n)]$. The aim of an effective comparison measure can detect an optimum 'n' appropriate image from the database related to the query image. The subsequent comparison measure is utilized. Euclidean distance measure (E_d):

$$E_d(db, q) = \sqrt{\sum_{f=1}^n |(FV_{db}(f) - F_q(f))^2|} \tag{14}$$

Where n represents length of Feature Vector. FV_q and FV_{db} denotes Feature Vectors of query and database images. The small the distance, greater is the retrieval of appropriate images.

GBT based Classification

In last stage, it trained a GBT multiclass classification by XGBoost Tchen, C. et al (2016) through every feature extracted from the prior stage is classified into appropriate plant disease class labels. The GBT, alongside other tree





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ensemble learning techniques, was broadly utilized in industry and data mining approaches. Diverse from another tree ensemble approaches, the GBT is trained in a preservative way. At every time step t , it develops other trees to minimize the residual of present module. Also, it is expressed by:

$$\square^{(t)} = \sum_{i=1}^n l(y_i, \hat{y}_i^{t-1} + f_t(x_i)) + \Omega(f_t), \quad (15)$$

whereas l represents loss function which measures the variance among labels of i -th sample y_i and the forecasted in the final stage add the present tree output; and $\Omega(f_t)$ indicates regularization term which penalizes the difficulty of the novel tree.

Performance Validation

This section validates the performance of the proposed model using Python 3.6.5 tool. The proposed model is validated using benchmark dataset consisting of 87K color images with 28 class labels. Besides, two datasets namely apple and grape plant disease datasets are used for experimentation. The details related to the dataset are given in Table 1. Both the datasets hold images under four class labels. Table 2 shows the results of the suggested DLCBIR-PD model's performance evaluation on the two datasets that were used. The proposed DLCBIR-PD model is examined in detail in Figure 6 using data from an actual study of Apple plant disease. The proposed DLCBIR-PD model diagnosed the scab illness with a precision of 89.39 percent and a recall of 85.90 percent from the figure. The DLCBIR-PD model is able to classify the black rot images with a 92.47 percent precision and 86.34 percent recall.

DLCBIR-PD eventually classifies the Cedar Apple Rust photos with 86.81 percent precision and 90.12 percent recall. As a result, the DLCBIR-PD approach has managed to classify healthy plant photos with 90.20 percent and 89.08 percent accuracy. On the test dataset of grape plant disease, the results of the DLCBIR-PD technique are shown in Figure. There is a 90.48 percent accuracy and 87.58 percent recall rate for the DLCBIR-PD method in identifying black measles, as seen in the figure. Similar to the DLCBIR-PD methodology, the black rot images are identified by the DLCBIR-PD method with 89.05 percent precision and 90% recall. DLCBIR-PD is also used to classify the leaf blight photos, resulting in an accuracy and recall percentages of 92.57% and 91.73%, respectively. When it comes to classifying photos of healthy plants, the DLCBIR-PD approach has achieved a precision of 94.68 percent.

A brief comparative study of the DLCBIR-PD model with existing methods in terms of average precision is depicted. The resultant values portrayed that the IDLCBIR-PD model has accomplished superior performance on the applied dataset with the maximum average precision. On the applied apple plant disease dataset, the DLCBIR-PD model has demonstrated effective outcome with a higher average precision of 89.72% whereas the LGGP, histogram, and SIFT models have exhibited a lower average precision of 38%, 44%, and 43% respectively. Likewise, on the test grape plant disease dataset, the DLCBIR-PD model has portrayed proficient performance by offering an increased average precision of 87.86% whereas the LGGP, histogram, and SIFT models have resulted in reduced average precision of 39%, 46%, and 45% respectively. A comparative analysis of the DLCBIR-PD technique with state-of-art approaches with respect to average recall is portrayed in Figure.

The outcome values exhibited that the DLCBIR-PD method has accomplished higher performance on the applied dataset with the maximal average recall. On the test apple plant disease dataset, the DLCBIR-PD technique has showcased effectual results with superior average recall of 91.70% whereas the LGGP, histogram, and SIFT methodologies have displayed a minimum average recall of 42.78%, 45.21%, and 43.89% correspondingly. Followed by, on the applied grape plant disease dataset, the IDLCBIR-PD manner has outperformed proficient performance by offering an improved average recall of 90.89% whereas the LGGP, histogram, and SIFT algorithms have resulted in a lesser average recall of 48.09%, 46.54%, and 47.20% correspondingly. Average accuracy analysis of the DLCBIR-PD model with recent state of art methods takes place in Table 2. From the figure, it is observed that the SVM model has gained worse outcomes with the least accuracy of 90.12% whereas a slightly enhanced performance is attained by the MLP model with an accuracy of 90.12%. Moreover, the 9-layer CNN model has accomplished moderate performance with an accuracy of 96.46%. Though the GoogleNet and DenseNet-121 models have demonstrated competitive



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accuracy values of 99.35% and 99.75%, the proposed IDLCBIR-PD model has outperformed the existing methods with an average accuracy of 99.78%.

CONCLUSION

This paper has presented an effective DLCBIR-PD model to retrieve the plant diseased images and classifies them into proper class labels. The proposed DLCBIR-PD model involves histogram equalization-based pre-processing, SPG-GC based image segmentation, Inception with ResNet-v2 based feature extraction, Euclidean distance based similarity measurement, and GBT based classification. The proposed DLCBIR-PD model has the ability to retrieve the related images based on the QI from the plant disease image database and then allocate proper class labels to it, i.e., determine the presence or absence of plant disease. The experimental examination of the DLCBIR-PD model takes place on the benchmark New Plant Diseases dataset comprising normal and infected crop leaves. The experimental outcomes indicated that the proposed method not only attained better retrieval results but also satisfactory classification results. As a part of future extension, the proposed DLCBIR-PD model can be deployed in smartphones to assist farmers to detect diseases in real time and provide expert suggestions.

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Table 1. Dataset Descriptions

Apple Plant Disease Dataset		Grape Plant Disease Dataset	
Disease	Number of Images	Disease	Number of Images
Scab	2016	Black Measles	1920
Black Rot	1987	Black Rot	1888
Cedar Apple Rust	1760	Leaf Blight	1722
Healthy	2008	Healthy	1692
Total Images	7771	Total Images	7222

Table 2. Result Analysis of Different Methods on Average Accuracy

Methods	Avg. Accuracy
DLCBIR-PD	99.78
GoogleNet	99.35
DenseNets-121	99.75
9-layer CNN model	96.46
SVM	87.56
MLP	90.12





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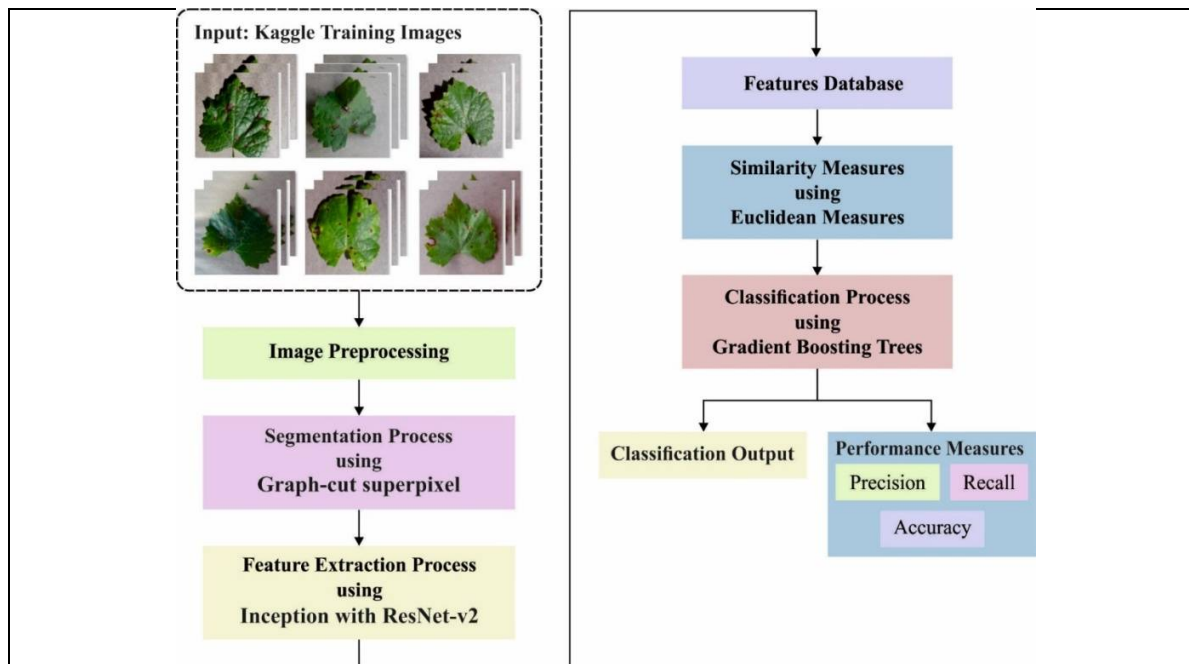


Figure 1. Block diagram of proposed model

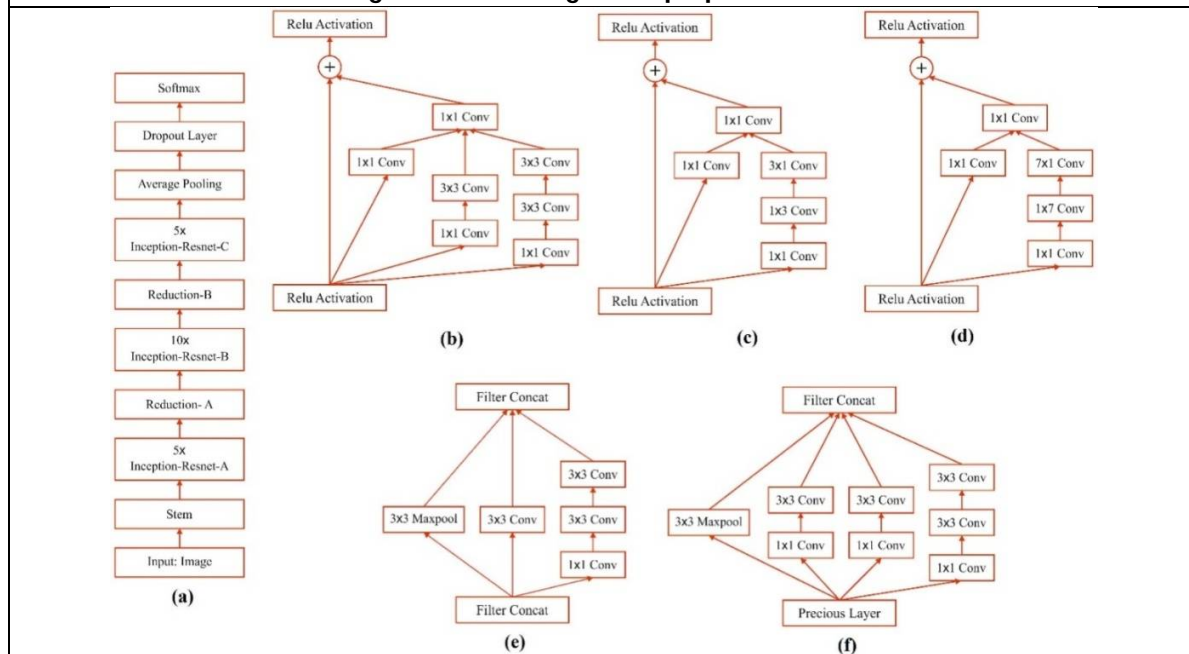


Figure 2. (a) Architecture of Inception ResNet V2 (b)Inception-ResNet-A, (c) Inception-ResNet-B, (d) Inception-ResNet-C, (e) Reduction-A, and (f) Reduction-B





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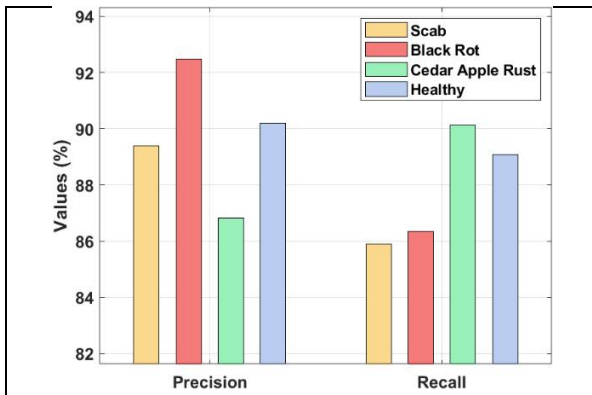


Figure 3. DLCBIR-PD model on Apple Plant Disease

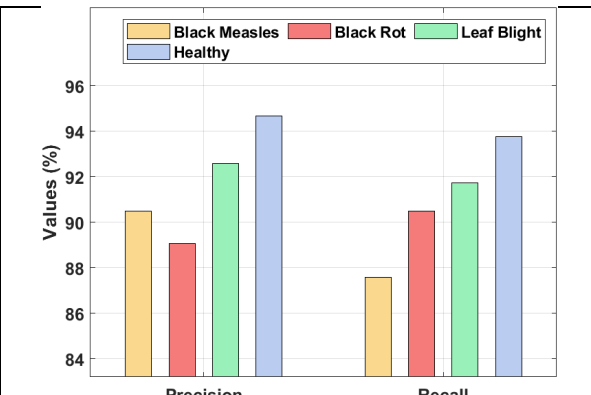


Figure 4. DLCBIR-PD model on Grape Plant Disease

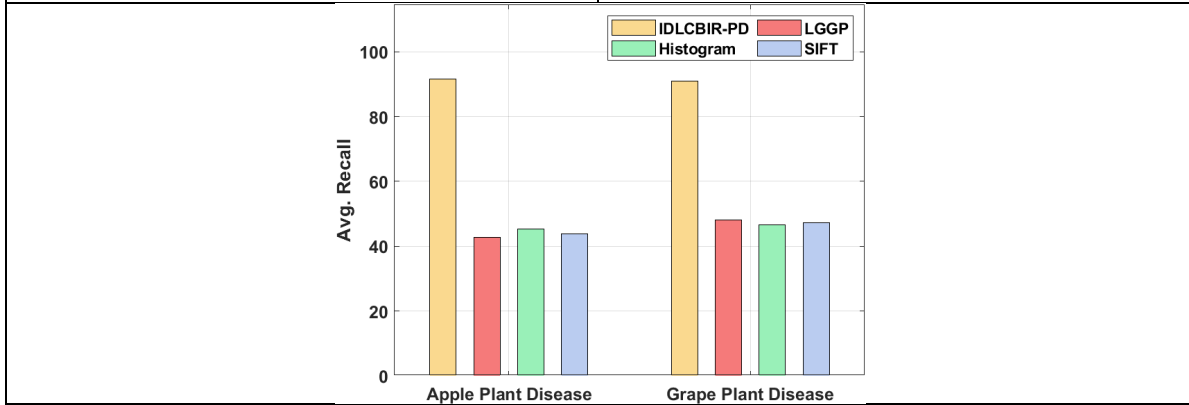


Figure 5. Average recall analysis of DLCBIR-PD model





Weighted Pi and Szeged Indices of Generalized Gear Graph

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ABSTRACT

The weighted (vertex-)Padmakar-Ivan index and weighted (vertex-)szeged index are degree and distance based topological indices in which reflects certain structure feature of molecular graph. In this paper, we present explicit formulae for weighted PI index and weighted szeged index of generalized gear graph. Moreover, we have given the correct value for weighted PI index of gear graph against the result obtained by Yan et al.

Keywords: Generalized Gear graph, Weighted szeged index, Weighted PI index.

MSC:05C12, 05C35,

INTRODUCTION

From the connectivity graph, a molecular descriptor of numerical values may be calculated that can be used to distil and compress the material contained in the patterns. According to institution in the fields of mathematical chemistry and chemical graph theory, several topological indices have been developed and applied to quantitative structure-activity relationships and quantitative structure-property relationships studies, in which the physicochemical properties of compounds have been linked to their molecular structures. So-called molecular descriptors relate to these indices. When it comes to describing the physicochemical, toxicologic, biological, and other properties of chemical substances, molecular descriptors (or topological indices) are utilized in [6,23]. With the help of topological indices, one may determine fundamental physical-chemical properties of the molecule, such as density and





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evaporation enthalpy, while saving time and money. Degree-based, distance-based and spectral forms of indices are all exist. In the field of topological indices, the Wiener index is one of the most popular. This subclass of descriptors has 148 Discrete Adriatic indices, which are computed as the total of edge contributions, and they are very intriguing (Randic-type indices, Balaban-type indices, Wiener index and its modifications, Szegedindex...) The Vertex and bond additive indices are examples of such indexes [22]. Wiener indices are obtained for the gear fan graph and gear wheel graph, followed by the r-corona [20]. As part of this research, we built and investigated a bond-additive index that evaluates individual bond peripherals (edges), sums up all edge contributions, and produces a global peripherality measure of a particular graph.

In the literature, there are several classes of topological indices that are worth mentioning. The Mostar index is based on distance, the Zagreb and Randic indexes on degree and the Estrada index on matching. Other works propose and evaluate the Adriatic indexes, a complete class of bond additive descriptors [15]. They're termed vertex and bond-additive or distance-based indices, and they aim to represent some significant features of entire graphs by adding contributions from each vertex and/or edge contributions, respectively. When it came to analyzing complicated networks and traditional chemical graph theory applications, it received a lot of interest from the scientific community. For example, the weighted Padmakar Ivan index and weighted Szeged index, which are evaluates the peripherality of individual bonds (i.e., edges), then adds up all of the contributions to generate a global peripherality measure for a graph, is a well-known example of a bond-additive distance-based index. In this paper, we obtain the exact formula of the weighted PI index and weighted Szeged index to the generalized gear graph.

PRELIMINARIES

A simple graph G contains no loops, many edges, or sub-dividend edges. Throughout this study we consider a simple graph G with vertex set $V(G)$ and edge set $E(G)$. The degree of the vertex $u \in V(G)$ is the number of edges incident with u denoted $d(u) = \deg(u)$ or $\deg_e^G(u)$. A simple graph the distance between vertices u and v of G is denoted $d(u, v)$, the minimal path connecting them the two vertices of graph. In [5] Gao and Shi determine to the wiener index of wheel, gear and fan graph and defined as $W(G) = \sum_{u,v \in E(G)} d(u, v)$. In [3] vertex-weighted wiener index polynomial composite graph. The mathematical properties of the PI and Szeged index and its applications of chemistry and nano-science [12, 13]. The PI index is defined over the vertices of G is

$$PI(G) = \sum_{e=uv \in E(G)} (n_e^G(u) + n_e^G(v))$$

and Szeged index by $Sz(G) = \sum_{e=uv \in E(G)} n_e^G(u)n_e^G(v)$

Where $n_e^G(u)$ denotes the number of vertices of G near to u than to v and $n_e^G(v)$ is defined analogously.

Inspired by an extension of the Wiener index, Ilić and Milosavljević proposed a modification of the Szeged index and the vertex PI index [8]. Defined as this quantity is named as weighted Szeged index and weighted PI index,

$$PI_w(G) = \sum_{e=uv \in E(G)} (\deg_e^G(u) + \deg_e^G(v))(n_e^G(u) + n_e^G(v))$$

$$Sz_w(G) = \sum_{e=uv \in E(G)} (\deg_e^G(u) + \deg_e^G(v))(n_e^G(u) + n_e^G(v))$$

Szeged and Wiener indices coincide for trees, recently szeged index to studied in [2] the graph operation known as subdivision vertex edge(SVE) join of graphs. This operation is applied on three graphs and results in one product graph, studied in [1] determine the szeged index of concentric wheel graph and co-normal and intersection of graph and obtained. The weighted szeged index some special graph related molecular graph to wheel, gear and fan graph and quotient graphs are refer in [16, 21]. Also defined by [7,14,17-19], the modified PI index has many applications in the field of mathematical





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chemistry, also graph operations are used to construct the graph whose structure is defined in terms of the structural properties of underlying graphs. In [4] Gao and Wang to derived the vertex version of weighted wiener number for bi-cyclic molecular structures. Junsheng and Gao, obtained weighted vertex PI Index for some special graph like fan graph, gear graph, gear wheel graph and r-corona graph in [20]. Recently in Kandan and Subramanian obtained the explicit formula bond-additive indices like PI, szeged and Mostar index to the generalized gear graph. For more topological index on wheel related graph refer [1-5,10,11,20]. In this connection, here we shown the exact expression of weighted Padmakar-Ivan, and weighted szeged index for generalized gear graph. For this we assume the following terminology to the the generalized gear graph.

Definition 2.1. [10] For $l \geq 1$ and $k \geq 2$, the generalized gear graph $C^*(l, 2k)$ is graph obtained from the conical graph with a vertex added between each pair adjacent vertices of the cycles (see Figure 1.)

Let vertex set of $C^*(l, 2k)$ can be written as $V(C^*) = \{u_0, \dots, u_{k-1}^1, u_1^2, \dots, u_{k-1}^2, \dots, u_{1,2}^l, \dots, u_{k,1}^l\}$ and for our convenience the edges set of $C^*(l, 2k)$ into four sets such that $E(C^*) = \cup_{n=0}^3 E_n$, where $E_0 = \{u_0 u_1^1, u_0 u_2^1, \dots, u_0 u_k^1\}$, $E_1 = \{u_1^{l-1} u_1^l, u_2^{l-1} u_2^l, \dots, u_k^{l-1} u_k^l\}$, $E_2 = \{u_1^l u_{1,2}^l, u_{1,2}^l u_2^l, \dots, u_{k,1}^l u_1^l\}$, $E_3(C^*) = E^+(C^*) \cup E^-(C^*) \cup E^*(C^*)$, where $E^+(C^*) = \{u_1^j u_{1,2}^{j+1}, u_2^j u_{2,3}^{j+1}, \dots, u_k^j u_{k,1}^{j+1}\}$, $E^-(C^*) = \{u_1^j u_{1,2}^{j-1}, u_2^j u_{2,3}^{j-1}, \dots, u_k^j u_{k,1}^{j-1}\}$, $E^*(C^*) = \{u_1^j u_{1,2}^{j+1}, u_2^j u_{2,3}^{j+1}, \dots, u_k^j u_{k,1}^{j+1}\}$. Its clear that for a generalized gear graph $C^*(l, 2k)$, we have $|V(C^*(l, 2k))| = 2kl + 1$ and $|E(C^*(l, 2k))| = |E_0(C^*)| + |E_1(C^*)| + |E_2(C^*)| + |E_3(C^*)| = 3kl$. Observe that degree of generalized gear graph as $deg^{C^*}(u_0) = k, deg^{C^*}(u_i^j) = 4$,

$$\text{if } i = 1, 2, \dots, k \text{ and } j = 1, 2, \dots, l - 1, deg^{C^*}(u_i^j) = 3, i = 1, 2, \dots, k, deg^{C^*}(u_i^l) = 3,$$

$i = 1, 2, \dots, k, deg^{C^*}(u_i^1) = 2$, if $i = 1, 2, \dots, k$ and $j = 1, 2, \dots, l$. Note that if $l = 1$ the generalized gear graph $C^*(l, 2k)$ is gear graph, also sometimes known as a bipartite wheel graph. The following Lemma is used to prove the main result of this section which follows immediately from the Figure 1 and using the edge partition as defined above.

Lemma 2.1. [10] For a generalized gear graph $C^*(l, 2k)$ with $l \geq 1$ and $k \geq 2$, we have

- (i) For $i = 1, 2, \dots, k$, if $e = u_0 u_i^1 \in E_0(C^*)$, then $n_e^{C^*}(u_0) = l(2k - 3) + 1$ and $n_e^{C^*}(u_i^1) = 3l$
- (ii) For $i = 1, 2, \dots, k$. if $e = u_i^{l-1} u_i^l \in E_1(C^*)$, then $n_e^{C^*}(u_i^{l-1}) = 2k(l - 1) + 1$ and $n_e^{C^*}(u_i^l) = 2k$
- (iii) For $i = 1 (= k + 1), 2, \dots, k$ and let $E_2(C^*) = E^-(C^*) \cup E^+(C^*)$, where $e = u_i^l u_{i,i+1}^l \in E^-(C^*)$ and $e = u_{i,i+1}^l u_{i+1}^l \in E^+(C^*)$
 - sub-case (a) if $e = u_i^l u_{i,i+1}^l \in E^-(C^*)$, then $n_e^{C^*}(u_i^l) = l(k + 1)$ and $n_e^{C^*}(u_{i,i+1}^l) = l(k - 1) + 1$
 - sub-case (b) if $e = u_{i,i+1}^l u_{i+1}^l \in E^+(C^*)$, then $n_e^{C^*}(u_{i,i+1}^l) = l(k - 1) + 1$ and $n_e^{C^*}(u_{i+1}^l) = l(k + 1)$
- (iv) For $e \in E_3(C^*) = E^+(C^*) \cup E^-(C^*) \cup E^*(C^*)$ then the three cases are
 - Case(a) For $i = 1 (= k + 1), 2, \dots, k$ and let $E^+(C^*) = E_a^+(C^*) \cup E_b^+(C^*)$, where $e = u_i^1 u_{i,i+1}^1 \in E_a^+(C^*)$ and $e = u_{i,i+1}^1 u_{i+1}^1 \in E_b^+(C^*)$
 - sub-case(a) if $e = u_i^1 u_{i,i+1}^1 \in E_a^+(C^*)$ then $n_e^{C^*}(u_i^1) = 2l(k - 1)$ and $n_e^{C^*}(u_{i,i+1}^1) = 2l + 1$
 - sub-case (b) if $e = u_{i,i+1}^1 u_{i+1}^1 \in E_b^+(C^*)$ then $n_e^{C^*}(u_{i,i+1}^1) = 2l + 1$ and $n_e^{C^*}(u_{i+1}^1) = 2l(k - 1)$
 - Case(b) For $i = 1, 2, \dots, k$ and $j = 2, 3, \dots, l - 1$ let $E^-(C^*) = E_a^-(C^*) \cup E_b^-(C^*)$, where $e = u_i^j u_{i,i+1}^j \in E_a^-(C^*)$ and $e = u_{i,i+1}^j u_{i+1}^j \in E_b^-(C^*)$
 - sub-case (a) if $e = u_i^j u_{i,i+1}^j \in E_a^-(C^*)$, then $n_e^{C^*}(u_i^j) = l(k + 1)$ and $n_e^{C^*}(u_{i,i+1}^j) = l(k - 1) + 1$
 - sub-case (b) if $e = u_{i,i+1}^j u_{i+1}^j \in E_b^-(C^*)$, then $n_e^{C^*}(u_{i,i+1}^j) = l(k - 1) + 1$ and $n_e^{C^*}(u_{i+1}^j) = l(k + 1)$
 - Case (c) For $e = u_i^j u_i^{j+1} \in E^*(C^*)$ then $n_e^{C^*}(u_i^j) = \sum_{j=1}^{l-2} (2kj + 1)$ and $n_e^{C^*}(u_i^{j+1}) = \sum_{j=1}^{l-2} 2k(l - j)$.

MAIN RESULTS

In this section, we compute exact value of weighted Szeged index, weighted PI-index in to the generalized gear graph $G(l, 2k)$. Using the Lemma 3.1, next determine the explicit formula of weighted Padmakar-Ivan index to the generalized gear graph $C^*(l, 2k)$.





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Theorem3.1. For a generalized gear graph $C^*(l, 2k)$ with $l \geq 1$ and $k \geq 2$, we have $PIw(C^*(l, 2k)) = (k^2 + 20k - 7k)(2kl + 1)$.

Proof.

By the definition of weighted Padmakar-Ivan index, to obtain it for the generalized gear graph $C^*(l, 2k)$, we have $PIw(C^*(l, 2k)) = \sum_{e=uv \in E(C^*)} (deg_e^{C^*}(u) + deg_e^{C^*}(v))(n_e^{C^*}(u) + n_e^{C^*}(v))$. Using the edge partition E_0, E_1, E_2 and E_3 of generalized gear graph $C^*(l, 2k)$ as define in the beginning and by the lemma 2.1, we have

Case (i): For $i = 1, 2, \dots, k$, if $e = u_0 u_i^1 \in E_0(C^*)$

$$\sum_{e=uv \in E_0(C^*)} (deg_e^{C^*}(u_0) + deg_e^{C^*}(u_i^1))(n_e^{C^*}(u_0) + n_e^{C^*}(u_i^1)) = \sum_{e=uv \in E_0(C^*)} (k + 4)((l(2k - 3) + 1) + 3l) = k(k + 4)(2kl + 1)$$

Case (ii): For $i = 1, 2, \dots, k$, if $e = u_i^{l-1} u_i^l \in E_1(C^*)$, we have

$$\sum_{e=uv \in E_1(C^*)} (deg_e^{C^*}(u_i^{l-1}) + deg_e^{C^*}(u_i^l))(n_e^{C^*}(u_i^{l-1}) + n_e^{C^*}(u_i^l)) = \sum_{e=uv \in E_1(C^*)} (4 + 3)((2k(l - 1) + 1) + 2k) = 7k(2kl + 1)$$

Case (iii): For $i = 1 (= k + 1), 2, \dots, k$, let $e = u_i^l u_{i+1}^l \in E_2(C^*) = E'(C^*) \cup E''(C^*)$, with $u_i^l u_{i+1}^l \in E'(C^*)$ and $u_{i+1}^l u_{i+1}^l \in E''(C^*)$, we have

$$\begin{aligned} & \sum_{e=uv \in E_2(C^*)} (deg_e^{C^*}(u_i^l) + deg_e^{C^*}(u_{i+1}^l))(n_e^{C^*}(u_i^l) + n_e^{C^*}(u_{i+1}^l)) \\ &= \sum_{e=uv \in E'(C^*)} (deg_e^{C^*}(u_i^l) + deg_e^{C^*}(u_{i+1}^l))(n_e^{C^*}(u_i^l) + n_e^{C^*}(u_{i+1}^l)) + \sum_{e=uv \in E''(C^*)} (deg_e^{C^*}(u_{i+1}^l) + deg_e^{C^*}(u_{i+1}^l))(n_e^{C^*}(u_{i+1}^l) + n_e^{C^*}(u_{i+1}^l)) \\ &= k(3 + 2)(l(k + 1) + (l(k - 1) + 1)) + k(3 + 2)((l(k - 1) + 1) + l(k + 1)) \\ &= 10k(2kl + 1). \end{aligned}$$

Case (iv): if $e \in E_3(C^*) = E^+(C^*) \cup E^-(C^*) \cup E^*(C^*)$, then the three sub-cases are

Sub-case (a): For $i = 1 (= k + 1), 2, \dots, k$, let $e = u_i^1 u_{i+1}^1 \in E^+(C^*)$, with $u_i^1 u_{i+1}^1 \in E_a^+(C^*)$ and $u_{i+1}^1 u_{i+1}^1 \in E_b^+(C^*)$, then we have

$$\begin{aligned} & \sum_{e \in E^+(C^*)} (deg_e^{C^*}(u_i^1) + deg_e^{C^*}(u_{i+1}^1))(n_e^{C^*}(u_i^1) + n_e^{C^*}(u_{i+1}^1)) \\ &= \sum_{e \in E_a^+(C^*)} (deg_e^{C^*}(u_i^1) + deg_e^{C^*}(u_{i+1}^1))(n_e^{C^*}(u_i^1) + n_e^{C^*}(u_{i+1}^1)) \\ &+ \sum_{e \in E_b^+(C^*)} (deg_e^{C^*}(u_{i+1}^1) + deg_e^{C^*}(u_{i+1}^1))(n_e^{C^*}(u_{i+1}^1) + n_e^{C^*}(u_{i+1}^1)) \\ &= k(4 + 2)(2l(k - 1) + (2l + 1)) + k(2 + 4)((2l + 1) + 2l(k - 1)) = 12k(2kl + 1) \end{aligned}$$

Sub-case (b): For $i = 1 (= k + 1), 2, \dots, k$, and $j = 2, 3, \dots, l - 1$, let $e = u_i^j u_{i+1}^j \in E^-(C^*)$, with $u_i^j u_{i+1}^j \in E_a^-(C^*)$ and $u_{i+1}^j u_{i+1}^j \in E_b^-(C^*)$ then we have

$$\begin{aligned} & \sum_{e \in E^-(C^*)} (deg_e^{C^*}(u_i^j) + deg_e^{C^*}(u_{i+1}^j))(n_e^{C^*}(u_i^j) + n_e^{C^*}(u_{i+1}^j)) \\ &= \sum_{e \in E_a^-(C^*)} (deg_e^{C^*}(u_i^j) + deg_e^{C^*}(u_{i+1}^j))(n_e^{C^*}(u_i^j) + n_e^{C^*}(u_{i+1}^j)) \end{aligned}$$





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$$\begin{aligned}
 & + \sum_{e \in E_0^-(C^*)} (deg_e^{C^*}(u_{i,i+1}^j) + deg_e^{C^*}(u_{i+1}^j)) (n_e^{C^*}(u_{i,i+1}^j) + n_e^{C^*}(u_{i+1}^j)) \\
 & = k(l-2)(4+2)(l(k+1) + (l(k-1) + 1)) + k(l-2)(2+4)((l(k-1) + 1) + l(k+1)) \\
 & = 12k(l-2)(2kl+1)
 \end{aligned}$$

Sub-case (c): For $i = 1, 2, \dots, k$ and $j = 2, 3, \dots, l-2$, if $e = u_i^j u_i^{j+1} \in E^*(C^*)$, then

$$\begin{aligned}
 \sum_{e \in E^*(C^*)} (deg_e^{C^*}(u_i^j) + deg_e^{C^*}(u_i^{j+1})) (n_e^{C^*}(u_i^j) + n_e^{C^*}(u_i^{j+1})) & = \sum_{e \in E^*(C^*)} (4+4)((2kj+1) + 2k(l-j)) \\
 & = 8k(l-2)((2kj+1) + 2k(l-j)) = 8k(l-2)(2kl+1).
 \end{aligned}$$

By summing the above four cases, we have the desired result of weighted Szeged index to the generalized index gear graph $C^*(l, 2k)$.

$$\begin{aligned}
 PIw(C^*(l, 2k)) & = PIw(E_0(C^*)) + PIw(E_1(C^*)) + PIw(E_2(C^*)) + PIw(E_3(C^*)) \\
 & = k(k+4)(2kl+1) + 7k(2kl+1) + 10k(2kl+1) + 8k(l-2)(2kl+1) \\
 & = (k(k+4) + 7k + 10k + 12k + 12k(l-2) + 8k(l-2))(2kl+1) \\
 & = k(2kl+1)(k+20l-7).
 \end{aligned}$$

Observe that the weighted Padmakar-Ivan index can be expressed in terms of Padmakar-Ivan index. For the generalized gear graph $C^*(l, 2k)$ as follows $PIw(C^*(l, 2k)) = (k+4)PI(E_0(C^*)) + 7PI(E_1(C^*)) + 5PI(E_2(C^*)) + 6PI(E^*(C^*)) + 6PI(E^-(C^*)) + PI(E^+(C^*))$

Using the above Theorem 3.1, we have the following corollary which gives the corrected version to the result by Yan.et.al[20] that the weighted Padmakar-Ivan index to gear graph, $PIw(C^*(l, 2k))$ is $2k^3 + 20k^2 + 10k$.

Corollary 3.2. For $l = 1$ and $k \geq 2$, the gear graph $C^*(1, 2k)$ whose weighted Padmakar-Ivan index $PIw(C^*(1, 2k)) = 2k^3 + 27k^2 + 13k$.

Using the Lemma 2.1, next we determine the explicit formula of weighted Szeged index to the generalized gear graph $C^*(l, 2k)$.

Theorem 3.3. For a generalized gear graph $C^*(l, 2k)$ with $l \geq 1$ and $k \geq 2$, we have $Sz_w(C^*(l, 2k)) = 3kl(k+4)(l(2k+1)+1) + 14k^2(2k(l-1)+1) + 2k(6l-7)(l^2(k^2-1) + l(k+1)) + 8k^2(l-2)(2k(l-1))(\frac{l+3}{3}) + (l+1)$.

Proof:

By the definition of weighted Szeged index, to obtained it for the generalized gear graph $C^*(l, 2k)$, we have $Sz_w(C^*(l, 2k)) = \sum_{e=uv \in E(C^*)} (deg_e^{C^*}(u) + deg_e^{C^*}(v)) n_e^{C^*}(u) n_e^{C^*}(v)$. Using the edge partition E_0, E_1, E_2, E_3 of the generalized gear graph $C^*(l, 2k)$ as defined in the beginning and by the Lemma 2.1. we have the following four case,

Case(i): For $i = 1, 2, \dots, k$, if $e = u_o u_i^1 \in E_0(C^*)$ we have

$$\begin{aligned}
 \sum_{e \in E_0(C^*)} (deg_e^{C^*}(u_o) + deg_e^{C^*}(u_i^1)) n_e^{C^*}(u_o) n_e^{C^*}(u_i^1) & = k(k+4)(l(2k-3)+1)(3l) \\
 & = 3kl(k+4)(l(2k-3)+1)
 \end{aligned}$$

Case (ii): For $i = 1, 2, \dots, k$, if $e = u_i^{l-1} u_i^l \in (E_1 C^*)$, we have

$$\begin{aligned}
 \sum_{e \in E_1(C^*)} (deg_e^{C^*}(u_i^{l-1}) + deg_e^{C^*}(u_i^l)) n_e^{C^*}(u_i^{l-1}) n_e^{C^*}(u_i^l) & = (4+3)k(2k(l-1)) \\
 & = 14k^2(2k(l-1)+1)
 \end{aligned}$$





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Case (iii): For $i = 1 (= k + 1), 2, \dots, k$, let $e = u_i^l u_{i+1}^l \in E_2(C^*) = E'(C^*) \cup E''(C^*)$, with $u_i^l u_{i+1}^l \in E'(C^*)$ and $u_{i,i+1}^l u_{i+1}^l \in E''(C^*)$, then we have

$$\begin{aligned} & \sum_{e \in E_2(C^*)} (deg_e^{C^*}(u_i^l) + deg_e^{C^*}(u_{i+1}^l)) n_e^{C^*}(u_i^l) n_e^{C^*}(u_{i+1}^l) \\ &= \sum_{e \in E'(C^*)} (deg_e^{C^*}(u_i^l) + deg_e^{C^*}(u_{i+1}^l)) n_e^{C^*}(u_i^l) n_e^{C^*}(u_{i+1}^l) \\ &+ \sum_{e \in E''(C^*)} (deg_e^{C^*}(u_{i,i+1}^l) + deg_e^{C^*}(u_{i+1}^l)) n_e^{C^*}(u_{i,i+1}^l) n_e^{C^*}(u_{i+1}^l) \\ &= k(3 + 2)(l(k + 1))(l(k - 1) + 1) + k(2 + 3)(l(k - 1) + 1)(l(k + 1)) = 10k(l^2(k^2 - 1) + l(k + 1)) \end{aligned}$$

Case(iv): if $e = E^+(C^*) \cup E^-(C^*) \cup E^*(C^*)$, then the three sub-cases are

Sub-case (a): For $i = 1 (= k + 1), 2, \dots, k$, let $e = u_i^1 u_{i+1}^1 \in E'(C^*)$ with $u_i^1 u_{i+1}^1 \in E_a^+(C^*)$ and $u_{i,i+1}^1 u_{i+1}^1 \in E_b^+(C^*)$, then we have

$$\begin{aligned} & \sum_{e \in E^+(C^*)} (deg_e^{C^*}(u_i^1) + deg_e^{C^*}(u_{i+1}^1)) n_e^{C^*}(u_i^1) n_e^{C^*}(u_{i+1}^1) \\ &= \sum_{e \in E_a^+(C^*)} (deg_e^{C^*}(u_i^1) + deg_e^{C^*}(u_{i+1}^1)) n_e^{C^*}(u_i^1) n_e^{C^*}(u_{i+1}^1) \\ &+ \sum_{e \in E_b^+(C^*)} (deg_e^{C^*}(u_{i,i+1}^1) + deg_e^{C^*}(u_{i+1}^1)) n_e^{C^*}(u_{i,i+1}^1) n_e^{C^*}(u_{i+1}^1) \\ &= k(4 + 2)(2l(k - 1)(2l + 1)) + k(2 + 4)(2l + 1)(2l(k - 1)) \\ &= 24kl(k - 1)(2l + 1) \end{aligned}$$

Sub-case (b): For $i = 1 (= k + 1), 2, \dots, k$, and $j = 2, 3, \dots, l - 1$, let $e = u_i^j u_{i+1}^j \in E^-(C^*)$, with $u_i^j u_{i+1}^j \in E_a^-(C^*)$ and $u_{i,i+1}^j u_{i+1}^j \in E_b^-(C^*)$ then we have

$$\begin{aligned} & \sum_{e \in E^-(C^*)} (deg_e^{C^*}(u_i^j) + deg_e^{C^*}(u_{i+1}^j)) n_e^{C^*}(u_i^j) n_e^{C^*}(u_{i+1}^j) \\ &= \sum_{e \in E_a^-(C^*)} (deg_e^{C^*}(u_i^j) + deg_e^{C^*}(u_{i+1}^j)) n_e^{C^*}(u_i^j) n_e^{C^*}(u_{i+1}^j) \\ &+ \sum_{e \in E_b^-(C^*)} (deg_e^{C^*}(u_{i,i+1}^j) + deg_e^{C^*}(u_{i+1}^j)) n_e^{C^*}(u_{i,i+1}^j) n_e^{C^*}(u_{i+1}^j) \\ &= K(4 + 2)(l - 2)l(k + 1)(l(k - 1) + 1) + k(2 + 4)(l - 2)(kl - l + 1)(kl + l) \\ &= 12k(l - 2)(l^2(k^2 - 1) + l(k + 1)) \end{aligned}$$

Sub-case (c): For $i = 1, 2, \dots, k$ and $j = 1, 2, \dots, l - 2$, if $e = u_i^j u_{i+1}^{j+1} \in E^*(C^*)$, then

$$\sum_{e \in E^*(C^*)} (deg_e^{C^*}(u_i^j) + deg_e^{C^*}(u_{i+1}^{j+1})) n_e^{C^*}(u_i^j) n_e^{C^*}(u_{i+1}^{j+1}) = \sum_{e \in E^*(C^*)} (4 + 4)(2kj + 1)2k(l - j)$$





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$$\begin{aligned}
 &= 8k \left(4k^2 \frac{l(l-2)(l-1)}{2} - 4k^2 \frac{(l-2)(l-1)(2l-3)}{6} \right) + 8k \left(2(l-2) - 2k \frac{(l-2)(l-1)}{2} \right) \\
 &= 8k \left(2k^2(l-2)(l-1) \frac{(l+3)}{3} + 2k(l-2) \frac{(l+1)}{2} \right) = 8k^2(l-2)(2k(l-1) \frac{(l+3)}{3} + (l+1))
 \end{aligned}$$

By summing the above four cases, we have the required value of weighted Szeged index to the generalized gear graph $C^*(l, 2k)$.

$$\begin{aligned}
 Sz_w(C^*(l, 2k)) &= Sz_w(E_o(C^*)) + Sz_w(E_1(C^*)) + Sz_w(E_2(C^*)) + Sz_w(E_3(C^*)) \\
 &= k(k+4)(3l(l(2k-3)+1)) + 14k^2(2k(l-1)+1) + 10k(l^2(k^2-1) \\
 &\quad + l(k+1)) + 24kl(2l+1)(k-1) + 12k(l-2)(l^2(k^2-1) \\
 &\quad + l(k+1)) + 8k^2(l-2) \left(2k(l-1) \left(\frac{l+3}{3} \right) + (l+1) \right) \\
 &= 3kl(k+4)(l(2k-1)+1) + 14k^2(2k(l-1)+1) + 2k(6l-7)(l^2(k^2-1) \\
 &\quad + l(k+1)) + 8k^2(l-2) \left(2k(l-1) \left(\frac{l+3}{3} \right) + (l+1) \right).
 \end{aligned}$$

Observe that the weighted Szeged index can be expressed in terms Szeged for the generalized gear graph $C^*(l, 2k)$ as follows.

$$\begin{aligned}
 Sz_w(C^*(l, 2k)) &= (k+4)Sz(E_o(C^*)) + 7Sz(E_1(C^*)) + 5Sz(E_2(C^*)) \\
 &\quad + 6Sz(E^+(C^*)) + 6Sz(E^-(C^*)) + 8Sz(E^*(C^*)).
 \end{aligned}$$

Using the above Theorem 3.3, we have following corollary.

Corollary 3.4. For $l = 1$ and $k \geq 2$, the gear graph $C^*(l, 2k)$ whose weighted Szeged index $Sz_w(C^*(1, 2k)) = 6k^3 + 72k^2 - 78k$.

CONCLUSION

In this paper, we have evaluated the exact formula of vertex weighted version of Padmakar-Ivan and Szeged indices of Generalized gear graph. Our exploration kept on determining new consequences of these graphs. In order to shed light on the relationship between these diverse ideas, several topological indices were given emphasis on the mathematical side. Consequently, our numerical values for the topological indices considered here can be of considerable use in future computations and experiments pertinent to more general form of such a new graph operation.

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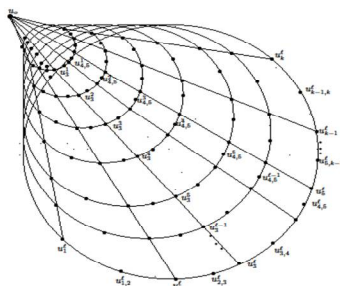


Figure 1. Generalized gear graph $C^*(l, 2k)$





Emotional Intelligence and Social Media Addiction among Students

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ABSTRACT

With the advent of technological changes and advancement in the field of information and communication technology, the increasing use of social media is quite evident. Social media platform has gradually taken over as one of the basic requirements amongst all age groups. Problem of internet addiction is increasingly being witnessed as a potential threat amongst youth. Excessive use of social media has begun to affect the mental health of individuals making them prone to problems like depression, anxiety and other mental health issues (Vannucci, Flannery & Ohannessian, 2017). Researches have shown that emotional intelligence can have a significant effect on the rate of social media usage (Parker, Taylor, Eastabrook, Schell, & Wood, 2008; Cho & Lee, 2017). The study aims at understanding the relationship between social media addiction and emotional intelligence. The sample comprises of 100 students, both males and females of 18-24 years of age. For the purpose of the study emotional intelligence scale -Hyde, Pethe & Dhar (2002) and Social Media Addiction scale- Student form by Sahin (2018) was administered on the sample. The data was analysed using Pearson's correlation method. The results showed a significant negative relationship between social media addiction and emotional intelligence. Informed consent was obtained from all individual participants included in the study.

Keywords: Emotional Intelligence; Social Media Addiction; Mental Health; Students; Depression

INTRODUCTION

With the ease of internet access, the number of social media users in India stood at 326.1 million in 2018. This increase is relatively lower as compared to the growth that occurred between 2016 and 2017. Nevertheless, the social network users in the country were expected to be almost 448 million in 2023. Although the purpose of the emergence of internet was to facilitate information and communication, it has slowly taken over the social scenario. Considering





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that internet usage is not dependent on space and time, social media has completely changed the communication scenario of world. The word addiction usually refers to some uncontrollable habits or practices and hence the extreme usage of social media is also termed as social media addiction (Kuss& Griffiths, 2012; Turel & Seronko, 2012).Internet addiction could be in any of the forms game addiction (Fisher, 1994, Griffiths & Hunt, 1998; Horzum, 2011), CyberSex addiction (Cavaglione, 2009; Schwartz & Southern, 2000); online addiction (Tüzer, 2011), Social network addiction (Griffiths, 2012), mobile phone addiction (Bianchi & Phillips, 2005; Fidan, 2016), Facebook addiction (Andreassen, Torsheim, Brunborg & Pallesen, 2012), Twitter addiction (Said, Al-Rashid & Abdullah, 2014), social media disorder (van den Eijnden, Lemmens& Valkenburg, 2016) and social media addiction (Andreassen, Torsheim, Brunborg and Pallesen, 2012). Too much exposure to social media creates an urge to be updated & notified on each and every movement on the internet. Such behaviour leads to social media addiction.

The graph above reflects the social media usage of India in the past one year i.e. Feb 2019 to Feb 2020. Excessive Internet usage and its negative effects on psychological well-being have long been researched. Social network sites have become extremely and increasingly popular among youths and professional individuals. Its pervasive influence is almost irresistible. There is a sea of social networking sites on the internet and students are tempted to be online 24X7. The oxford dictionary defines addiction as “the condition of being unable to stop taking or doing something harmful. The term emotional intelligence has been gaining popularity in the recent times owing to its impact on various aspects of humans. One common perspective about EI is that higher the level of EI higher are the positive traits and more happy and successful life than others (Chamorro-Premuzic, Bennett & Furnham, 2007; Martinez-Pons, 1997). There have been evidences in the past indicating mental health issues due to excessive usage of social media. Social media addiction may be detrimental to the physical, psychological and mental health of the users. Incidents of usage of platforms like blue whale have shown the dangerous side of social media leading to life threats. Due to the safety concerns of parent’s kids in current generation tend to create their virtual spaces to serve their need for belongingness. Parents also consider that kids are safe being online rather than being out in the open.

They create virtual spaces which serve their need to belong, as there appear to be increasingly limited options of analogous physical spaces due to parents’ safety concerns. Being online is viewed as safer than roaming the streets and parents often assume using technology in the home is normal and healthy. Interestingly, recent research has demonstrated that sharing information on social media increases life satisfaction and loneliness for younger adult users, whereas the opposite was true for older adult users, suggesting that social media use and social networking are used and perceived very differently across generations. Emotional intelligence (EI) is a recent concept with emphasis on behavioural aspects of humans. The rising levels of mental health issues necessitated the study of emotional health of individuals. It became increasingly essential for human beings to be aware of their self and creating a balance between their intellectual and emotional self. Emotional intelligence takes into its purview neuroscience of emotions, metacognition, self-regulation and cognitive abilities over and above the academic intelligence. EI is associated with quality of life. Studies in the past have suggested that emotional intelligence was positively associated with a better psychological health (Fernández Abascal and Martín-Díaz, 2015), and showed a negativereleation with problem behaviours (Siu, 2009; Gugliandolo et al., 2015).

Literature Review

Social media addiction is perceived as the compulsive usage of social media sites and it also manifests in itself behavioural addiction symptoms like salience, tolerance, conflict, withdrawal, relapse, and mood modification (Griffiths, 2005). People tend to share their photos, videos, offline activities and lifestyle through social media. A study on usage of Facebook found that people who spent longer duration of their time on Facebook felt that other people were happier and had a better life compared to theirs. This developed frustration leading to a feeling of life being unfair to them (Chou & Edge, 2012). Denti et al., 2012 concluded from their study that people tend to display only the interesting events and their best moments making others perceive their life to be happening making others feel less privileged. This in turn lowers the self-esteem and well-being. Any positive feedback from online friends led to arise in the self-esteem and social well-being of the individual and simultaneously a negative feedback lowered



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the self-esteem (Valkenburg, Peter, & Schouten, 2006). Studies have confirmed in the past that social media addiction is for real and users do exhibit symptoms of addiction such as withdrawal, salience, relapse, conflict etc. (Andreassen, 2015; Griffiths et al., 2014; Ryan et al., 2014). According to Young (2009), from psychological perspective, social media addiction is a disorder as it has revealed addiction criteria such as neglect of personal life, mental preoccupation, mood modifying experiences, tolerance and concealing the addiction behavior appear to be present in some people who use social network sites excessively. Past research has proved that internet use interferes with the addicts' academic, professional as well as social performances and life. (Louis and Paul, 2012)

Amarasinghe (2010) stated that there are certain intrinsic and extrinsic factors that motivate social media interactions such as altruism, curiosity, sense of efficacy, pleasure of sharing, reciprocity, affiliation, power, collaboration, reward and recognition. Yen et al. (2008), found in their study that adolescents with high Internet use presented more psychopathology in contrast to peers with lower usage. Whang, Lee, and Chang (2003) found a significant correlation between degree of Internet addiction and negative psychological states such as loneliness, depression, and compulsive behavior. Different ethics schools of thought believe that individuals are rational beings who have the ability to use their critical judgment to manage their lives (J. Reiman, 1997). Several studies in the past have emphasized that higher level of EI correlates with more adaptive ways of coping (Salovey, Bedell, Detweiler, & Mayer, 1999; Salovey, Stroud, Woolery, & Epel, 2002), is a contributor in the achievement of better academic results (Parker, Summerfeldt, Hogan, & Majeski, 2004; van der Zee, Thijs, & Schakel, 2002), is associated with better interpersonal relations (Mayer, Caruso, & Salovey, 1999), and is a protective factor in both physical and mental health (Austin, Saklofske, & Egan, 2005; Tsaousis & Nikolaou, 2005). Numerous studies in the past have shown that addiction to technology including internet and social networking sites have a positive association with stress, anxiety and depression and negative association with academic performance. This in turn impacts the overall life satisfaction of the individuals (Hawi & Samaha, 2016; Kabasakal, 2015; Lepp, Barkley, & Karpinski, 2014)

Purpose of Study

To investigate the relationship between Emotional intelligence and social media addiction among students.

Hypothesis

There will be a negative relationship between emotional intelligence and social media addiction among students.

Methodology

The data was collected from the undergraduate and post-graduate students from various academic disciplines. The study uses convenience sampling method for data collection and primary data was collected based on the availability and willingness of the respondents. A total of 150 students were administered with Emotional Intelligence Scale by Hyde, Pethe & Dhar (2002) and social media addiction scale – Student Form by Sahin (2018). A total of 109 respondents filled out the online survey.

Data Analysis

Mean, SD and Pearson's correlation was computed for the present study.

RESULTS

Table 1

Mean, SD of dimensions of emotional Intelligence and social media addiction

Table 2

Showing the correlation between dimensions of Emotional Intelligence and Social Media Addiction

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).



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DISCUSSION

The results of the present study show a significant impact of emotional intelligence on social media addiction. The various dimensions of Emotional Intelligence are, Self-Awareness (Understanding of one's own emotions and the impact of it on others, either positively or negatively), Empathy (the ability to understand the emotions and feelings of other person by putting oneself in their shoes), Self-Motivation (reflects how much one is committed to his/her goals is resilient and manages time effectively), Emotional Stability (one's ability to strongly withstand emotional storm and to overcome the situation with optimism and courage), Managing relations (ability to maintain positive and healthy relationships with others), Integrity (the ability to be honest about one's own emotions wherein one is authentic in accepting his/her own feelings), Self-Development (where one is aware of their own values, habits, personality, needs, etc), Value Orientation (having a sense of right and wrong based on one's personally idealised values and follows it religiously), Commitment (dedication towards something meaningful in life, something having a purpose and meaning bigger than our own self), and Altruistic Behaviour (selfless, prosocial behaviour towards society at large).

On the other hand, the dimensions of Social media addiction are Virtual tolerance, Virtual Communication, Virtual problem and Virtual Information; wherein, Virtual Tolerance signifies the emotional dependence of an individual on social media in terms of forming habit even when consumption is not required. Virtual Communication implies focusing on forming friends and associations majorly on online platform. The extent can be seen even at the expense of sacrificing real life connections. Virtual problem signifies complete submission to the cyberspace that one loses track of performing daily life tasks, like doing homework, eating etc. Virtual Information shows dependence on internet for deriving information about everything happening in the immediate as well as the distant world, also leading to various psychological and physical pain.

The Pearson Correlation between Emotional Intelligence (TEI) and Social Media Addiction (TSM) is -0.544 . This shows a significant negative correlation at 0.01 level, showing an inverse relationship between the two variables. This reflects the inverse relationship, which indicates that low emotional intelligence can be a predictor of high consumption of social media or excessive use of cyberspace may lead to eventual decline in emotional intelligence. The factors of emotional intelligence showing significance at 0.01 level with negative correlation is further mentioned. The correlation co-efficient of self-awareness is -0.458 with Virtual Tolerance (SMVT), -0.566 with Virtual Communication (SMVC), -0.503 with Virtual Problem (SMVP) and -0.324 with Virtual Information (SMVI). This shows that higher the self-awareness, lower will be dependence on social media. Similar interpretation can be made for Empathy, Managing relations, Commitment, and Altruistic behaviour. The values of Pearson Correlation-Coefficient, as mentioned in the result table, although different, but the outcome remains the same.

The correlation co-efficient of Social Motivation is negatively correlated and significant at 0.01 level with SMVT, SMVC and SMVP. Unlike the above mentioned above factors, SMVI shows negative correlation at 0.05 level of significance. Similar observation is made for Emotional Stability and Value Orientation factors of emotional intelligence with the four factors of social media addiction. For the Integrity factor, a 0.05 level of significance is found for SMVT with negative correlation, 0.01 level of significance for SMVC and SMVP with negative correlation. The Integrity factor shows negative correlation with SMVI, 0.71 , but is not significant. Similarly, Self-Development factor of emotional intelligence shows no significant relationship with SMVT and SMVI. On the other hand, it shows significant negative correlation at 0.01 level with SMVC and SMVP.

A cross-sectional study was performed on 201 students, wherein it was found that internet addiction and emotional intelligence holds inverse relationship (Hamissi et al, 2013). In another study of a sample of 200 males and females, it was found that internet addiction disorder can significantly impact the emotional intelligence of an individual, along with making them prone to many physical as well as psychological ailments, problems in maintaining interpersonal relationships, inefficient time-management, even making one aggressive and hostile, etc (Khoshakhlagh and





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Faramarzi, 2012). As per the above data and researches, it can be inferred that almost all the factors of both the variables under study shows significant inverse relationship and helps in reaching to a meaningful conclusion of how the emotional intelligence of an individual and social media consumption rate has influence on one another.

Implications of the study

The findings of the study can be implemented in daily life. The key is in raising awareness that can be launched in universities, schools, and families that targets students in general, students with low self-esteem, or students addicted to social media. Despite their complexity, prevention, intervention, and treatment are needed too.

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Table 1. Shows the Mean, SD of the dimensions of emotional Intelligence and social media addiction.

	Mean	Std. Deviation	N
EISA	17.3394	4.39111	109
EIEM	16.9633	3.97195	109
EISM	20.1743	4.83974	109
EIES	13.8807	3.02987	109
EIMR	10.0459	2.85899	109
EIIN	10.5138	2.59848	109
EISD	7.2110	1.61631	109
EIVO	7.2936	1.95932	109
EICO	6.8807	2.03999	109
EIAB	6.7064	1.97345	109
TEI	117.0092	25.07636	109
SMVT	14.6881	4.81644	109
SMVC	25.8991	8.15128	109
SMVP	24.3028	8.19158	109
SMVI	18.1560	4.98549	109
TSM	83.0459	22.40428	109

Table 2. Shows the correlation computed between the dimensions of Emotional Intelligence and Social Media Addiction, The results of correlation computed for the data collected are as under.

VARIABLES		SMVT	SMVC	SMVP	SMVI	TSM
EISA	Pearson Correlation	-.458**	-.566**	-.503**	-.324**	-.560**
	Sig. (2-tailed)	.000	.000	.000	.001	.000
	N	109	109	109	109	109
EIEM	Pearson Correlation	-.468**	-.501**	-.408**	-.314**	-.502**
	Sig. (2-tailed)	.000	.000	.000	.001	.000
	N	109	109	109	109	109
EISM	Pearson Correlation	-.249**	-.500**	-.461**	-.196*	-.448**
	Sig. (2-tailed)	.009	.000	.000	.041	.000
	N	109	109	109	109	109
EIES	Pearson Correlation	-.402**	-.451**	-.425**	-.240*	-.459**
	Sig. (2-tailed)	.000	.000	.000	.012	.000
	N	109	109	109	109	109
EIMR	Pearson Correlation	-.427**	-.519**	-.460**	-.318**	-.519**
	Sig. (2-tailed)	.000	.000	.000	.001	.000
	N	109	109	109	109	109
EIIN	Pearson Correlation	-.220*	-.366**	-.388**	-.071	-.338**
	Sig. (2-tailed)	.021	.000	.000	.466	.000
	N	109	109	109	109	109





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EISD	Pearson Correlation	-.157	-.357**	-.435**	-.039	-.331**
	Sig. (2-tailed)	.103	.000	.000	.690	.000
	N	109	109	109	109	109
EIVO	Pearson Correlation	-.311**	-.409**	-.357**	-.193*	-.389**
	Sig. (2-tailed)	.001	.000	.000	.044	.000
	N	109	109	109	109	109
EICO	Pearson Correlation	-.347**	-.488**	-.428**	-.247**	-.464**
	Sig. (2-tailed)	.000	.000	.000	.010	.000
	N	109	109	109	109	109
EIAB	Pearson Correlation	-.343**	-.584**	-.453**	-.298**	-.518**
	Sig. (2-tailed)	.000	.000	.000	.002	.000
	N	109	109	109	109	109
TEI	Pearson Correlation	-.412**	-.567**	-.512**	-.278**	-.544**
	Sig. (2-tailed)	.000	.000	.000	.003	.000
	N	109	109	109	109	109





Design and Development of Multifunctional Super Absorbent Natural Fiber Composite for Biomedical Applications

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ABSTRACT

The present study is aimed to design and develop multifunctional superabsorbent natural fibre composites from cellulose polymer for biomedical applications to absorb fluids and converting to gel. The study involved a one-pot technique for designing the superabsorbent natural fibre composites using the natural cellulose polymer and other excipients along with silver nitrate particles for the anti-bacterial property. Pre-formulation studies were carried for the fibres with average length 4.26cm, diameter 28.93µm and phytochemical analysis showed the presence of cellulose and lower lignin content. Further, formulation characterisation was carried including Fourier Transform Infrared Spectroscopy (FTIR) and Differential Scanning Calorimetry (DSC) showing no incompatibility between the drug and the excipients used. The Scanning Electron Microscopy-Energy Dispersive X-Ray Spectroscopy (SEM-EDS) justified the three-dimensional network formed in the fibres to absorb water and swell while Energy Dispersive X-Ray Spectroscopy (EDS) showed the presence of Na⁺ for creating osmotic pressure for absorption and Ag⁺ for anti-bacterial property. X-Ray Diffraction (XRD) study revealed the crystallinity





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index of superabsorbent natural fibre composite was 27.35% with 72.65% amorphous fraction proving the amorphous nature of the formulation. The physical properties, water content and other moisture behaviours are also studied exhibiting good results comparable to the cotton being used generally. Zone of Inhibition (ZOI) was carried which showed anti-bacterial property against *S.aureus* and *E.coli* in 10mg/ml concentration. The superabsorbent natural fibre composites formulated proved to have 10-1000 times better absorbency compare to cotton. The developed multifunctional superabsorbent natural fibre composites could be used for biomedical applications.

Keywords: Superabsorbent hydrogel; natural fibre; superabsorbent composite; anti-bacterial; cellulose polymer.

INTRODUCTION

In the dental environment, the transmission of contamination by aerosol and splatter has long been considered one of the key concerns. The probable contamination by the airborne path was known long before the detection of actual infectious agents such as bacteria and viruses. Our research paper published in the British Microbiology and Research Journal (British Microbiology Research Journal 14(2): 1-8, 2016) illustrated the occupational risk that dentists are exposed to in the form of aerosols. In the presence of body fluids such as blood, saliva and dental plaque, dentists employ high-energy instruments, such as drills and scalers. It has been demonstrated that this mixture produces aerosols from oral micro-organisms and blood. The cumulative impact, referred to as bio aerosols, provides patients, dentists, and nursing workers with a major microbial challenge [1]. Recent studies have reported that during the use of ultrasonic scalers, dental hand pieces and other dental equipment that generates an aerosol spray, aerosolized bacterial contamination is produced. In dental environments, pathogenic microorganisms can be spread by inhalation of airborne microorganisms that can stay trapped for long periods in the air. Infections could be present in dental clinics and hospitals, particularly during the epidemic of 2019-nCoV, by either of these conditions involved in an infected person.

Droplets and aerosols in dental setting [2-5]

Some of the dental devices/procedures known to cause air borne contamination

Device	Contamination
Ultrasonic and sonic scalers	> amount of aerosol contamination
Airpolishing	Contamination is equal to the use of scalers
Air-water syringes	Contamination is equal to the use of scalers
Tooth preparation with air turbine hand piece/air abrasion	> amount of aerosol contamination

One of the key priorities for patient and staff protection of dentistry is to sever the chain of transmission of infections. To improve the humidity resistance, dental aerosol splatter and water absorption capacity needs to be increased by means of development of natural Hydrogels. Although the majority of the superabsorbent are nowadays manufactured from synthetic polymers (essentially acrylics) due to their superior price-to- efficiency balance, the world's firm decision for environmental protection, potentially support the ideas of partially/totally replacing the synthetics by "greener" alternatives is the need of the hour. In this age of the Covid 19 pandemic, there is a greater need for a hydrophilic super absorbent substance that could solidify oral fluids such as saliva from contaminated patients, disinfect, economic and eco-friendly to avoid cross-contamination between health care professionals and dental nurses.

Superabsorbent hydrogels are three-dimensional hydrophilic networks with a high capacity to absorb, swell and retain the solvent/solution up to 100 times of its dry weight. The hydrogels are prepared from superabsorbent



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materials: synthetic and natural polymers. The use of synthetic polymers is trending due to its price: efficiency ratio (mostly preferred material is acrylics) [6]. In synthetic polymers, the properties of cross-linkers such as swelling property and retractive force neutralising the thermodynamic force of swelling result in the polymeric network formation [7]. These hydrogels have higher absorbency due to the presence of specific functional groups such as –CONH₂, –CONH, –COOH, –OH and –SO₃H attached to the polymeric chain [8]. They are non-recyclable, formulated from petroleum-based monomers being harmful to the environment [9]. The hydrophilicity, permeability, compatibility and lower friction coefficient of hydrogels facilitate their application in the fields of agriculture, medical and other important fields [10,11]. Also, superabsorbent hydrogels serve their application as controlled drug release, super-disintegrant and enhancing the soil fertility [12]. The hydrogels are setting a milestone in the field of medical science by providing the structural integrity of tissues and bones [13]. They act as an adhesive, gluing the tissues and the prosthetics/materials of the surface. Also, they facilitate maintenance of drug level at the targeted site exhibiting extended-release property; their physicochemical properties facilitate biocompatibility and aqueous drug release from the matrix [14].

Now, the world is shifting from synthetic towards an “eco-friendly” alternative to protect the environment from negative effects such as non-biodegradability/poor biodegradability and bio-incompatibility [15]. Over synthetics, polymers of natural origin are being preferred such as polysaccharide and cellulose. Polysaccharide-based hydrogels exhibit a property of being utilised as stimuli-responsive drug delivery system, controlled drug delivery system and cell immobilization [16]. They are extracted from natural sources in a way more reproducible serving biocompatibility, non-toxicity, eco-friendly and easily available. Cellulose is also a natural alternative providing a safe and non-toxic profile over acrylics, being a strong absorbent with high strength, salt-resistance and biodegradability [17]. The chemical structure of cellulose is made up of glucose polymer, a plant product found in cotton, lignin and *wrightia tinctoria* and easily broken by microorganisms. However, it is water insoluble and other solvents due to their 1, 4-β-glucosidic linkages. There are two types of cellulose: bacterial cellulose and plant cellulose. They serve with higher absorbency, easy availability, and a non-toxic profile. Carboxymethyl cellulose engenders absorbance in water along with swelling rate in distilled water and saline water [18].

Cellulose esters and cellulose ethers are two major components for hydrogel preparation where cellulose esters facilitate film-forming property due to their insolubility and cellulose ethers provide good solubility indeed being utilised as food stabilisers and pharmaceutical and cosmetic stabilisers. These ethers are hydrophilic become hydrogel on encountering water and gradually dissolve in it, whereas the insoluble ethers forming a layer of gel surrounding the tablet in which the drug is dispersed slowly [19]. The cellulose-based hydrogels also undergo several modifications to enhance their activity by incorporating cross-linking agents through a chemical reaction. Now-a-days, these are the most widely utilised preparation present in baby diapers to sanitary pads and many other hygiene products. They absorb the volume of about 100-1000 times of their original weight and give a dry feeling. Researchers are shifting their interest from cotton to other cellulose-derived products since there have been pieces of evidence for cotton affecting soil fertility due to their slow biodegradability and accumulation to one place. Also, they have been claimed to absorb the nutrients from the soil making it unsuitable for growing other crops indeed, leading to infertility [20].

The increased usage and demand of the cotton-based products at their disposal is becoming a challenge. The concept of renewable cellulose derivatives-based disposable diapers, napkins, bed sheets, sanitary napkins and sanitary towels can be a revolutionary step in protecting the environment from degradation. Other renewable cellulose-based derivatives such as *wrightia tinctoria*, lignin, etc can be utilised in nanomedicine, feminine incontinence products, baby diapers, bed sheets and sanitary towels. They give the same or in some formulation's better properties than the cotton. They do not affect the soil fertility upon being disposed of, on the other hand, even acts as a crops fertiliser indeed improving the quality. Some derivatives have been reported to show better properties than cotton for the delivery of nanosponges loaded with herbal gel of *wrightia tinctoria* [21]. The research work showed another cellulose-based derivative (*wrightia tinctoria*) showing better moisture content and swelling index than cotton²². Many research works are going on and reported to date utilising *wrightia tinctoria* fibres for various other



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pharmaceutical purposes. It has shown better results than cotton in terms of moisture content, absorbency, tensile strength, and other properties.

This research also utilizes one of the cellulose-based derivatives formulated as Multifunctional Superabsorbent Natural Fibre Composites for Bio-Medical Applications. These nanocomposites serve as a better alternative for cotton and have shown better properties in terms of moisture regain, moisture content, absorbency, and other morphological and chemical properties. This formulation has anti-bacterial property as it is embedded with silver nitrate particles. This can prove to be a game-changer in the times of COVID-19 as the dentists can use it as a pad while attending to their patients avoiding the oral fluids as it will absorb the fluids and swell, then it can be discarded; additionally, will provide anti-bacterial property.

MATERIALS AND METHODS

Materials

Wrightia tinctoria was procured from Srinidhi Industries, sodium hypophosphite (SHP) and acrylamide(AC) were purchased from Loba Chemie Pvt. Ltd., Mumbai. Sodium hydroxide (NaOH), acrylic acid (AA) and glucose were purchased from Merck specialities Ltd., Mumbai. Silver nitrate (AgNO_3) was purchased from Sisco Research Laboratories Pvt. Ltd., Taloja(Maharashtra) and badam gum(BG) was bought from Govindaraja Shetty and Sons, in Mysore.

Methods

Compatibility studies

Fourier Transform Infrared Spectroscopy (FT-IR)

Fourier Transform Infrared (FTIR) (Shimadzu 8400S, Japan) elucidates the presence of chemical bonds and functional groups in the drug and excipients contributing to compatibility study. *Wrightia tinctoria* and SHP, NaOH, AC, AgNO_3 and glucose were mixed with 100 times the weight of KBr, triturated and compressed in KBr press (Technosearch instruments, India) at 4-5 ton/ nm^2 pressure preparing KBr pellets. These pellets were then analyzed for FTIR study (Shimadzu 8400S, Kyoto, Japan) at a selected wavelength of 400-4000 cm^{-1} [23].

Differential Scanning Calorimetry (DSC)

The compatibility study of *Wrightia tinctoria* and SHP, NaOH, AC, AgNO_3 and glucose were carried in Differential Scanning Calorimetry (Shimadzu, DSC 60). The equipment was calibrated using indium metal as standard along with liquid nitrogen supplied for cooling. Approximately, 6-8mg of drug and other excipients were taken in an aluminium pan and pressed to get a pellet using an optional crimper. The pellet was then kept in the sample holder and scanned from ambient to 400°C at a rate of 10°C/min [24].

Pre-Formulation Studies

Qualitative phytochemical analysis

Phytochemical analysis was carried out preliminarily to identify the phytochemicals present in the plant extract. It was done through common tests in the laboratory which included Mayer's test, Molish test, Lead acetate test, Ninhydrin test, Salwonski test, Keller killani test, Benedict's test and Legal test. The results are recorded in table 1 [25].

Physical properties analysis

Length: The fibre length analysis using advanced instruments was not possible due to the brittle nature of the fibre. Hence the fibre length was measured manually using a calibrated scale. The staple lengths of *Wrightia tinctoria* were calculated manually the average mean value was recorded [26].

Diameter: The fibre diameter observed on Scanning Electron Microscopy (SEM). The sample was frozen in liquid

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nitrogen, further leading to their breakdown into smaller pieces to analyze their cross-section. The dimension was found to be in the range with a mean value of *Wrightia tinctoria* [27].

Water content

The water content of *Wrightia tinctoria* was examined by soaking the fibres in water for 24hr and then weighing them. The soaked extract was then dried at 105°C for 40min and reweighed. The weight of the compound after soaking (wet weight) and dry weight were compared. Also, the amount of water being absorbed was calculated using formula [28].

$$\% \text{ Water content} = \frac{\text{wet weight} - \text{dry weight}}{\text{wet weight}} \times 100$$

X-Ray Diffraction (XRD)

The X-ray diffractometer (Bruker D8 Advance) examined the *Wrightia tinctoria* for its crystallinity and amorphism through diffraction peaks recorded. The diffraction was carried at room temperature using a radiation point source of $K\alpha$ Cu at 40kV and 40mA with a diffraction range of 5°-80° (2 θ) [29].

Preparation of Multifunctional Superabsorbent Natural Fiber Composites (MSNFC) Extraction of fibres from plant extract

The fruits of *wrightia tinctoria* were collected from local botanical gardens and dried for a week in sunlight. After 7 days, the seed pods broke, and fibers were exposed through them. These pods were further dried at room temperature. Then, the fibers were extracted manually from the pods by hand stripping method. If the pods were not dried more external force will be needed to break the pods and collect the fibers by plugging from the seeds as shown in figure 1. After collecting the fibers, they were directly stored in the air-tight containers to avoid any contact with the air. The collected fibers were then sent to the Botanical Survey of India, Coimbatore, Tamil Nadu for identification of the sample.

Preparation of the multifunctional superabsorbent natural fiber composite (MSNFC)

The multifunctional superabsorbent natural fiber composite was formulated by one-pot method as shown in figure 2. Fibers were chopped into smaller pieces and added to 20ml distilled water by continuous stirring at 65°C; also, 1g of BG was added to it. Then, 0.2g SHP in 10ml of water was added to this mixture as an initiator to trigger free radical production (mixture 1). On an ice bath, 4g of NaOH (8g/100ml), 6ml of AA and 1.6ml of AC (0.05gm in 5ml solution; 1g/100ml) were mixed, further, adding to mixture 1. Then, 30mg in 3ml of $AgNO_3$ solution (1g/100ml) and 60mg in 3ml of glucose solution (2g/100ml) in 1:2 ratios were mixed with the prepared system at 65°C to undergo a reduction of Ag^+ to silver particles. Then, the prepared formulation was washed with ethanol continuously for the complete removal of water. Later, it was dried at 80°C in a cooled vacuum oven for 10hrs, lastly, the dried samples were sifted and converted to powder for further study and tests [30].

Characterization of MSNFC

Fourier Transform Infrared spectrometry (FTIR)

The samples were examined for the presence of various functional groups and their interaction between the drug and excipients. The FTIR analysis for done for two samples at a scan range of 400-4000 cm^{-1} : X1 and X2 respectively, where X1 is the formulation before the incorporation of $AgNO_3$ and X2 is the formulation after the incorporation of $AgNO_3$. The graphs were obtained and recorded [31].

X-Ray Diffraction (XRD)

X-ray diffraction was carried for the samples X1 and X2 through the X-Ray diffractometer at 40kV, 40mA, and scanning range: 5°-80°. This analysis was performed to study the amorphous nature and incorporation of silver particles in the formulation. The samples were triturated and kept in the sample holder, further, the x-rays were allowed to diffract and diffractograms were obtained and recorded [32].



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The SEM-EDS (Jeol 6390LA/ OXFORD XMX N) analysis facilitated précised information about the chemicals and their functional groups present. The sample was analyzed for SEM paired with EDS detector, the electron beam hits the sample and an electron from the inner shell is knocked off, hence, it becomes positively charged. The electron from the outer shell moves to the inner shell to occupy that space which leads to an energy difference reflected in the form of an x-ray. This x-ray is detected by the EDS detector to analyze the different chemical information as we know specific elements and transitions have specific x-rays to identify them [33]. Hence, the graph and image are obtained and recorded in table 2.

Antibacterial study

Antimicrobial activity of given sample X2 was investigated using a well diffusion method against bacterial strain *S.aureus* (MTCC: 737) and *E.coli* (MTCC: 443). Test plates (diameter 10 cm) were prepared with 20 mL of LB agar (LBA). After the media get solidified, 100µl of 24hr bacterial culture (1.5×10^8 CFU/mL) was added and uniformly spread over plates using L shaped loop. Then made well (about 6mm diameter) and 50µL of different concentrations of the plant extract 10, 50 and 100mg/ml were added respectively. The wells loaded with sterile media considered as Blank 30ug in 40µl streptomycin were used as a standard. After loading plates were kept in a sterile condition until complete absorption of the test compounds. Plates were incubated at 37°C in an appropriate gaseous condition for 24 hrs. Zones of inhibition (ZOI) of microbial growth around the well were measured and recorded after the incubation time in table 3. The inhibitory zone was considered the shortest distance (mm) from the outside margin of the samples to the initial point of the microbial growth. All measurements were performed twice by the same blinded operator. Three replicates were done [34].

Swelling studies

The sample X2(0.1gm) was weighed (dry weight) and immersed in 100ml distilled water and 50ml 0.9% NaCl solution for 2hrs. After the stipulated time, the sample was taken out and kept aside for 30min to strain the excess water. Then, it was reweighed (wet weight) and recorded³⁵. The swelling ratio was calculated by the following equation and tabulated in table 4

$$\% \text{Swelling} = \frac{\text{wet weight} - \text{dry weight}}{\text{dry weight}} \times 100$$

Drying time of MSNFC

The sample X2 was immersed in distilled water for 24 hrs and kept aside. After 24hrs, the sample was taken out and excess water was removed. The wet sample was then weighed every 15min until the weight became constant [36]. The time needed for drying was recorded in table 5.

Stability studies

The prepared formulation was stored at an ambient temperature for 3 months to study their stability. The formulation was stored at different temperatures i.e., 45±2°C, 25±2°C, 4±2°C and the changes were recorded. The observation was recorded on the 0th, 15th, 30th, 45th, 60th, 75th and 90th day.

RESULT AND DISCUSSION**Compatibility studies****Fourier Transform Infrared Spectroscopy (FT-IR)**

From this analysis, the peaks were obtained at different wavenumbers specifying the presence of significant functional groups and their intermolecular bonding. The spectra obtained at 3404.47cm⁻¹, 2924.18cm⁻¹, 1460.16cm⁻¹ give -O-H, -C-H and -N-H stretching for *Wrightia tinctoria*. 3751.67cm⁻¹ frequency signifies SHP-*Wrightia tinctoria* bonding. 1732.13cm⁻¹, 1701.27cm⁻¹ and 1666.55cm⁻¹ showed -COOH and -C=O groups present in the sample X1. 1055cm⁻¹, 1560.46cm⁻¹ and 1591.33cm⁻¹ showed the presence of -C-O-C-, -C=C and -NH stretching. Hence, the pure





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Wrightia tinctoria and sample X1 showed similar characteristic peaks concluding no chemical incompatibilities between the two as shown in figure 3 and figure 3.

Differential Scanning Calorimetry (DSC)

During the thermal analysis, the thermograms were obtained by heating from 5°C - 400°C recording a peak at 275.77°C for pure *Wrightia tinctoria*. For sample X1, the peak was obtained at 277.10°C upon heating at the earlier mentioned temperature. The DSC peaks obtained from the analysis are similar hence, proving the presence of no additional compounds or impurities, concluding the *Wrightia tinctoria* and sample X1 to be compatible as shown in figure 4 and figure 5.

Pre-formulation studies

Qualitative phytochemical analysis

The results of the phytochemical analysis carried by primary tests are recorded in table 1. The tests showed the presence of various phytoconstituents present in the compound such as amino acids, alkaloids, flavonoids, tannins, carbohydrates, glycosides, saponins, and triterpenoids.

Physical properties analysis

Length: The average of the fibre length was recorded and the mean was calculated for them as shown in figure 6. The mean length was found to be 4.26cm with a shorter fibre percentage being higher and a wider variation in fibre length was observed.

Diameter: The diameter was measured using SEM at a magnification of 250X-3.00k X. The diameter was recorded to be in the average range of 50µm-100µm. The average diameter was recorded as 28.93µm. The SEM image also showed pits and ridges present on the fibres in figure 7.

Water content

The mean for both dry weight and original weight was calculated. Then, % water content is calculated as:

$$\begin{aligned} \% \text{ Water content} &= \frac{\text{original weight} - \text{dry weight}}{\text{dry weight}} \times 100 \\ &= \frac{0.022 - 0.021}{0.021} \times 100 \\ &= 4.76\% \end{aligned}$$

X-Ray Diffraction (XRD)

XRD was conducted and the graph was recorded as shown in figure 8. The diffractograms showed two major peaks at 22.3° and 16.2° where the first peak signifies crystalline cellulose and the second peak indicates an amorphous fraction of the pure compound. The crystallinity index was:

$$C.I. = \frac{I(\text{crystalline}) - I(\text{amorphous})}{I(\text{crystalline})} \times 100$$

The C.I. was calculated to be 27.35% and the amorphous fraction to be 72.65% showing it to be a better candidate for the formulation. A higher amorphous fraction can be deduced as a having higher absorption capacity.

Characterization of MSNFC

Fourier Transform Infrared spectrometry (FTIR)

The peaks obtained from the analysis of the two samples X1 and X2 were interpreted. The peaks obtained at 3404.47cm⁻¹, 2924.18cm⁻¹, 1460.16cm⁻¹ give –OH, –CH and –NH stretching respectively. 1055.60cm⁻¹, 1114.89cm⁻¹ and 1161.19cm⁻¹ give –C-O-C stretching for anhydrous glucose in sample X1. 1701.27cm⁻¹ and 1666.55cm⁻¹ showed -COOH and -C=O groups present in the samples X1 and X2. 1560.46cm⁻¹ and 1591.33cm⁻¹ showed the





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presence of –C=C and –NH stretching. 3751.67cm⁻¹ frequency signifies SHP-*Wrightia tinctoria* bonding. After AgNO₃ grafting, there were no significant changes in the spectra of X2. Hence, showing the compatibility of the formulation prepared and proper grafting of the cross linkers and other excipients in figure 9 and figure 10.

X-Ray Diffraction (XRD)

Sample X1 and X2 both were analysed by this method giving peaks before and after AgNO₃ incorporation as shown in figure 11 and figure 12. The major peaks observed in samples X1 and X2 are 22.3°, 16.2° and 27.7° showing the presence of both crystalline and amorphous fractions. Other smaller peaks were also obtained at 32.15°, 34.5°, 34.83° and 46.11° because of the quantity of AgNO₃ particles in the formulation.

Scanning Electron Microscopy-Energy dispersive spectrum (SEM-EDS)

The SEM images obtained for the formulation X2 as in figure 13 and figure 14 show a network formation within the fibres to absorb water. The EDS data shows a small amount of Ag and Na present in the formulation. The Na⁺ creates an osmotic pressure to enhance the water absorption capacity with Ag⁺ adding an anti-bacterial property to it as shown in figure 15 and table 2.

Antibacterial study

The antibacterial study report was tabulated in table 3 with figure 16.

Swelling studies

After straining excess water from the sample, the sample was reweighed as wet weight and this was repeated three times and the average wet weight was taken. Similarly, dry weight was average and the swelling index was tabulated in table 4 and calculated as:

$$\begin{aligned} \% \text{ swelling} &= \frac{0.056 - 0.045}{0.045} \times 100 \\ &= \frac{0.011}{0.045} \times 100 \\ &= 24.44\% \end{aligned}$$

Drying time of MSNFC

The sample was weighed every 15 min and the weight and time were recorded in table 5 until the weight becomes constant.

Stability studies

The stability study is being done for 90 days and the formulation was evaluated for the change in their parameters. It was observed that even after 90 days of study in different temperatures there were no significant changes in their water content, swelling index, colour, texture, and drying time as shown in figure 17.

CONCLUSION

In this research work, the multifunctional superabsorbent natural fibre composite was formulated using the one-pot method exhibiting anti-bacterial properties studied by the zone of inhibition against *S.aureus* and *E.coli* at a concentration of 10mg/ml due to the silver particles embedded in the formulation. The presence of functional groups, crystallinity and surface morphology was studied by FTIR, XRD and SEM. The sample showed better absorbency, moisture content, drying time and swelling properties with being an eco-friendly option. The formulation can be a feasible, economical, and biodegradable alternative for cotton in the field of medical sciences. There is no documented literature which showcases grafting of *Wrightia* fibres onto badam Gum molecules to form superabsorbent polymers embedded with AgO particles from Ag⁺ reduced by glucose to exhibit anti-microbial properties, enhancing effective saliva absorption, reduced aerosol splatter, compounded with safe disposal of contaminated waste. Hence the current research focuses on, an easy, fast and energy-saving, one-pot method to





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prepare composite superabsorbent polymers with excellent antibacterial abilities, together with safe disposal on usage thus benefitting the dental fraternity from the havoc of aerosol contamination in this era of covid 19 pandemic.

Future Prospective

- It can be a revolutionary formulation for dentists especially in this time of COVID-19 as this will protect them from coming in contact with the oral fluids by absorbing them and swelling to about 10-100 times of their original weight.
- It can serve as a better renewable and eco-friendly option over cotton as it will act as a fertiliser for the soil upon disposal instead of degrading it.

CONFLICT OF INTEREST

There were no conflicts of interest among the authors.

ACKNOWLEDGEMENT

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Table 1: Result of primary phytochemical analysis

S. No.	Constituents	Test	Observation	Results
1.	Alkaloids	Mayer's test	Formation of a creamy precipitate.	Positive
2.	Flavonoids	Lead acetate test	Formation of yellow precipitate.	Positive
3.	Carbohydrates	Molish test	Formation of a violet ring at the junction.	Positive
4.	Triterpenoids and Steroids	Salwonski test	The presence of steroids is confirmed if the lower layer turns red and that of triterpenoids by Golden yellow layer at the bottom.	Positive
5.	Deoxy sugars	Keller killani test	Formation of blue color in the acetic acid layer	Positive
6.	Glycosides	Legal's test	Formation of pink to a blood-red color	Positive
7.	Reducing sugars	Benedict test	Depending on the amount of reducing sugar present in the test solution appears green or yellow or red	Positive
8.	Amino acids	Ninhydrin test	Formation of blue color	Positive

Table 2: Elements present in the formulation

Element	Line Type	Wt%	Atomic %
C	K series	53.08	61.26
O	K series	43.25	37.47
Na	K series	1.33	0.8
S	K series	0.25	0.11
Cl	K series	0.35	0.14
Ag	L series	1.73	0.22
Total:		100	100

Table 3: Anti-bacterial activity against *S. aureus* and *E.coli*

Zone of inhibition in cm						
Organism: <i>Staphylococcus aureus</i>						
Test Compounds	Std	Blank	10mg/ml	5mg/ml	1mg/ml	
Sample W1	2.4 cm	...	1.4cm	0.3cm	----	
Organism: <i>E. Coli</i>						
Sample W1	1.9cm	2 cm	1.3cm	----	----	

Table 4: Swelling study of MSNFC

S.No.	Weight before swelling(g)	Weight after swelling(g)
1.	0.045±0.02	0.057±0.02
2.	0.046±0.02	0.056±0.02
3.	0.048±0.02	0.059±0.02
4.	0.045±0.02	0.056±0.02
5.	0.044±0.02	0.053±0.02
Avg.- 0.045±0.02		0.056±0.02





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Table 5: Drying time of the MSNFC

S.no.	Drying time(min)	Weight of the sample(gm)
1.	0	1.32
2.	15	1.02
3.	30	0.82
4.	45	0.73
5.	60	0.73

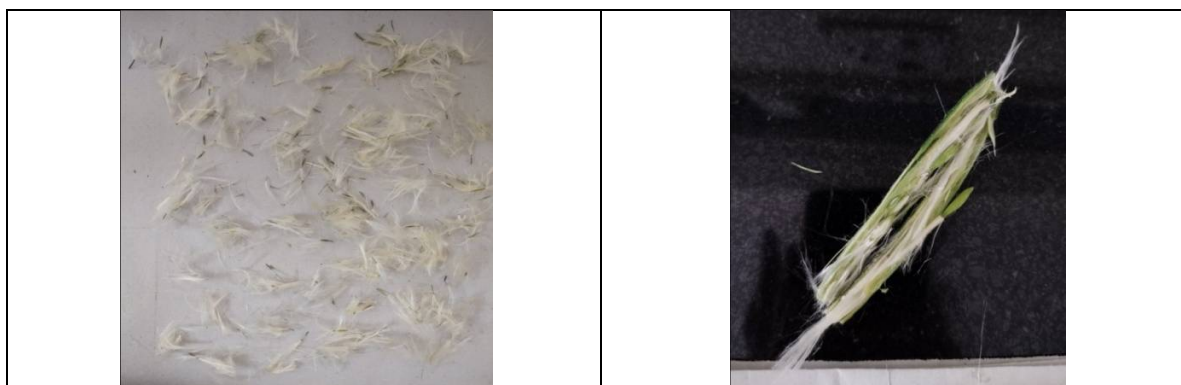


Fig 1: Extraction of fibers from plant extract

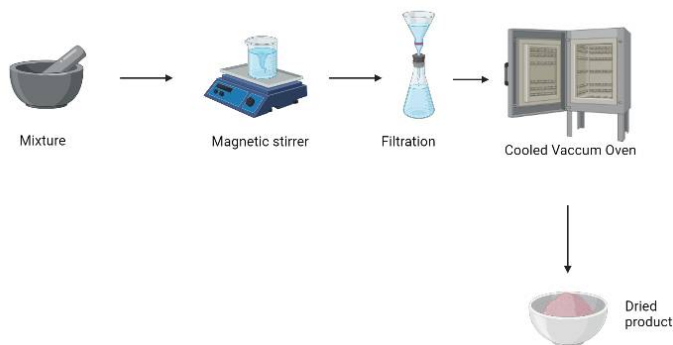


Fig 2: Preparation of Multifunctional Superabsorbent Natural Fiber Composites

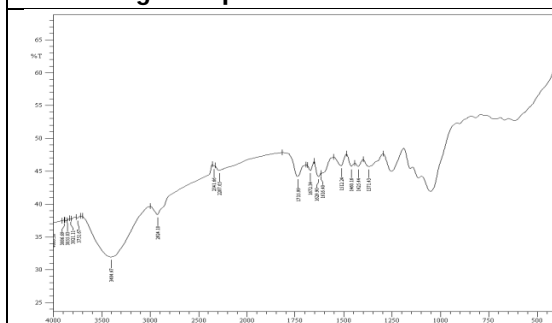


Fig 3: FTIR spectra of *Wrightia tinctoria*

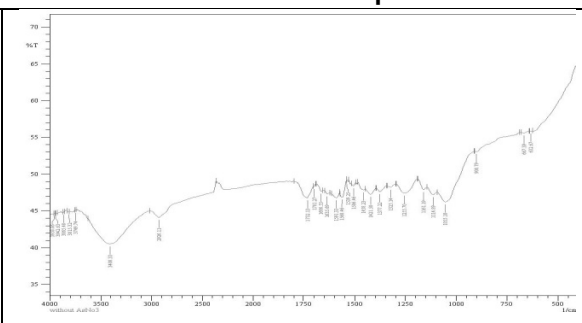


Fig 4: FTIR spectra of sample X1





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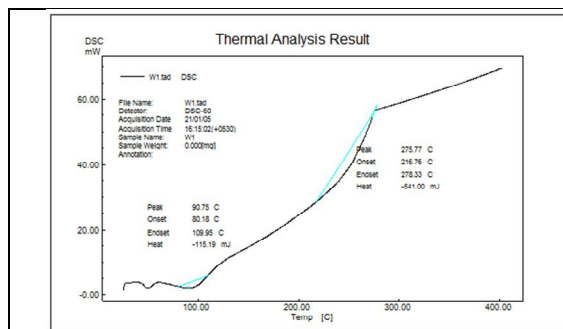


Fig 5: DSC thermogram of pure *Wrightia tinctoria*

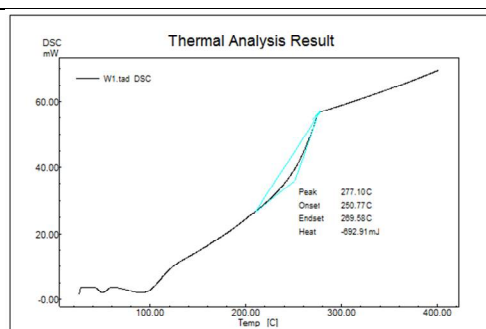


Fig 6: DSC thermogram of sample X1

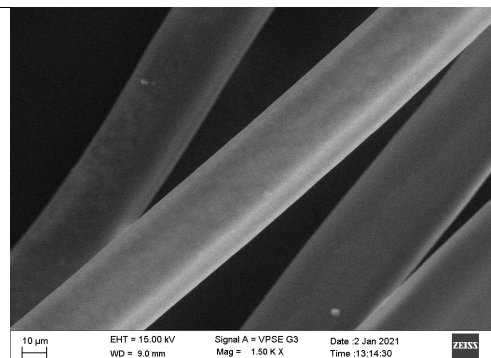
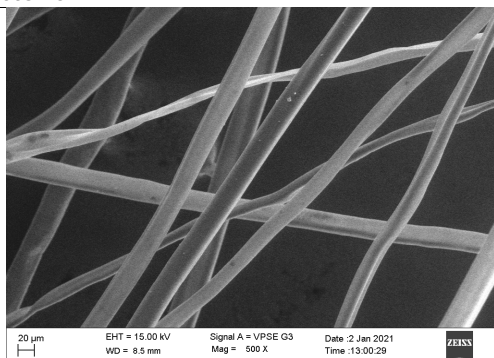


Fig 7: Measurement of fibre diameter using SEM

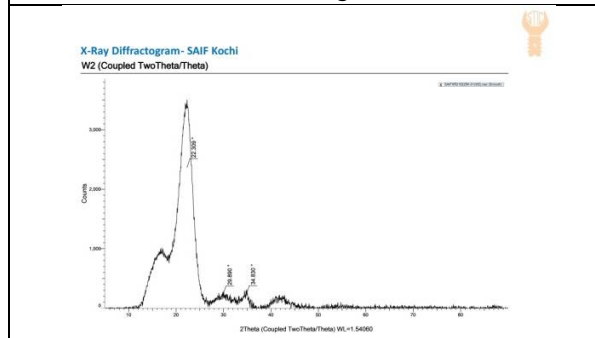


Fig 8: XRD pattern for pure *Wrightia tinctoria*

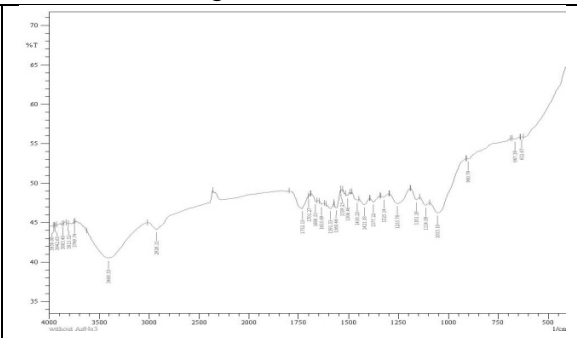


Fig 9: FTIR spectra of compound X1

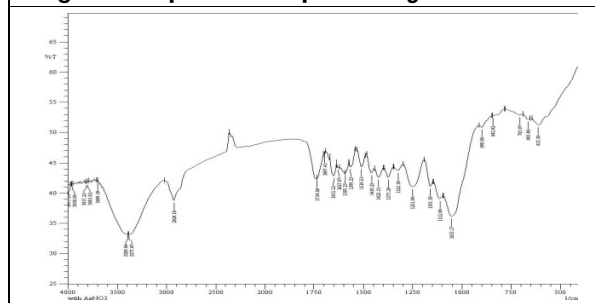


Fig 10: FTIR spectra of compound X2

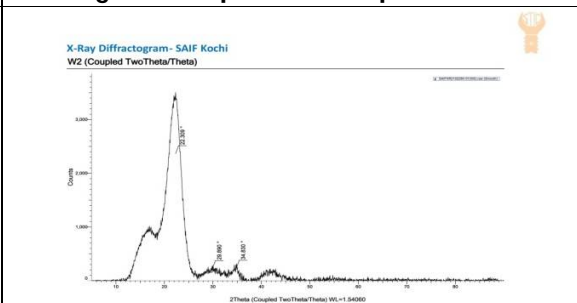


Fig 11: XRD diffractogram for X1





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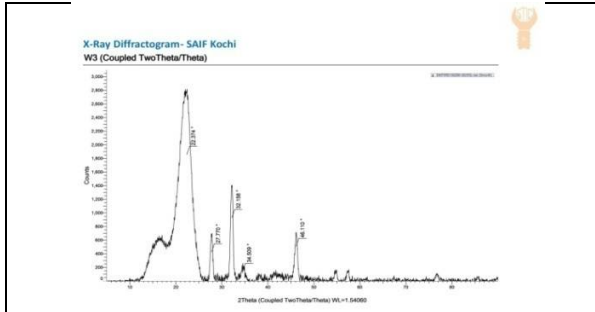


Fig 12: XRD diffractogram for X2

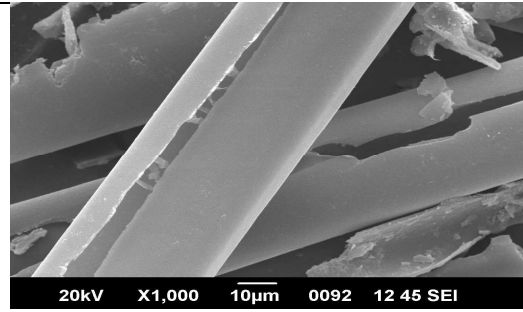


Fig 13: SEM image of sample X2

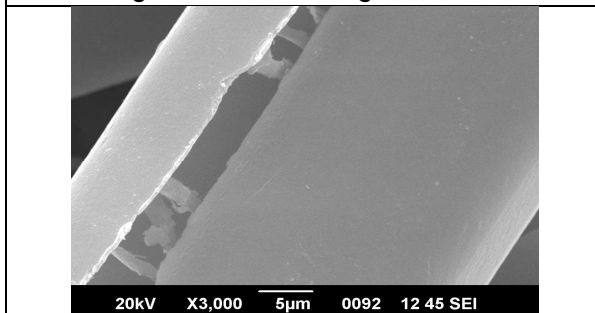


Fig 14: SEM image of sample X2 (magnified view)

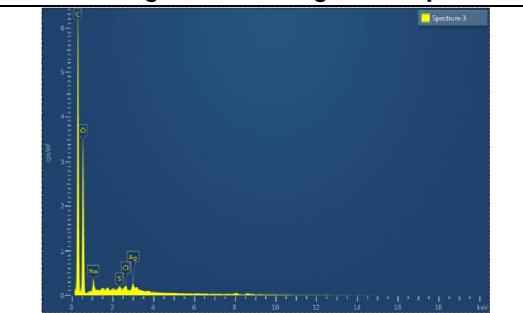


Fig 15: Graph showing the presence of elements in the formulation

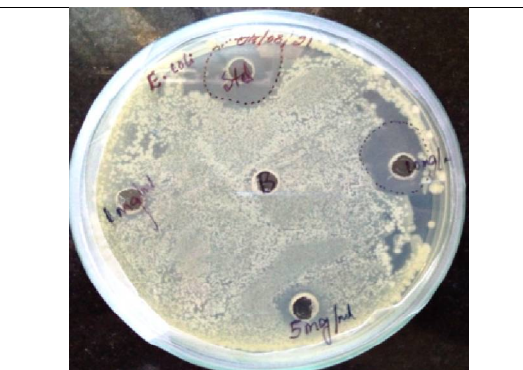
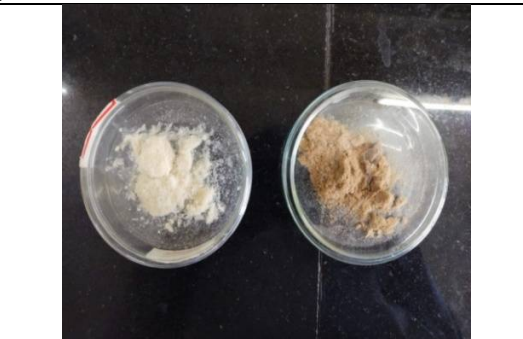


Fig 16: Antibacterial activity against *S.aureus* and *E.coli*.



0 days



90 days

Fig 17: Stability studies of the MSNFC





On the Product of Orbit Spaces and Smirnov Compactification

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ABSTRACT

In this paper the p-action of a proximal group G on a proximity spaces X is dealt with. It is shown that the orbit space of the Smirnov compactification of a separated proximity space X is the Smirnov compactification of the orbit space.

Keywords: proximal, orbit, Smirnov, Spaces.

INTRODUCTION

In this paper, the p-action θ of a proximal group G on a proximity space X has been dealt with. Further it is shown that the p-action can be extended to the Smirnov compactification ΨX . It has been shown that, when G is finite and discrete, the group action : $\tilde{\theta} : G \times \Psi X \rightarrow \Psi X$ defined by $\tilde{\theta}(g, \sigma) = \Psi \text{Tr}(\sigma)$, $g \in G$, $\sigma \in \Psi X$, is the unique extension of the p-action θ of X .

It is prove that the orbit space $\Psi X/G$ of the Smirnov compactification ΨX of a proximal transformation group X , is the Smirnov compactification $\Psi (X/G)$ of the orbit space X/G . The p-action θ on the product proximity space $X \times Y$ is introduced and some result concerning product of orbit spaces have been proved.

Proximal Transformation Groups

In this section preliminaries of the theory of proximal transformation groups is given. An example has been provided to show that a topological transformation group need not be a proximal transformation group; whereas all proximal transformation groups are topological transformation groups. Note that compact topological transformation groups are proximal transformation groups.





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Definition 2.1 A proximal group or a p- group is a proximity space which is also a group such that the group operation on $G \times G$ to G and the map of G onto G taking g to g^{-1} are p- continuous.

Example 2.2 A topological group G may not be a proximal group with respect to a proximity which induces the topology of G . Denote by (\mathbb{R}^*, \cdot) the multiplicative group of nonzero real numbers with the subspace topology inherited from \mathbb{R} . Then (\mathbb{R}^*, \cdot) is a topological group. A compatible proximity δ for \mathbb{R}^* is defined by $A \delta B$ if $D(A, B) = \inf \{|a - b| : a \in A, b \in B\} = 0$. But (\mathbb{R}^*, δ) is not a proximal group.

The map $f_0: \mathbb{R}^* \times \mathbb{R}^* \rightarrow \mathbb{R}^*$ defined by $f_0(x, y) = xy$ is continuous but it is not p-continuous.

Note that the map $f: \mathbb{R}^* \rightarrow \mathbb{R}^*$ given by $f(x) = x^2$ is not p-continuous; for if $A = \{(n-1/2n) : n \in \mathbb{N}\}$ and $B = \{n : n \in \mathbb{N}\}$,

then $A \delta B$, $f(A) = \{(n-1/2n)^2 : n \in \mathbb{N}\}$, $f(B) = \{n^2 : n \in \mathbb{N}\}$ and $f(A) \not\delta f(B)$.

Suppose to the contrary that f_0 is p-continuous. Then, by the definition of product proximity and the fact that the map $(\text{Id}, \text{Id}): \mathbb{R}^* \rightarrow \mathbb{R}^* \times \mathbb{R}^*$ is p-continuous, we obtain that the composite map $f = (f_0 \circ (\text{Id}, \text{Id}))$ is p-continuous which contradicts the p-discontinuity of f .

Definition 2.3 A p-action θ of a p-group G on a proximity space X is a p-continuous action, i.e. $\theta: G \times X \rightarrow X$ is a p-continuous map with respect to the product proximity on $G \times X$. We say that G acts proximally on X .

Proposition 2.4 Let G be a proximal group acting on a proximity space X . For $g \in G$ the map $T_g: X \rightarrow X$ defined by $T_g(x) = g$

$x, x \in X$, is a p-homeomorphism.

Definitions 2.5 A triple (X, G, θ) , consisting of a proximity space X , a proximal group G and a p-action θ of G on X . is called a proximal transformation group or a PG-space and is denoted by X . A PG-space (X, G, θ) where θ is a trivial p-action will be called a trivial PG - space.

Since p-continuous maps are continuous with respect to induced topologies, a proximal transformation group is a topological transformation group.

Example 2.6 Let G be a discrete, finite p-group and X be a discrete proximity space. Then $G \times X$ has discrete proximity. So any action of G on X is p-continuous. In particular, $(\mathbb{Z}, Z_2, \theta)$, with $\theta(0, m) = m$ and $\theta(1, m) = -m$ for all $m \in \mathbb{Z}$, is a proximal transformation group; \mathbb{Z} is the set of integers with discrete proximity and Z_2 is the

discrete 2-group. An example of a topological transformation group which is not a proximal transformation group with respect to compatible proximities is given by $(\mathbb{R}^*, \mathbb{R}^*, \cdot)$, where the multiplicative group (\mathbb{R}^*, \cdot) acts on itself and the action is given by multiplication. The topology on \mathbb{R}^* is the subspace topology inherited from \mathbb{R} , the proximity on \mathbb{R} is $A \delta B$ if and only if $D(A, B) = 0$.





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Definitions 2.7 Let (X, G, θ) or X be a PG-space. A subset A of X is called a p -invariant set if $\theta(G, A) = A$, i.e. $G A = A$. If $A \subset X$ is p -invariant, then the triple (A, G, θ_A) is a PG-space, called a PG-subspace of X , where $\theta_A: G \times A \rightarrow A$ is such that $\theta_A(g, x) = \theta(g, x)$ for $g \in G, x \in A$.

Let A be a proximal subspace of a proximity space X and θ_A be a p -action of a proximal group G on A . Then a p -action θ of G on X is called an extension of θ_A to X if θ agrees with θ_A on $G \times A$; θ is called an extended p -action on X obtained from the given p -action θ_A on A .

Definitions 2.8 Let $(X, G, \theta), (Y, G, \theta)$ be PG-spaces. A map $f: X \rightarrow Y$ is called equivariant if $f(gx) = g f(x), g \in G, x \in X$. If $f(gx) = f(x)$ for all $g \in G$ and $x \in X$, then f is called an invariant map.

A composition of equivariant maps is equivariant. A map f from a PG-space X to a trivial PG-space Y is equivariant if and only if f is invariant. An equivariant p -homeomorphism between PG-spaces is called a PG-homeomorphism.

Orbit Spaces

In this section, introducing the notions of orbit map and orbit space. It is shown that for a dense proximal PG-subspace A of a PG-space X , the orbit space A/G is a dense proximal subspace of X/G . Further it is true that if $f: X \rightarrow Y$ is a p -continuous equivariant map, then the map $\Pi f: X/G \rightarrow Y/G$ defined by $\Pi f(Gx) = Gf(x)$ is p -continuous.

Definition 3.1 A map $f: (X, \delta_1) \rightarrow (Y, \delta_2)$ is called p -open if for subsets $A, B \in P(X), A \ll_1 B$ implies $f(A) \ll_2 f(B)$.

Let (X, G, θ) be a PG-space and let X/G be the set of orbits on X . The orbit G_x of x as an element of X/G is denoted by G_x and $G_A = \{G_x : x \in A\}, A \subset X$. Define a map $\Pi: X \rightarrow X/G$ by $\Pi(x) = G_x, x \in X$. The map Π is called the orbit map on X . The set X/G together with the quotient proximity relative to the map Π is called the orbit space of X .

The natural p -action on X/G taking (g, G_x) to G_{gx} is trivial p -action.

Theorem 3.2 Let X be a PG-space with G finite and T_2 . Then the following are true :

- (i). the orbit map Π is p -open and hence is open;
- (ii). X/G is separated (Hausdorff).

PROOF. (i). It suffices to show that, for $A, B \subset X, A \ll B$ implies $\Pi(A) \ll \Pi(B)$, or $G_A \ll G_B$. Note that the map $T_g: X \rightarrow X$, defined by $x \rightarrow gx$, for $x \in X$ is a p -homeomorphism. This gives that $gA \ll gB$, for every $g \in G$, whenever $A \ll B$ in X . Since G is finite, we get

$$\bigcup_{g \in G} gA \ll \bigcup_{g \in G} gB, \text{ or } G_A \ll G_B.$$

It follows that $G_A \ll G_B$ in X/G and hence Π is p -open.

(ii). It suffices to show that for G_x, G_y in $X/G, G_x \neq G_y$ if and only if $G_x \ll (X/G - G_y)$.





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Suppose $G_x \neq G_y$. This gives that $x \neq g y$ for any $g \in G$. Since, X is separated $x \delta g y$; for any $g \in G$. Equivalently $x \ll (X - g y)$ for any $g \in G$. This implies $G_x \ll (X/G - G_y)$.

Conversely, suppose $G_x \ll (X/G - G_y)$. Using the p -continuity of the map Π . we get $\Pi^{-1}(G_x) \ll \Pi^{-1}(X/G - G_y)$, or $G_x \delta G_y$. This implies $x \delta g y$ for any $g \in G$. Thus $x \neq g y$ for any $g \in G$ and hence $G_x \neq G_y$.

Proposition 3.3 If X is a PG-space and Y is a trivial PG-space, then $\tilde{f} \rightarrow \tilde{f} \circ \Pi \equiv f$ is a one to one correspondence between maps \tilde{f} of X/G into Y and equivariant maps f of X into Y .

If \tilde{f} is p -continuous, then f is p -continuous.

Remark 3.4 If G is finite and T_2 and (X, G, θ) is a G -space, then X/G is compact if and only if X is compact.

Proposition 3.5 If A is a PG-subspace of a PG-space X . then A/G is a proximal subspace of X/G . Further, if A is dense in X , then A/G is dense in X/G .

Proof. Let $i : A \rightarrow X$ and $j : A/G \rightarrow X/G$ be inclusion maps and $\Pi_A : A \rightarrow A/G$, $\Pi_X : X \rightarrow X/G$ be orbit maps. Then $j \circ \Pi_A = \Pi_X \circ i$. Also $\Pi_A = \Pi_X|_A$.

Suppose that for $G_C, G_D \subset A/G$, $G_C \delta G_D$. Since Π_A is p -continuous, $G_C \delta G_D$ in A . Since A is a proximal subspace of X , $G_C \delta G_D$ in X or $G_C \ll X - G_D$. As Π_X is p -open $G_{G_C} \ll G_{X - G_D}$ or $G_C \ll X/G - G_D$ or $G_C \delta G_D$ in X/G .

Conversely, suppose that G_C, G_D are subsets of A/G and $G_C \delta G_D$ in X/G . Since Π_X is p -continuous, $G_C \delta G_D$ in X . It follows that $G_C \delta G_D$ in A or $G_C \ll A - G_D$. The p -openness of Π_A yields $G_{G_C} \ll G_{A - G_D}$ or $G_C \delta G_D$ in A/G . For the second part, we have $cl(A) = X$. Hence $x \delta A$ for each $x \in X$. Since the orbit map Π_X is p -continuous, $G_x \delta G_A$ or $G_x \delta A/G$. This implies $G_x \in cl(A/G)$.

Thus $cl(A/G) = X/G$.

Theorem 3.6 Let $(X, G, \theta), (Y, G, \theta)$ be PG-spaces with G finite T_2 . If $f : X \rightarrow Y$ is a p -continuous equivariant map, then $\Pi f : X/G \rightarrow Y/G$ defined by $\Pi f(G_x) = G_{f(x)}$ is a p -continuous map.

Proof. That Πf is a map is a consequence of the equivariance of f .

Denote by Π_X and Π_Y the orbit maps on X and Y respectively. Suppose $G_C \ll G_D$ in Y/G . Since Π_Y is p -continuous, $\Pi_Y^{-1}(G_C) \ll \Pi_Y^{-1}(G_D)$. Using the p -continuity of f , we get

$$f^{-1}(\Pi_Y^{-1}(G_C)) \ll f^{-1}(\Pi_Y^{-1}(G_D)),$$

or

$$(\Pi_Y \circ f)^{-1}(G_C) \ll (\Pi_Y \circ f)^{-1}(G_D).$$





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Since $\Pi_Y \circ f = \Pi_f \circ \Pi_X$, we obtain

$$(\Pi_f \circ \Pi_X)^{-1} G_C \ll (\Pi_f \circ \Pi_X)^{-1} (G_D),$$

or

$$\Pi_X^{-1} (\Pi_f)^{-1} (G_C) \ll \Pi_X^{-1} (\Pi_f)^{-1} (G_D).$$

As Π_X is p-open, we get

$$\text{Or } (\Pi_f)^{-1} (G_C) \ll (\Pi_f)^{-1} (G_D).$$

This proves the p-continuity of Π_f .

Group Action Extended to ΨX

Let (X, G, θ) be a proximal transformation group and ΨX be the Smirnov compactification of X . We obtain that if G is finite with discrete proximity, then the p-action θ of G on X extends to the p-action $\tilde{\theta}$ of G on ΨX .

Lemma 4.1 If (X, G, θ) or X is a PG-space, $g \in G$ and σ is a cluster in X , then $g\sigma$ is also a cluster in X .

Proof. CL1 and CL2 follow from the definitions. We prove CL3. Suppose $C \cup D = g\sigma$. Then $C \cup D = gA$ for some $A \in \sigma$ and $C \cup D = [(gA \cap C) \cup (gA \cap D)]$. Therefore

$$g^{-1}(gA \cap C) \cup g^{-1}(gA \cap D) \in \sigma.$$

Consequently either $g^{-1}(gA \cap C) \in \sigma$ or $g^{-1}(gA \cap D) \in \sigma$. It follows that either $gA \cap C = C \cap g\sigma$ or $gA \cap D = D \cap g\sigma$.

$$D = D \cap g\sigma.$$

Lemma 4.2 Suppose that X, Y and G are proximity spaces and G is finite and discrete. If $G = \{g_i : 1 < i < n\}$, $X_i = \{g_i\} \times X$ and $f_i : X_i \rightarrow Y$ are p-maps, then $f : G \times X \rightarrow Y$ defined by $f|_{X_i} = f_i, 1 < i < n$, is a p-continuous map.

Proof. We have $G \times X = \bigcup_{i=1}^n X_i$ and $X_i \cap X_j = \emptyset$ for $i \neq j$. Thus f is a map. Let A, B be subsets of $G \times X$ and $A \delta B$. Then $A = \bigcup_{i=1}^n A \cap X_i = \bigcup_{i=1}^n A_i$, and $B = \bigcup_{j=1}^n B \cap X_j = \bigcup_{j=1}^n B_j$, say. For some i and $j, 1 < i, j < n, A_i \delta B_j$, i.e.

$P_k(A_i) \delta P_k(B_j)$ for $k = 1, 2$. But $P_1(A_i) = g_i, P_1(B_j) = g_j$ and $g_i \delta g_j$ if and only if $i = j$. Thus, for some $i, A_i \delta B_i$. Since A_i, B_i are subsets of X_i , under the hypothesis, $f_i(A_i) \delta f_i(B_i)$ or $f(A_i) \delta f(B_i)$. It follows that $f(A) \delta f(B)$. This proves the p-continuity of f .





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Theorem 4.3 Let (X, G, θ) be a PG-space, where G is a finite discrete p-group. Then the map $\tilde{\theta} : G \times \Psi X \rightarrow \Psi X$ defined by $\tilde{\theta}(g, \sigma) = \Psi T_g(\sigma)$, $g \in G, \sigma \in \Psi X$, is the unique extension of the p-action θ of X to ΨX .

Proof. Under the hypothesis on G , by Lemma 4.2, the map $\tilde{\theta}$ is p-continuous. Since $T_e = Id_X, T_{g_1} \circ T_{g_2} = T_{g_1 g_2}$ and Ψ as a functor preserves identities and composition, we obtain

$$\tilde{\theta}(e, \sigma) = \sigma$$

and

$$\tilde{\theta}(g_1, \tilde{\theta}(g_2, \sigma)) = \tilde{\theta}(g_1 g_2, \sigma).$$

Thus $\tilde{\theta}$ is a p-action of G on ΨX .

For a cluster σ of X , we have

$$\begin{aligned} \Psi T_g(\sigma) &= \{P \subset X : P \delta T_g(A), \forall A \in \sigma\} \\ &= \{P \subset X : P \delta gA, \forall A \in \sigma\} \\ &= \{P \subset X : g^{-1}P \delta A, \forall A \in \sigma\} \\ &= \{gQ \subset X : Q \delta A, \forall A \in \sigma\} \\ &= g\sigma. \end{aligned}$$

Moreover,

$$\begin{aligned} \tilde{\theta}(g, i(x)) &= \tilde{\theta}(g, \sigma_x) = g\sigma_x = \{gA : x \delta A\} = \{B : g \times x \delta B\} \\ &= i(gx) = i(\theta(g, x)) \end{aligned}$$

show that the diagram

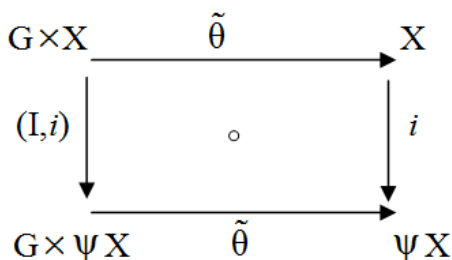


Fig. 5.1

commutes. Thus $\tilde{\theta}$ is a p-continuous extension of θ . Uniqueness follows from the identity $\Psi(G \times X) = G \times \Psi X$.





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Corollary 4.4 Let (X, G, θ) be a topological transformation group, where X is Tychonoff space and G is finite and discrete. Then θ extends continuously to the unique action θ_β on βX , where βX is the Stone – Čech's compactification of X .

Proof. If δ is the largest compatible proximity on X and ΨX is the Smirnov compactification on (X, δ) , then $\Psi X = \beta X$ and $\theta : G \times X \rightarrow X$ is continuous implies θ is p-continuous. Since $\beta(G \times X) = G \times \beta X = G \times \Psi X$, $\tilde{\theta}$ of Theorem 4.3 is the required action θ_β .

THEOREM 4.5 Let (X, G, θ) and (Y, G, θ) be PG-spaces, where G is finite and discrete. if $f : X \rightarrow Y$ is a p-continuous equivariant map, then its Smirnov extension $\Psi f : \Psi X \rightarrow \Psi Y$ is also equivariant.

PROOF. Note that for $g \in G$ and $\sigma \in \Psi X$,

$$\begin{aligned} \Psi f(g\sigma) &= \{P \subset X : P \delta f(C), \forall C \in \sigma\} \\ &= \{P \subset X : P \delta f(gA) = gf(A) \forall A \in \sigma\} \\ &= \{gQ \subset Y : Q = g^{-1}P \delta f(A), \forall A \in \sigma\} \\ &= \{gQ \subset Y : Q = g^{-1}P \delta f(A), \forall A \in \sigma\} \\ &= g\Psi f(\sigma). \end{aligned}$$

Proposition 4.6 The orbit space X/G of a PG-space X , with X , with G finite and discrete, is a dense subspace of the orbit space $\Psi X/G$.

Proof. The assertion follows from Proposition 3.5.

Theorem 4.7 For a PG-space X with G finite and discrete, $\Psi X/G$ is the Smirnov compactification of X/G . That is to say that $\Psi(X/G)$ and $\Psi X/G$ are p-homeomorphic and $\tilde{i} : \Psi(X/G) \rightarrow \Psi X/G$ is a p-homeomorphism, where \tilde{i} is the Smirnov extension Ψi of the p-continuous map $i : X/G \rightarrow \Psi X/G$ given by $i(Gx) = G\sigma_x$.

Proof. Since G is finite and discrete, $\Psi X/G$ is compact and Hausdorff. Therefore, by Proposition 3.5, it follows that $\Psi X/G$ is the Smirnov compactification of X/G . We proceed to show that \tilde{i} is a p-homeomorphism. Note that

$$(4.7.1) \quad i \circ \Pi_X = \tilde{\Pi} \circ i_X$$





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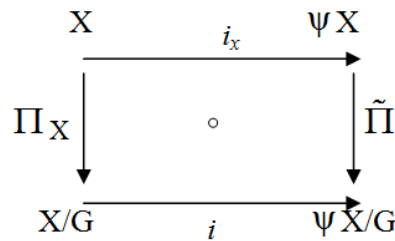


Fig. 5.2

where $\Pi_X : X \rightarrow X/G$ and $\tilde{\Pi} : \Psi X \rightarrow \Psi X/G$ are the orbit maps and $i_x : X \rightarrow \Psi X$ is the canonical p-embedding. We obtain the Smirnov extensions \tilde{i} of i and $\tilde{\Pi}_X$ of Π_X . Thus $\tilde{i} : \Psi(X/G) \rightarrow \Psi X/G$, $\tilde{\Pi}_X : \Psi X \rightarrow \Psi(X/G)$ are such that –

(4.7.2) $\tilde{i} \circ i_{X/G} = i$

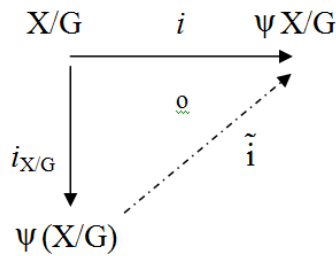


Fig. 5.3

and

(4.7.3) $i_{X/G} \circ \Pi_X = \tilde{\Pi}_X \circ i_x$

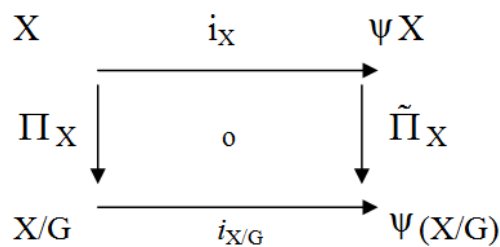


Fig. 5.4

where $i_{X/G} : X/G \rightarrow \Psi(X/G)$ and $i_x : X \rightarrow \Psi X$ are the canonical p-embeddings and $\Pi_X : X \rightarrow X/G$ is the orbit map. Composing with Π_X on both sides of (4.7.2), we get

$\tilde{i} \circ i_{X/G} \circ \Pi_X = i \circ \Pi_X$.





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Using equations (4.7.1) and (4.7.3), we obtain

$$(4.7.4) \quad \tilde{i} \circ (\tilde{\Pi}_X \circ i_X) = \tilde{\Pi} \circ i_X$$

Since X is dense in ΨX , we get

$$\tilde{i} \circ \tilde{\Pi}_X = \tilde{\Pi}$$

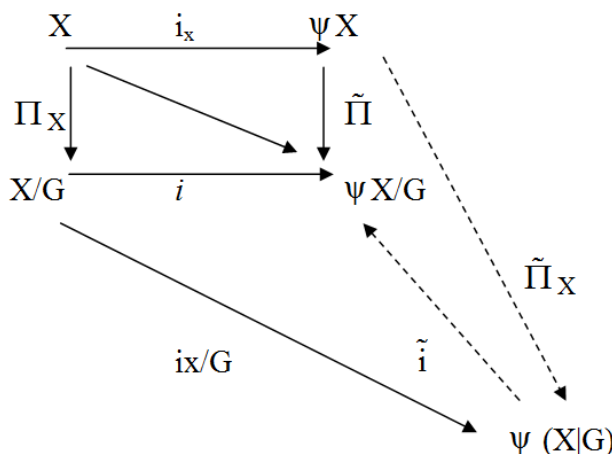


Fig. 5.5

Note that the map $\tilde{\Pi}_X$ is onto. Also, for $\sigma \in \tilde{\Pi}_X^{-1}(\rho)$, $\rho \in \Psi(X/G)$,

$$\tilde{i}(\sigma) = \tilde{i}(\tilde{\Pi}_X(\sigma)) = \tilde{\Pi}(\sigma) = G_\sigma$$

For $\rho_1, \rho_2 \in \Psi(X/G)$, $\tilde{i}(\rho_1) = \tilde{i}(\rho_2)$ implies that $G_{\sigma_1} = G_{\sigma_2}$, where $\sigma_1 \in \tilde{\Pi}_X^{-1}(\rho_1)$ and $\sigma_2 \in \tilde{\Pi}_X^{-1}(\rho_2)$. This gives that $\sigma_1 = g\sigma_2$, for some $g \in G$. Since $\tilde{\Pi}_X$ is equivariant, $\tilde{\Pi}_X(\sigma_1) = \tilde{\Pi}_X(g\sigma_2) = g\tilde{\Pi}_X(\sigma_2)$. Again, since the action on $\Psi(X/G)$ is trivial, we get $\tilde{\Pi}_X(\sigma_2) = \tilde{\Pi}_X(\sigma_2)$. Therefore $\tilde{\Pi}_X(\sigma_1) = \tilde{\Pi}_X(\sigma_2)$. Thus $\rho_1 = \rho_2$. This proves that \tilde{i} is one-one.

Let $G_\sigma \in \Psi(X/G)$, for $\sigma \in \Psi X$. Then $\tilde{i}(\tilde{\Pi}_X(\sigma)) = \tilde{\Pi}(\sigma) = G_\sigma$ proves that \tilde{i} is onto.

Thus \tilde{i} is a continuous bijection from a compact space $\Psi(X/G)$ to a Hausdorff space $\Psi(X/G)$. Hence \tilde{i} is a homeomorphism and therefore p-homeomorphism.

Orbits of Product Spaces

Let (X, G, θ_1) and (Y, G, θ_2) be PG-spaces with G finite and T_2 . The p-actions θ_1 and θ_2 induce a p-action θ on the product proximity space $X \times Y$ defined by $\theta(g, (x, y)) = (\theta_1(g, x), \theta_2(g, y))$. $(X \times Y, G, \theta)$ is called the product PG-space. The orbit maps $\Pi_X : X \rightarrow X/G$ and $\Pi_Y : Y \rightarrow Y/G$ are p-continuous, p-open and onto.





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Consequently the map $(\prod_X \times \prod_Y) : X \times Y \rightarrow X/G \times Y/G$ defined by $(\prod_X \times \prod_Y) (x, y) = (\prod_X(x), \prod_Y(y))$ is p-continuous, p-open and onto.

Theorem 5.1 If X and Y are PG-spaces with G finite and discrete, then $\prod_G(G(x,y)) = (Gx, Gy)$ defined a map on $(X \times Y)/G$ to $(X/G \times Y/G)$ which is onto, p-continuous and p-open.

Proof. Since $G(x_1, y_1) = G(x_2, y_2)$ implies $(x_1, y_1) = g(x_2, y_2)$ for some $g \in G$, $x_1 = gx_2$ and $y_1 = gy_2$. Therefore $Gx_1 = Gx_2$ and $Gy_1 = Gy_2$ and hence $\prod_G(G(x_1, y_1)) = \prod_G(G(x_2, y_2))$. Thus \prod_G is a map. By definition \prod_G is onto.

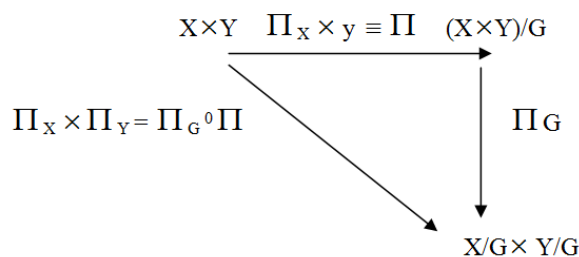


Fig. 5.6

Let $\prod_x : X \rightarrow X/G$, $\prod_y : Y \rightarrow Y/G$ and $\Pi \equiv \prod_X \times \prod_Y : X \times Y \rightarrow (X \times Y)/G$ be orbit maps and let \prod_1, \prod_2 be the first and second projections from the product space $X/G \times Y/G$ to its factor spaces. For the p-continuity of \prod_G , it is sufficient to show that $\prod_1 \circ \prod_G \equiv \prod_{G_1}$ and $\prod_2 \circ \prod_G \equiv \prod_{G_2}$ are p-continuous.

The p-continuity of \prod_{G_1} requires, for $G_A, G_B \subset X/G$,

$$G_A \ll G_B \Rightarrow \prod_{G_1}^{-1}(G_A) \ll \prod_{G_1}^{-1}(G_B).$$

By definition.

$$\prod_{G_1}^{-1}(G_A) \ll \prod_{G_1}^{-1}(G_B)$$

If and only if for binary rational s, t in $(0, 1)$, $s < t$, there exist subsets C_s, C_t of $(X \times Y)/G$ such that

$$\prod^{-1}\{G_{(x,y)} : x \in G_A\} \ll \prod^{-1}(C_s) \ll \prod^{-1}(C_t) \ll \prod^{-1}\{G_{(x,y)} : x \in G_B\},$$

or

$$(5.1.1) \quad \bigcup_{x \in A} G_x \times Y \ll \bigcup_{x \in C_s} G_x \times Y \ll \bigcup_{x \in C_t} G_x \times Y \ll \bigcup_{x \in B} G_x \times Y.$$





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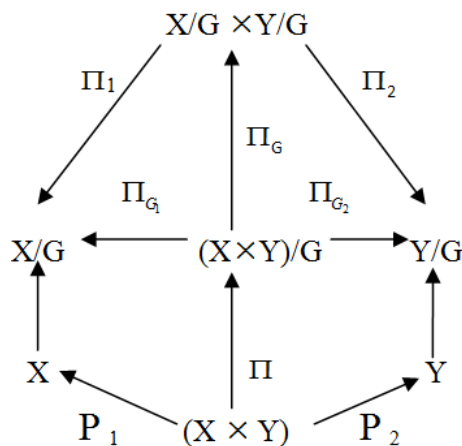


Fig. 5.7

Also, $G_A \ll G_B$ if and only if for binary rationals $s, t \in (0, 1)$, $s < t$, there exist subsets C_s, C_t of X/G such that

$$\Pi_X^{-1}(G_A) \ll \Pi_X^{-1}(C_s) \ll \Pi_X^{-1}(C_t) \ll \Pi_X^{-1}(G_B),$$

or

$$\bigcup_{x \in A} G_x \ll \bigcup_{x \in C_s} G_x \ll \bigcup_{x \in C_t} G_x \ll \bigcup_{x \in B} G_x$$

Using the p-continuity of $\langle P_1 \rangle$, we obtain

$$P_1^{-1}\left(\bigcup_{x \in A} G_x\right) \ll P_1^{-1}\left(\bigcup_{x \in C_s} G_x\right) \ll P_1^{-1}\left(\bigcup_{x \in C_t} G_x\right) \ll P_1^{-1}\left(\bigcup_{x \in B} G_x\right),$$

or

$$\left(\bigcup_{x \in A} G_x \times Y\right) \ll \left(\bigcup_{x \in C_s} G_x \times Y\right) \ll \left(\bigcup_{x \in C_t} G_x \times Y\right) \ll \left(\bigcup_{x \in B} G_x \times Y\right).$$

By (5.1.1), this proves the p-continuity of the map Π_{G_1} . The p-continuity of the map Π_{G_2} follows similarly.

Therefore the map Π_G is p-continuous.

Recall that the map Π_G is p-open if and only if, for subsets G_A and G_B of $(X \times Y)/G$, where $A, B \in P(X \times Y)$

$$G_A \ll G_B \text{ implies } \Pi_G(G_A) \ll \Pi_G(G_B).$$

Let $G_A \ll G_B$. Then, from the p-continuity of the orbit map $\Pi_{X \times Y}$, we get

$$\Pi_{X \times Y}^{-1}(G_A) \ll \Pi_{X \times Y}^{-1}(G_B).$$

Since the map. $\Pi_X \times \Pi_Y$ is p-open, we obtain





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$$(\prod_x \times \prod_y) \circ \prod_{X \times Y}^{-1} (G_A) \ll (\prod_x \times \prod_y) \left(\prod_{X \times Y}^{-1} (G_B) \right)$$

By the commutativity of the diagram 5.6, we obtain

$$\prod_G \left(\prod_{X \times Y} (\prod_x \times \prod_y^{-1} (G_A)) \right) \ll \prod_G \left(\prod_{X \times Y} (\prod_x \times \prod_y^{-1} (G_B)) \right)$$

Since $\prod_{X \times Y}$ is onto, we get

$$\prod_G (G_A) \ll \prod_G (G_B).$$

Therefore the map \prod_G is p-open.

Theorem 5.2 if X and Y are PG-spaces with G finite and discrete, and the p-action of G on X is trivial, then $(X \times Y)/G$ is PG-homeomorphic to $X/G \times Y/G$.

Proof. In view of Theorem 5.1 it suffices to show that the map $\prod_G : (X \times Y)/G \rightarrow (X/G \times Y/G)$ defined by $\prod_G (G_{(x,y)}) = (G_x, G_y)$ is injective.

For $(x_1, y_1), (x_2, y_2) \in (X \times Y)$, $\prod_G (G_{(x_1, y_1)}) = \prod_G (G_{(x_2, y_2)})$ implies that $(G_{(x_1, y_1)}) = (G_{(x_2, y_2)})$.

Therefore $x_1 = x_2$ and $y_1 = g y_2$ for some $g \in G$. Thus $(x_1, y_1) = g (x_2, y_2)$ for some $g \in G$ and hence $G_{(x_1, y_1)} = G_{(x_2, y_2)}$.

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Role of Social Media in Promoting Peace and Peace Education

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ABSTRACT

Education is the means to generate individuals with self-confidence and authorize them by consciousness to live with respect and pride in peace and harmony with all. If we wish to create a peaceful environment and harmony within human societies which we need, Peace education becomes very essential. Education is only possible when there is a peaceful environment. Now the question arises how and who can make a peaceful environment in the present time. It is the responsibility of educated youth and also it is the responsibility of social media with which our youth are connected. This article enhances the progression of peace education and peace in the present scenario. It concludes with recommendations to boost the success and visibility of this work and to prop up peace education in India. In the present time role of social media in promoting peace, and education is necessary.

Keywords: Media, social media, Peace, peace Education, Conflict

INTRODUCTION

Social media has long been used as a power tool in the field of peace education with even the United Nations (UN) making use of several social media platforms including Facebook, Twitter, and Instagram to not only highlight their work in the field but also to help convey their pertinent messages to the world. In 2021 there were an estimated 4.55 billion social media users in the world according to the annual Global Digital. When used correctly, social media can be used with great success in terms of peace promotion. Media plays an important role in communication through a mass communication medium, provides information to the public, creates awareness among the public, and educates the common man. Especially at the time of communal riots and wars, media is thus one of the principal



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agents for societal development, democracy, and good governance. Media can be an instrument for peace and conflict management, which promotes messages and strategies that can lead to peaceful agreements and tolerant behavior in a given society. Policymakers, journalists, and social scientists are involved in creating peace. These advances, such as printing, the telegraph, the telephone, the radio, television, the computer, and the internet, however, were in large part also touted as promoting understanding and even peace. A government could use the media to help defuse crisis social media has changed the resources available to engage conflict parties, civil society, peace activists, and the universal public in large-scale peace and war efforts. It has created opportunities in the early stages of the peace process, including assistance in data collection and analysis, strengthening peace, messaging, and an array of dialogues. But it also brings dangers. vicious conflicts have become increasingly complex and protracted, and more difficult to prevent or resolve. Information and communication technology, including social media, has added complexities in new ways. Social media can create new rankings by discounting access to the Internet or promoting propaganda and hate speech.

Social media may be used efficiently, in promoting peace education across the world through meaningful communication which can nurture the universal values and behaviors in people on which a culture of peace is predicted. Peace education could be measured as a social process, through which peace is accomplished. It includes the learning skills of non-violent conflict resolution and respect for human rights. Peace education needs to be included in the curriculum and should carry forward from the primary stages to higher education. ICT offers immense opportunities to make the process of teaching and learning about peace more effective and valuable. Efficient use of ICT in teaching and also learning peace education will provide abundant information which could act as a medium for both personal and national development. The thought of peace building through ICT brings to mind the perception of customized messages to meet specific needs or solve particular problems. The current generation is at ease with rapidly changing technology as technology is all-pervasive with smartphones in the pockets of today's youth. As a valuable goal of humanity, peace has to be accomplished and in all possible ways.

Peace and Peace education

Peace is an occurrence of harmony characterized by lack of violence, conflict behaviors and the freedom from fear of violence. Commonly understood as the absence of hostility and retribution, peace also suggests sincere attempts at reconciliation, the existence of healthy or newly healed interpersonal or international relationships, prosperity in matters of social or economic welfare, the establishment of equality, and a working political order that serves the true interests of all.

Peace education is a process of attaining the values, gaining the knowledge, and mounting the attitudes, skills, and behaviors to live in peace and harmony with oneself, others, and the natural environment. Social media deviates the way of people; especially young people perceive the world, communicate and interact.

Role of social media in promoting peace:

Social networking sites are created to help in online networking. These sites are generally communities created to support a common theme. Since the creation of social media such as Facebook, Myspace, LinkedIn, Instagram, google meet, skype providing individuals opportunities to meet new people and friends in their own community, country and across the world. In India there are diversity of religions, communities, languages social media did a great role in providing peace and bind them in a single rope of love and harmony. Information distribution across the internet and social media, telling their stories which may gain world-wide recognition and turn viral, as many videos on the internet have. Locally, we expect that recipients of this effort will spread information and stories about peace through word-of-mouth to others in the community, creating a buzz that will bring peace on local and national level. Communication, using interpersonal contacts, emails, blogs, the dominant social media Facebook, Twitter and YouTube, and mobile applications. Conventional internet emails and blogs for long-term sustainable relationships between our clients and government officials for peace.

Social media Facebook for maintaining communications and building "friends" and groups who share peace building information and ideas. Twitter for engaging individuals and groups across borders, and for gaining recognition for



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achievements in peacebuilding. YouTube for video distribution, sharing stories for peace building. Mobile applications that will give ensure instant access among the people for peaceful coexistence. social media can provide lists with photos, reports, and videos in their places, these sources can affect the balancing of the reports, as it can be from one side against the other which can affect the peace process.

Need/Rationale

Social media are the platform where people across borders can communicate and discuss common themes, topics and ideas. This communication and discussion help in building relationships between one community with another community, state to another state, and country to another country. Mostly the young educated generation is connected with social media it is their responsibility to foster peace with each other. Steady advances in ICT propelled education and expansions of new media of communication have enhanced expectations of laymen in almost all spheres of their activities, including long-lasting peace. ICT offers enormous opportunities to make the teaching as well as the learning process smooth towards peace. Efficient use of ICT in teaching and also learning peace will provide abundant information which could act as a catalyst for both personal and national development.

The thought of peace building through ICT brings to mind and provides the notion of customized messages to meet specific needs or solve particular problems. The current generation is at ease with rapidly changing technology as technology is all-pervasive with smartphones in the pockets of today's youth. The quintessence of using digital media is to communicate peace. As a valuable goal of humanity, peace has to be accomplished and sustained in all possible ways. Technology and social media may be used effectively, in promoting peace and peace education across the globe, have meaningful communication, and nurturing the universal values and behaviors in people on which a culture of peace through peace education is predicted.

Review of Related Literature

Social media plays an important role to promote peace and harmony. Print media, electronic media and web media provides foster to that news which is useful for promoting peace. During conflicts, Andolans and so, wars, media spread the message of peace. Whenever there comes the barrier in relation between India and Pakistan, social media published news related to shantivarta, for development of peaceful relation. Social media in India always takes a stand for promoting peace and harmony with other countries. Social media played a central role in building a better relationship among individuals, communities, and countries. A number of articles, editorials, and columns features are frequently published in newspapers, magazines and blogs by various web portals for advancing peace. In social media different panel discussions are planned by the government, private TV channels, and radio for promoting peace. During the Mumbai attack, Godhra, Ram Mandir, Babri Masjid, and other communal riots, the media took precautions against publishing disheartening news, and photographs and broadcasting aggressive visuals on TV channels and radio. They only broadcasted useful news about the same. Media is also aware and poses information about the possibilities of terrorist attacks. Media also broadly covers nonviolence as the birthday of Mahatma Gandhi on the 2nd of October every year. Media also covers various symposiums, seminar conferences, workshops, cultural activities, and other kinds of events on nonviolence, which are organized by various religious, social, educational, national as well as national organizations and institutions. So, we can say media plays a positive role in promoting love, peace, happiness, bliss and purity.

SOCIAL MEDIA AS A SPACE FOR PEACE EDUCATION

Social media is a place for peace and social self-renewal, we are well aware that the same place is being used to recruit young people, spread hate messages and writings and spread their violent ideologies among other violent groups. ISIS is an important issue they have skillfully used social media to engage young people from almost all parts of the world, including Canada. It has also used social media to spread fear and violence (Blaker, 2015; Farwell, 2014). The limitations of social media were also clear on numerous levels during the so-called Arab Spring (Arshad-Ayaz, 2014). However, we know that whenever the advances in social media and the social rejuvenation of peace building through them cannot be as rapid and astonishing as the use of social media by extremists and haters, now it is also a place where there are peaceful social bridges where citizens can and do emerge.



**Ishfaq Bashir and K.Raveendran****Youth, Technology, and Peace**

Though technology is for all, the involvement of youth with technology is probably insurmountable. Youngsters and technology are considered to be thoroughly entwined and interrelated. The innovative skills of youth stand them in good stead for utilizing the power of these media and mechanisms to create a better society with improved systems. Be it social welfare, economic upheaval, or political processes, the youth can be seen everywhere making apposite use of ICT and social media. But the fact remains that the youth are also the worst affected when it comes to the drawbacks of technology. Dangers of being involved in cybercrime, mental harassment, persecution on political and religious lines, cyber-bullying, threats and lures from organized crime and other extremist groups, are rife for the youth who may possibly constitute the largest chunk of social media users. Specifically in regions marred with constant conflicts, the youth exhibit a greater proclivity towards being recruited to a life of crime, in recent times, more a game played by social media. While it poses a risk, on the contrary, it also holds the power to mitigate risk and spread peace and tranquility, provided its potential is exploited with care. Indeed, in a bid to make the youth truly participate in peace building, it would be essential to integrate them into the broader policy-making. Today, even though policymaking is driven by the public opinion generated through the influence of messages targeted through social media, the youth become vital to the process.

social media can be profound in enhancing the awareness of youth vis-à-vis the need for peace at the local as well as global level. The hate campaigns, the trolling, and other such activities aimed at disrupting societal peace can be overcome to a large extent by the integration of youth.

Social media users

In world 4.66 billion were active internet users as of October 2020 which is 59% of global population. The smart phones user in world estimated to reach over 3.8 billion in year 2021. The mobile smart phones users in India were estimated to reach over 760 million in 2021. As social media expert Craig Smith says, Facebook has become a continent on its own, with roughly 2.8 billion monthly active users and near about 1.69 billion Facebook users are right now in world. In India near about 320 million are using Facebook in year 2020. Google+ has 1.5million active users right now, Twitter pulls 340 million in 2024, and there are 2 billion YouTube users in world. This shows just how many people's lives are influenced by social media and online engagement

**Facebook in promotion of peace**

They are so many of pages related peace on Facebook such as "peace has 172 thousand followers, peace having 1.1m followers. Facebook takes on peace tracks and smoothes the ways towards peace. Social media connections bridging ethnic or religious divides — between, Christians and Atheists, Sunnis and Shiites, and, Israelis and Palestinians just to name a few. With 2.8 billion Facebook users, is already showing to be a fascinating, real-life laboratory. Complete with line graphs, the site continuously flashes different data points collected over the last 24 hours: 9,401 Albanian-Serbian connections, 8,039 India-Pakistan connections, 82,555 Muslim-Christian connections, and even 31,518 Republican-Democrat connections here in the United States. The numbers are high enough to make an impression

Facebook, Stanford asks — can social networking promote world peace?

Facebook launches portal to promote world peace <http://techxav.com/facebook-peace/>

In an effort to bring together conflicting sides in some of the most bitterly divided areas of the planet, cheering online friendships between Indo-Pak people. Jews and Muslims, Turks and Greeks and US liberals and conservatives, social networking giant Facebook launches the "Peace on Facebook" hub as a part of the "Peace Dot" movement. The Internet Company believed it's passionate about "promoting peace by building technology that helps people better understanding each other" and "by enabling people from varied backgrounds to easily communicate and share their ideas, we can decrease world conflict in the short and long term.

The Peace on Facebook website features several interesting graphs and a live stream widget which allows Facebook users to share their opinions and thoughts about peace. This chart highlights the volume of friendship connections



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created each day between people of different countries, religions, and political groups. In the past 24 hours, the site revealed that there had been 5,189 Israel-Palestine connections; 8,088 Albania-Serbia connections; 6,809 India-Pakistan connections, and 12,824 Greece-Turkey Connections. Surprisingly, according to the results of Facebook's daily poll, only 8.97% U.S users believe world peace is achievable within 50 years. Meanwhile, 35.0% and 29.5% users from Colombia and Taiwan are optimistic. In addition to the data of online friendships, Facebook also search results to the assessment question (asked 500 users of Facebook every day) "Do we think we will accomplish world peace in 50 years?" Right now, only 7 percent of U.S. respondents replied "yes." The figure is higher in all of the other polled countries, with Colombia at 38 percent. Notably, the most developed nations — the U.S. and Germany — have the least reported faith in world peace, while Egypt and Colombia have the highest. Other features on Facebook are designed sites that include a series of comments on the project, which are updated every 10 seconds by Facebook users. Most of them are positive: "show your brothers as you love your loved ones and yourself and PEACE is possible" and "Think this is the next generation of the peace movement." There is also a link to a good, fan page for Facebook, a group that reports in various ways that Facebook has been helped to do good deeds, such as searching for a lost thing or forming a support group. On April 1 each year, the One Billion Acts of Peace campaign reviews every Act of Peace that has been added to our website in the past year. The Website look at the impact and scope of each Act, and 10 are chosen as the Billion Acts Hero Award semi-finalists representing 5 categories: Best Non-profit Act.

Best Youth Act Best University Act Best Business Act Best Up and Coming Peacemaker Beginning in mid-April, all 10 semi-finalists are featured on this website and social media channels reaching more than 1 million worldwide for one month giving supporters and peacemakers worldwide the chance to learn more about each, and cast their votes for their favorite Acts, projects, and initiatives. Voting for an act rises a semi-finalist's "impact rank", but impact only counts for half of the award, the other half of the award is juried by the Nobel eminent serving on our board. During the month of May, five winners are selected by our Board representatives based on the impact rank and merit of each project. Our Board consists of 13 Nobel Peace Prize Winners. Five of the projects are awarded and then privileged at the Hero Awards ceremony in MonteCarlo in June, receiving their Hero Award from a Nobel Peace Laureate. This year's honored guest Laureate is Oscar Arias!

**Twitter**

Twitter is an online news and social networking service Founded: 21 March 2006, San Francisco, California, United States through which sophisticated users post and interact with messages, "tweets," restricted to 140 characters. There is a page of Peace and Justice Institution on Twitter on which people can post quotes for promoting peace, upload videos which spread harmony, and follow the campaigns promoting peace.

**You Tube**

YouTube is an American online video-sharing whose headquarter is in San Bruno, California, created in February 2005 by three former PayPal employees namely Jawed Kareem, Steven Chen, and Chad Hurley. On YouTube, there are a lot of videos, channels and webinars related to peace and peace education.

**WhatsApp Messenger**

More than 1.5 billion people in over 180 countries uses WhatsApp to stay in touch with friends, class fellows, teachers and family. They can share messages, photos, videos anytime and anywhere through WhatsApp. And remains in touch with the groups of people that are most valuable for user, like your family or co-workers. With group chats, you can share messages, photos, and videos with up to 256 people at once. You can also name your group, mute or customize notifications, and more. Message your friends, class fellows, teachers and family and your loved ones for free. With WhatsApp, photos and videos send quickly even if you're on a slow connection. This App is not only helpful in sharing information but is very helpful in various educational purposes for example sharing information among educationists through groups. It is very popular these days the sharing of messages, lessons,



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quotes of great personalities, pictures and videos and even animations among young people through this App. So this is very helpful in Sending Messages of Peace, harmony and unity. Because through these App we can reach large population in a very short of period time.

SOCIAL MEDIA AND CONFLICT PREVENTION**Pre-Conflict**

Peace is directly correlated to conflict, in that, the need for peace is the most where conflict prevails. Peace-keeping and –building operate at different levels considering the prevalent conditions, as to whether it is a pre-conflict or post-conflict situation. Before a conflict is triggered, there can be measures directed at preventing such a thing from happening. The possible roles that social media can play in conflict prevention have been discussed by Betz (2018) as

- Bring together different groups for discussion
- Help improve governance
- Increase knowledge of complex issues
- Provide early warning
- Outlet to express emotions
- Motivator for peace One of the best examples of social media fomenting mutual discussion and dialogue across different ethnicities is that of Iraq, where SalamShabab.com (Peace Youth) - the first real-life TV program for youth in Iraq, complemented by a website and Facebook group of about thirty thousand active users - registered a change in behavior regarding ethnic tolerance among them. (Zenko, 2013)

Post-Conflict

Research establishes that modern digital media (interactive systems with audio-visual and textual components), which are the quintessential elements of social media, are yet to be applied with full force in the social media enabled peace processes. Best, Long, Etherton & Smyth (2011) capture how the rich digital media have been used by Liberia, a country that emerged from a long-drawn civil strife. They conclude that through the use of these media to foster reconciliation and trigger process of truth, the citizens experienced a feeling of self-efficacy, which ensues forgiving, healing and development of understanding. Thus, social media can effectuate peace in true sense in post-conflict situations. Baitiyeh (2019) asserts that conflicts have a direct bearing upon the social and economic capital. In conflict-prone settings, social media is addressing the issues of bridging gaps and stimulating dialogue, thus supporting communities in post-conflict recovery. Although the use of social media is continuously on the rise, yet its efficacy in peace initiatives so far remains largely unexplored. Acting as a great unifying factor among groups, it has also been found beneficial in helping handle mental health issues like Post-Traumatic Stress Disorder (PTSD), which are very common in residents of conflict-battered regions.

CONCLUSION

As a social media user, you have the power to manipulate a lot of people with what you post. One of the biggest evils of social media today is one who breeds the most hatred and spreads fake news. Social media can contribute to peace and peace education by engaging incredible representation and representing balance opinions on its page, content, article, audio, and videos and by opening up communication platforms among parties in conflict. Social networking with all its means and type can do a significant role and can influence the conflict area positively by applying its influence towards ending the conflict and enhancing the peaceful environment, promoting peace, and driving youth toward peace. Information distribution on the internet and telling the stories which may gain global recognition will spread information about peace through word of mouth to others in the community, creating a buzz that could bring peace on local and national level. While the topic of peace is often considered highly emotional, you don't always have to feel compelled to use social media as an affecting medium. Instead, it is important to deliver dynamic, personalized messages to people at appropriate times. When it comes to social media, visually engaging content is much more popular than text-based content. Instead of posting a long story on Facebook, record a video to post on YouTube. All you need is a good video recorder and a heartfelt, clear message to resonate well with your





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target audience. In the case of Facebook, you can either join existing communities focused on peace education or try to create your own. This can be achieved by creating a global message across all platforms, either by creating Facebook pages or Facebook groups or by linking to your other social media accounts. Political media is a very powerful tool and whether it is natural Good or bad is considered entirely up to you how you use it. By combining your passion with the power of social media, you can reap great benefits in bidding to promote peace education among the people.

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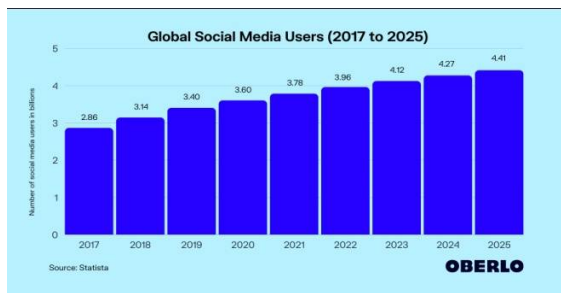


Fig.1. Global Media Source

Is World Peace Possible?

Every day, we ask thousands of people on Facebook:

“ Do you think we will achieve world peace within 50 years? ”

In the U.S., **8.97%** believe that we can. How can we grow this number?

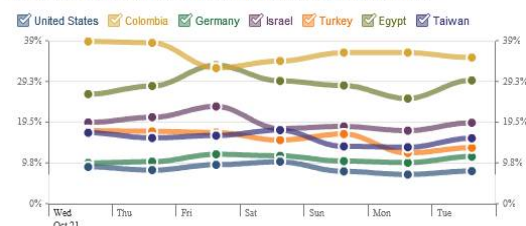


Fig.3. Peace on Facebook website features



Fig.2. Facebook in promotion of peace

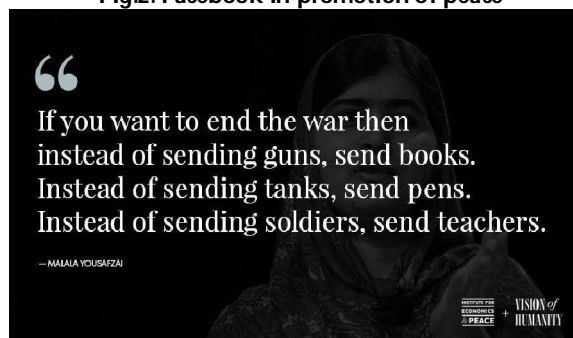


Fig.4.





Assessment of Microbial Biomass Carbon and Physico-Chemical Properties from Secondary Forest to Oil Palm (*Elaeis guinensis*) Plantation in Kolasib District, Mizoram

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ABSTRACT

Slope position is one of the important factors in determining the local spatial variation of soil characteristics. The aim of this study is to examine the effects of slope gradient and land use changes from secondary forest to oil palm plantation on soil microbial biomass carbon (MBC) and physico-chemical properties and also to provide the basic information about the soil fertility status. Soil sampling was carried out in November 2017 at Khamrang village, Kolasib District using standard protocol. Soil samples were taken at a depth of 0-5cm, 5-15 cm for three different slopes, Upper (U), Middle (M) and Lower (L). Higher concentration of MBC and other physico-chemical properties was observed in forest soil than oil palm soil. Bulk density (BD) increases down the slope on both study sites and pH of forest is fairly acidic than oil palm, values ranging between 4.58-4.91. All soil properties were significantly affected by slope gradient, therefore, there is need to manage parts of oil palm plantation on different topographic positions differently, taking cognizance of variations in soil properties in order to ensure long term sustainability.

Keywords: oil palm, microbial biomass carbon, soil fertility, slope gradient

INTRODUCTION

Oil palm (*Elaeis guinensis*) is one of the world's number one fruit crop according to Reiger [1]. It was estimated that more than 95% of oil palms grown in South East Asia are on acid, low fertile and highly weathered soils [2]. Soils are characterized by high degree of spatial variability due to the combined effects of physical, chemical or biological processes that operate with different intensities and at different scales [3]. Soil physical properties such as depth,

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available nitrogen, phosphorus, potassium (NPK), pH, bulk density (BD), soil organic carbon (SOC), microbial biomass carbon (MBC) are major determinants of suitability for large-scale oil palm planting. Oil palm requires a large amount of nutrients from the soil to grow and develop properly. This causes excessive nutrient removal from the soil, resulting in a decrease in soil fertility. Some studies have shown that the availability and use of inorganic and organic fertilizers was low, especially on large plantation farms. As a result, the decline in soil fertility in oil palm plantations is widespread. [4, 5]. Land use change from forest to plantations has a significant effect on soil quality status. With the introduction of oil palm plantation in an objective to reduce shifting cultivation under the New Land Use Policy (NLUP) from the year 2005 by the Govt. of Mizoram, little is known on its effect on soil. Therefore, the main objective of this study was to evaluate the fertility status of oil palm plantation in Kolasib district, Mizoram for better understanding of environmental effects.

MATERIALS AND METHODS

Study Area

Kolasib district is located in the state's northernmost regions, bordered on the south and east by Aizawl district, the west by Mamit district, and the north by Assam state. The district's geographical area is 1382.51 square kilometres. It is located between the latitudes of 23° 5' and 24° 35' N and the longitudes of 92° 3' W – 93° E. The tropical monsoon climate zone encompasses Kolasib District, which is subject to direct monsoon impact. The average annual rainfall is 2703 mm. Temperatures range from 11 to 34 degrees Celsius with no extremes (average). The relative humidity ranges between 69 and 80 percent.

Selection of sampling sites

15 years old Oil Palm Plantation located at Khamrang village, Kolasib District and secondary forest (control) which have been left undisturbed for about 30 years near the experimental plot was selected.

Soil Sampling

Soil samples were taken from three places in a 'triangle' shape at a depth of 0-5cm, 5-15cm for three different slope position of upper, middle and lower with an auger in the post-monsoon season (November 2017). The temperature of the samples was maintained by transporting them in a sterile plastic bag in an insulated ice box. A portion of the freshly obtained soil samples was immediately placed in a refrigerator (4 °C) for microbiological and biochemical analysis. The remainder of each sample was air dried at room temperature and hand-sieved through 2mm sieve (0.2mm sieve for SOC detection) for analysis of physical-chemical properties.

Laboratory Analysis

The soil samples were analysed following standard laboratory procedures. Briefly, soil bulk density was measured using Core Method [6]. Soil pH was measured in a soil-water suspension (1:2.5 soil-water ratios) with pH meter. The wet-oxidation technique of [7] was used to determine the soil organic carbon (SOC). The Alkaline Potassium Permanganate technique was used to determine the available nitrogen [8]. The exchangeable/available potassium was determined using the neutral 1N ammonium acetate extraction technique [9]. The amount of phosphorus that was available was calculated using [10]. Microbial Biomass Carbon (MBC) was analysed using Chloroform fumigation method [11] and soil moisture content (SMC) was determined by the Gravimetric Method [12].

RESULTS AND DISCUSSION

The results are the mean of three replicates. Bulk density (BD) was found higher in oil palm plantation site than secondary forest, and increases with increasing depth on both sites. Maximum density was found on the lower slope of oil palm (1.29g/cm³) and lowest density on the upper slope on forest site (1.16g/cm³). Soil moisture content (SMC) decreases as we go down the slope on both sites. SMC was found highest in the upper slope of oil palm and lowest in lower slope of forest, values ranging 26.35% and 25.01% respectively. The soils were found to be acidic in nature, values ranging between 4.58 -5.21. The pH in forest was more acidic as compared to oil palm site. The highest was



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seen in lower slope of oil palm and lowest in upper slope of forest. Available nitrogen (N) increases with increasing depth on both sites, and was seen higher in forest than oil palm. N value was seen highest in the lower slope of forest and lowest in upper slope of oil palm, values ranging 76.01kg/ha and 55.33kg/ha respectively. The amount of available phosphorus (P) was found to be higher in the forest than in the oil palm. The highest value (38.58 kg/ha) was found on the middle slope of a forest, while the lowest value (13.58 kg/ha) was found on the middle slope of an oil palm. Available potassium (K) decreases with increasing soil depth, and was found higher in forest soil than oil palm soil. Highest K value was observed in the upper slope of forest (814.8 kg/ha) and lowest in lower slope of oil palm (394.81kg/ha). The maximum level of soil organic carbon (SOC) was found on the higher slope of the forest (1.45%) and the lowest level was found on the lower slope of the oil palm (0.72%). Microbial biomass carbon (MBC) was found to be significantly higher in forest soil than in oil palm soil, and its value decreased as the slope was climbed. The maximum concentration was observed on the upper slope of the forest (533.81 mg/kg) and the lowest concentration was found on the middle slope of the oil palm (289.05 mg/kg).

Soil bulk density (BD) is an important soil physical parameter of soil structure. Increasing soil bulk density may indicate the loss of soil organic matter [13]. Having high bulk indicates low soil porosity and compaction, which may impede root growth and restrict air and water movement. Higher BD was observed in oil palm than forest soil, it is likely that the conversion of natural forests to plantations resulted in the loss of soil organic matter that caused a higher bulk density in the plantation soils. Soil BD under the two land use system was found to be less than 1.6 g/cm³, which indicates that the soils are not compacted [14]. Soil moisture content (SMC) was found to be slightly higher in forest because of the presence of fully and partially decomposed litter covers over the soil. SMC also decreases as the slope increases on both study sites. Several studies have also found a decrease in soil moisture content with the increase in soil depth, such as [15-17]. Soil pH measures the activity of the hydrogen ion (H⁺) and hydroxyl ion (OH⁻), which indicates whether the soil is acidic, neutral or alkaline in reaction [18]. pH on both study sites are acidic in nature, this may be due to the acidity of mother rock coupled with high rainfall causing intensive leaching of bases.

Plants require a fairly large amount of nitrogen to develop, which explains why a lack of nitrogen limits plant growth more than any other nutrient. We observed a higher value of available nitrogen (n) in forest than in oil palm soil. The application of nitrogen fertilizers and organic resources (compost, manure) is one key to increasing the soil N content of oil palm soil. Phosphorus (P) plays an important role in energy transformations and metabolic processes in plants [19]. We observed a higher value of P content in forest which may be due to rapid recycling of nutrients by decomposition and mineralization of litters. Potassium (K) is one of the three major nutrients required for the growth of biomass in plants. It is a major mineral that exists within soil and plays a major role in plant growth [20]. We observed a fairly higher value of K in forest soil than oil palm soil, this may be due to plant materials that has decayed replenishes soils with a large amount of potassium ions. As a result, if a soil is amended with a large amount of compost, naturally, higher concentrations of organic matter and nutrients in the soil of forest. However, the available K content was sufficiently high on both soils of the studied land uses.

Soil organic carbon (SOC) is one of the most important indicators of soil quality and fertility. Our findings suggest that conversion of forests to oil palm plantations is associated with a decrease in SOC. Guillaume *et.al* [21] reported the SOC stock under a 14 year old oil palm plantation to be 42% lower compared to a forest in Indonesia. We observed a higher concentration of SOC in forest soil, this is due to a denser canopy and a higher input of litter, which results in maximum carbon stock storage. And higher concentration was observed on the upper layer on both study sites, this is due to rapid decomposition of forest litter in a favourable environment and less influence of parent materials. The higher concentration of soil organic carbon in top layer has also been reported by various authors [22, 23]. The high contents of MBC generally indicate better soil quality. The results of many studies showed a close relation between MBC and SOC because most microorganisms are heterotrophic and their distribution and biological activity often depend on organic matter [24, 25]. Landgraf and Klose [26] found that carbon source that easily decomposes, such as glucose and sucrose, could make the soil microorganism rapidly propagate and increase activity, suggesting that the MBC content is effectively limited by SOC. In this study, we observed a significantly higher concentration of MBC in forest soil than oil palm plantation which could be attributed to increased litter



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input, which raises the C and N content relative to the plantation. SOC, MBC had the highest weight suggesting that they are one of the most important parameters for soil quality discrimination. Lower concentration of MBC in oil palm may be due to disturbances like burning activities, the capacity of microbes to maintain the MBC: SOC ratio decrease. On both plantation sites, MBC content decreases with soil depth, implying an obvious surface accumulation of soil microbial biomass carbon.

CONCLUSION

According to the findings of this study, changing land use from native forest to monoculture of oil palm plantation has a significant impact on soil physico-chemical properties. Changes in land use also affect soil microbial activity and were significantly affected by slope position. The decline in quality of soil properties was observed from upper to lower gradient. Our findings showed that slope aspect in relation to different land uses could be a useful reference for land management strategies in the context to sustainable development. The study indicates that, to some extent, a close relationship between soil microbial biomass carbon and soil physico-chemical properties exist and partially reflect the quality of the soil status.

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Table 1: Mean and standard errors of selected soil properties of secondary forest and oil palm plantation under different slope gradient.

Soil Properties	Slope Gradient	Forest	Oil Palm
Bulk density (g cm ⁻³)	upper	1.16±0.02	1.25±0.02
	middle	1.17±0.03	1.27±0.02
	lower	1.18±0.01	1.29±0.01
Soil Moisture Content(%)	upper	28.69±0.20	26.35±1.57
	middle	27.55±2.48	25.76±1.05
	lower	25.77±0.64	25.01±0.66
pH	upper	4.58±0.02	5.20±0.03
	middle	4.68±0.01	5.16±0.03
	lower	4.91±0.07	5.21±0.05
Available Nitrogen(kg/ha)	upper	60.33±3.2	55.33±2.03
	middle	65.50±1.3	61.16±3.90
	lower	76.01±1.5	67.83±2.60
Available Phosphorus(kg/ha)	upper	28.28±3.5	25.62±4.3
	middle	28.58±5.0	13.58±4.3
	lower	16.29±0.6	22.41±4.0
Available Potassium(kg/ha)	upper	814.8±55.28	450.23±36.86
	middle	792.95±7.77	451.93±53.33
	lower	416.63±19.39	394.81±47.53
Soil Organic Carbon (%)	upper	1.45±0.02	1.10±0.04
	middle	1.25±0.03	0.90±0.05
	lower	1.19±0.03	0.72±0.08
Microbial Biomass Carbon(mg/kg)	upper	533.81±30.36	316.82±7.09
	middle	491.60±27.76	289.05±16.80
	lower	417.27±25.59	293.56±12.46





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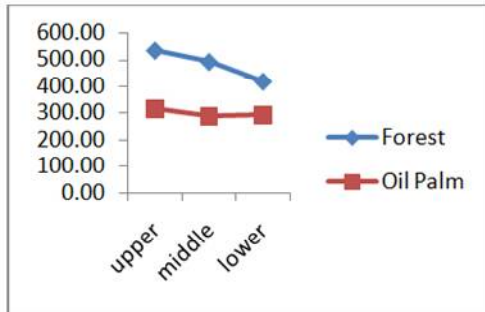


Figure 1: Bulk density (g cm⁻³)

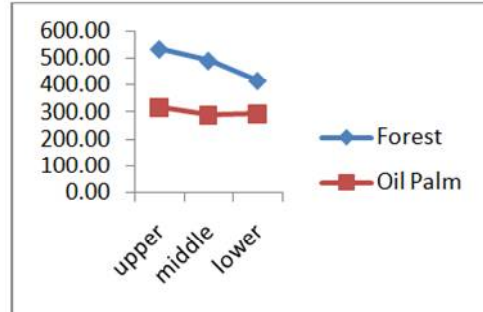


Figure 2: Soil Moisture Content (%)

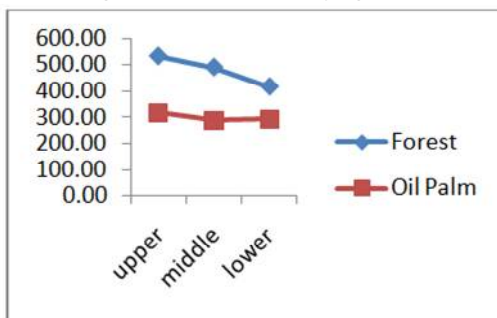


Figure 3: pH

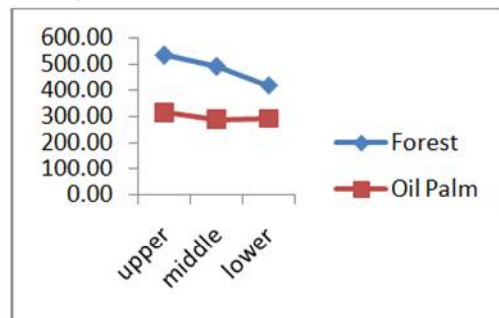


Figure 4: Available Nitrogen(kg/ha)

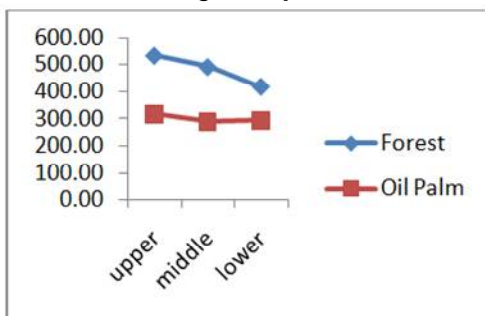


Figure 5: Available Phosphorus(kg/ha)

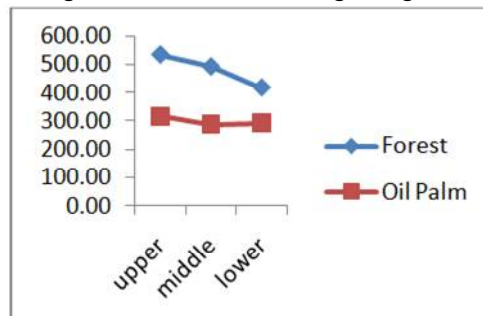


Figure 6: Available Potassium(kg/ha)

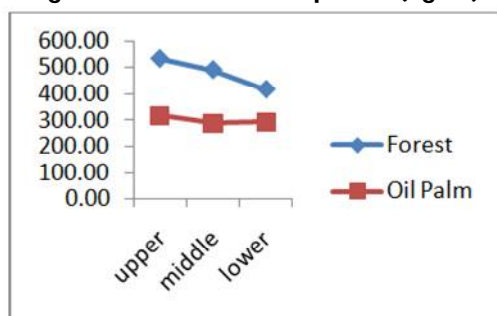


Figure 7: Soil Organic Carbon (%)

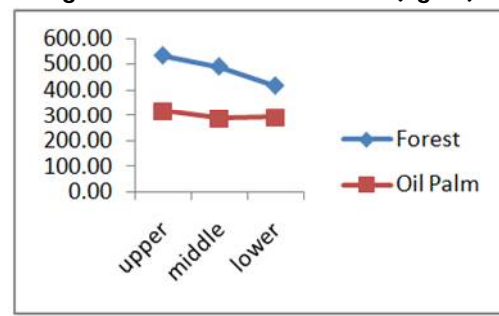


Figure 8: Microbial Biomass Carbon(mg/kg)

Figures: Graphical representation of selected soil properties under secondary forest and oil palm.





RESEARCH ARTICLE

A Correlative Study between the Inflow of Queries into the Drug Information Centre and Drug use Pattern of Cardiovascular Drugs in a Multispecialty Hospital

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ABSTRACT

The study was carried out at the drug information centre of a multispecialty hospital in Tamilnadu, to investigate the relationship between the inflow of drug information queries and the utilization pattern of cardiovascular drugs. Prescriber desk card, nurses' station note, ward rounds record, library note, and interns entry were introduced and implemented, apart from regular educational programmes. The inflow of queries from physicians increased from 6 to 11 bimonthly. The queries from surgeons showed a gradual increase from 3 to 8, while the queries from dentists increased from 1 to 4. The queries from nurses was higher than that from pharmacists. While the rate of inflow of queries increased during the study period, the use of cardiovascular drugs also showed considerable differences at the end of the study. Though the use of metoprolol, cilnidipine, and amlodipine didn't show a considerable change, the usage of ACE inhibitors increased and the use of ARBs decreased slightly. Ramipril showed an increase in use from 106 prescriptions bimonthly to 152. The use of nebivolol was higher compared to metoprolol, while the use of propranolol and atenolol decreased. The number of queries from the physicians showed a positive linear relationship with the use of ramipril and nebivolol, while the use of telmisartan and atenolol showed a negative linear relationship. The results of the study shows that the implementation of novel methods of drug information query generation increased the inflow of queries and influenced the drug use pattern in the hospital.





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Keywords: correlation; drug information service; prescription drugs; evidence based medicine; rational drug use

INTRODUCTION

Drug information services constitute an inevitable part of the routine in a healthcare setup. It functions in offering flawless details and information on drugs and drug usage in therapeutic processes. Insufficient drug information and lack of informed decisions by prescribers of drug products leads to practice of irrational drug use [1]. Evidence based medicine should be practiced in all healthcare organizations for safe use of medications. Although the concept of evidence based medicine is under practice, healthcare professionals in developing countries continue to face hindrances in accessing materials that offer reliable drug information [2]. The practice of evidence based medicine requires a judicious integration of top quality research evidences [3]. Even-though clinicians have accepted the concept of evidence based medicine, there are barriers to practise it which doesn't make it go in synchronization with daily clinical practice [4]. The services offered by a drug information centre can overcome few of these barriers since lack of knowledge being on top of them [5]. The elimination of noncompliance of evidence based medicine in clinical practice relies on the processes of identification of the reasons behind it. The drug information pharmacists have the responsibility and the space for research to find out the implementational barriers to practising evidence based medicine. Irrational drug use is one of the serious global considerations that hugely impact the economic and the pathophysiological state of patients [6]. Irrational drug use constitutes chiefly of polypharmacy, non-patient-selective drug use, and ineffective drug or dosage regimen. These factors result in wastage of resources, time, and potentially deteriorating patients' health status. Lack of knowledge, apart from ignorance and negligence, is the main reason for adopting prescription patterns that are irrational. This study explains how novel approaches in generating and responding to drug information queries from drug prescribers improve query in-flow and how it impacts the drug use pattern of various classes of cardiovascular drugs in the hospital.

MATERIALS AND METHODS

The study was an observational study, and it was conducted from March 2018 to October 2019 for a period of 20 months, at the Drug Information Centre of Vivekanandha Medical Care Hospital, Tiruchengode, Tamilnadu. This 500 bedded multispecialty hospital provides medical facilities in many departments. Queries obtained both through novel approaches and conventional method were included in the study. This study did not involve human subjects and patient-specific drug information queries were not included in the study.

Study methods

Novel strategies implemented to improve query inflow

Prescriber Desk Card

A printed card containing the name of the prescriber was supplied at the desk of the prescriber in the outpatients department. This is specially designed for non-patient selective queries. The card contains the name of the prescriber, department, qualification and blank space for the query. This card is directly collected and responded by the drug information pharmacist. This card is collected during the working hours at the end of the patient consultation hours and responded immediately as required by the prescriber, or on the next working day before the start of the patient consultation hours.

Nurses Station Note

A query entry format was supplied to the nurses station as a facility for easy access for nurses to drug information. This note offers the drug information pharmacist to collect the queries from the nurses at one informed location. In this format the nurse would register her/his name, qualification, department of posting, and the query. The response



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to the queries would be delivered at the nurse's station based on the requirement of the nurse or it will be delivered in the morning of the next working day.

Ward Rounds Record

Ward rounds happen to be a dynamic routine of the day and professionals of various qualifications are involved in the same ward. Questions arising during the ward rounds, that might require a drug information pharmacist consultation, can be entered in a common record which would be collected by the drug information pharmacist. In this case, the response would be delivered to the respective professional at his/her location of work based on his/her requirement.

Library Note

The hospital has associated libraries for academic purpose since it was a teaching hospital. All healthcare professionals using the library could register their query mentioning their academic details. Responses to the query would be delivered to the respective professional at his/her location of work as per his/her requirement.

Interns Entry

Interns occupy every departments in the hospital and the range of queries extend mostly between the basics and research questions. The formats for interns query entry were supplied at the wards and the libraries. The responses to these queries were delivered at the interns desk of the drug information centre which should be collected by the interns themselves.

Measures and analyses

The number of queries registered at the drug information centre during the period of study was documented. The drug use pattern of cardiovascular drugs in the hospital was obtained from the preceptor copy of clerkship reports submitted by Pharm. D interns. The entries were documented and correlated with the number of queries from the physicians of general medicine, nephrology, and cardiology departments.

Statistics

The number of queries and the drug use pattern were analyzed and expressed by descriptive statistical techniques and charts. Correlation was tested by two-tailed bivariate correlation tests using IBM's SPSS v27. A p-value < 0.05 was considered statistically significant.

RESULTS AND DISCUSSION

After the start of the study, novel strategies were implemented to generate more drug information queries from the healthcare professionals. There were 2 consultant physicians, 1 nephrologist, 1 cardiologist, and 3 general physicians in the physicians category. One general surgeon and 1 orthopaedic surgeon were in the surgeons category. Apart from them 2 ophthalmologist, 1 otorhinolaryngologist, and 1 anaesthetologist were practising in the hospital. There were drug information queries from the physicians which averaged below 3 per month was found to be an outcome of insufficient drug information service. After the start of the study, the average inflow of 3 queries per month has elevated gradually to 5.5 per month at the end of the study (Table 1). There was an increase in inflow of drug information queries from all category of healthcare professionals in the hospital. This shows that the novel strategies apart from the regular education programmes worked productively to improve the involvement of the healthcare professionals to acquire up-to-date drug information. Nurses and interns utilized the drug information service to a considerable extent which reflected on the number of queries generated by them. Drug information among prescribers can be expected to reflect in the usage of drugs by them. Cardiovascular drugs were studied in this investigation. Cardiovascular drugs are chiefly employed by consultant physicians and cardiologists. Few categories of drugs in the cardiovascular segment were taken in to account, beta blockers, angiotensin-converting enzyme (ACE inhibitors), angiotensin II receptor blockers (ARBs), and calcium channel blockers (CCBs) were among them.



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During the study period of 20 months, a total of 5005 prescriptions were found to bear these categories of drugs, prescribed by 2 consultant physicians, 1 nephrologist, 1 cardiologist, and 3 general physicians. Beta blockers were found to be in 2472 (49.39%) prescriptions, ACE inhibitors in 2096 (41.87%) prescriptions, ARBs in 1552 (31%) prescriptions, and CCBs in 1386 (27.69) prescriptions. A study states that there was an average number of prescription of 1026 recorded in the cardiology department [7] of a hospital in Tamilnadu, which relates well with the number of prescriptions recorded in the current study in the cardiology department. The number of prescriptions of beta blockers in the current study nearly coincides with that of a study from Northern Telangana [8] which was 1037 for a period of 7 months. Among the 5005 prescriptions, ramipril was found to be the most prescribed drug found in 26.49% of the prescriptions. But a study from Western Maharashtra [9] states that ramipril was prescribed at a higher percentage of 42.68% which was much higher than that found in the current study, while metoprolol was prescribed at a rate of 26.83% and it was 18.04% in the current study. A study from Assam [11] states that metoprolol was prescribed at a rate of 61.6% which was much higher than that of the current study and other past studies.

A study from India [10] states that beta blockers were prescribed at a rate of 15.69% which can be stated as very low compared to the current study. A drug utilization study conducted in Pakistan [12] reported that among the cardiovascular drugs prescribed 52% were beta blockers which is very nearer to the prescription pattern of beta blockers found in the current study. A Malaysian study [13] reported that the utilization of beta blockers was 33.33%, ACE inhibitors being 19.6% and calcium channel blockers at 52%, while the current study results deviates slightly in all the parameters from the aforesaid study. An Ethiopian study [14] in 2018 reported that ramipril was rarely used in the hospital and enalapril was prescribed at a rate of 34.9% which was 15.38% in the current study. Beta blockers are found to reduce mortality substantially among patients with cardiovascular diseases [15], which needs to be considered in selecting beta blockers among other categories of drugs. A multinational cohort study [16] reports that ARBs are the first line safe drugs over ACE inhibitors while initiating antihypertensive therapy.

On the progress of the study there was an obvious pattern of changes in the prescription of these categories of drugs. At the start of the study, the total number of prescriptions of beta blockers was at an average of 124 per month, which increased to 129.5 per month. Among them the prescription of nebivolol showed a steady and considerable increase (Table 2) while the prescription of propranolol and atenolol showed a decrease. The total number of prescriptions of ACE inhibitors was 96 per month at the start and it showed a considerable increase to 110 prescriptions per month. Among the ACE inhibitors the use of ramipril increased considerably while that of enalapril decreased to a lesser extent. At the start of the study, the number of prescriptions of ARBs was 87 per month on an average, which decreased to 67 per month. Among them the prescription of both telmisartan and losartan showed a decrease at the end of the study. The total number of prescriptions of calcium channel blockers was 70 per month at the start and it showed an insignificant change at the end of the study. Among the CCBs the use of cilnidipine increased slightly while that of amlodipine decreased slightly.

The correlation between the number of drug information queries from the physicians and the number of prescriptions of various drugs belonging to the cardiovascular segment shows that there exists a linear relationship between them. Both positive and negative linearity was seen between them. The correlation between the number of queries and the number of prescriptions of ramipril and nebivolol was positively linear. The positive linearity can be attributed to the fact that drug information services have helped the physicians to select the appropriate drug for pharmacotherapy. Based on evidences, ramipril and nebivolol have been known, being the latest generation drugs, to offer more safety to the patients reducing the incidence of morbidity and mortality. The correlation between the number of queries and the drug use pattern of ARBs was negatively linear. There was reduction in the number of prescriptions of telmisartan and losartan as the study progressed. The reason for this occurrence may be attributed to the fact that ACE inhibitors are more effective in reducing the incidence of cardiac events than that by ARBs as evidences state. Even-though ACE inhibitors influence withdrawal from therapy due to brassy dry cough, it offers excellent outcomes in patients who tolerate ACE inhibitors. ARBs are tolerated well by patients but it becomes more reliable in cardiac patients with deteriorating kidneys. The correlation between the number of queries and the prescription of CCBs was linear but not a statistically significant correlation, especially cilnidipine. As per this study





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the use of metoprolol and cilnidipine didn't alter much to show a statistical significance reflecting the fact that they take an inevitable position in the pharmacotherapy of hypertension associated with other cardiovascular conditions. The prescription and drug utilization differs from prescriber to prescriber depending upon their need and knowledge. The variations among the studies on this question can be attributed to the need of the mass population, prescriber preferences and drug availability, undoubtedly lack of update in knowledge.

CONCLUSION

The study results state that constant and effective drug information services are capable of improving healthcare professionals' involvement in continuing education by utilizing the services of the drug information pharmacist. The correlation tests suggest that the prescribers' attitude in updating knowledge can influence the drug use pattern in a hospital. The drug use pattern should be based primarily on the principles of evidence based medicine and rational drug use which can be achieved by continuous update of drug information. The services offered by a drug information pharmacist should be improved by involving modern drug information retrieving techniques and communication technologies.

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Conflicts of Interest

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Table 1. Inflow of drug information queries during the study period

Category	Inflow of drug information queries during the study period (20 months)									
	1	2	3	4	5	6	7	8	9	10
Physicians	6	8	8	8	9	8	8	9	10	11
Surgeons	3	5	5	5	5	6	6	8	8	8
Dentists	1	2	2	3	2	3	4	2	5	4
Pharmacists	9	7	8	8	8	9	10	12	12	13
Nurses	9	7	12	14	14	16	16	17	15	17
Interns	8	11	12	12	11	12	15	17	16	15
Students	9	9	12	12	12	14	18	22	23	17
Care-takers	2	2	3	2	1	3	2	2	3	2
Public Initiators	0	1	0	1	2	2	1	1	0	1

Table 2. Drug use pattern of cardiovascular drugs at the cardiology and general medicine departments

Drug	Number of prescriptions during the study period (20 months)									
	1	2	3	4	5	6	7	8	9	10
Ramipril	106	110	120	116	130	138	146	152	156	152
Enalapril	86	88	85	80	77	80	74	68	64	68
Telmisartan	104	106	102	104	98	90	92	82	86	82
Losartan	70	66	70	64	66	60	54	54	50	52
Nebivolol	96	94	101	97	105	112	121	136	131	135
Metoprolol	90	87	88	90	86	90	96	92	90	94
Propranolol	38	37	34	30	28	24	18	20	16	16
Atenolol	24	28	20	16	18	20	16	12	12	14
Cilnidipine	92	90	88	90	96	98	98	94	94	94
Amlodipine	48	50	46	48	47	44	42	43	42	44



**Joseph Stalin et al.,****Table 3. Correlation between the number of drug information queries from physicians and utilization of cardiovascular drugs**

Drug	Correlation Coefficient	p-value
Ramipril	0.7654	0.0099
Enalapril	- 0.7884	0.0067
Telmisartan	- 0.7259	0.0175
Losartan	- 0.7230	0.0181
Nebivolol	0.7461	0.0132
Metoprolol	0.2282	0.5260
Propranolol	- 0.7563	0.0114
Atenolol	- 0.6674	0.0350
Cilnidipine	0.2168	0.5473
Amlodipine	- 0.4988	0.1422





A Comparative Study of P and O and Fuzzy based MPPT Techniques for a Standalone PV System

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ABSTRACT

The characteristics of a photovoltaic (PV) cell is non-linear and it depends mainly on the solar irradiation level and the atmospheric temperature. The Maximum Power Point Tracking (MPPT) technique is widely used as it helps in increasing the efficiency of the PV cell effectively in varying atmospheric conditions. The main objective of this paper is to investigate the performance of a standalone PV system with Perturb and Observe (P&O) algorithm, and Fuzzy logic controller based MPPT techniques. A detailed simulation study using MATLAB/ Simulink is presented in this paper to prove the superiority of the proposed method.

Keywords: photovoltaic (PV) cell, Maximum Power Point Tracking (MPPT) Perturb and Observe (P&O), Fuzzy logic controller (FLC).

INTRODUCTION

There are many types of research on renewable energy sources are going on especially research related to solar power generation is in more demand. India's target of achieving 450GW renewable energy by 2030 is the most important contribution to climate change mitigation at the United Nations – COP26 summit. Out of 450 GW renewable energy, 280 GW has to be produced from solar power. This is why most of the research methods focus on obtaining maximum power from PV cell. But there is a major issue with the conversion of energy from a solar panel that it converts only 30-40% of solar irradiation into electrical energy and the remaining percentage of solar energy cannot be utilized effectively. To overcome this issue, many algorithms were implemented such as Perturb and





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Observe (P&O) algorithm, Incremental conductance (IC) technique, sliding mode control (SMC), algorithms based on Variable Structure Control (VSC), intelligent control method such as Fuzzy logic, Neural network, Genetic algorithm and so on. These techniques were also combined with the MPPT technique with the main objective of utilizing solar power effectively without any loss of energy in conversion.

The role of MPPT is to implement it in PV inverters to adjust the solar array so that the PV system operates close to the peak power point under certain conditions such as a change in solar irradiance, atmospheric temperature, and load conditions. The following are the literature survey of papers that explains the various techniques that are combined with the MPPT algorithm. These literature surveys help in developing the idea of comparative analysis of various MPPT algorithms for a standalone PV system.

The combination of MPPT techniques with modified incremental algorithm, P&O algorithm for Standalone PV system and various performance analysis to improve the efficiency of Solar PV system helps in identifying the problems associated with each technique [1]-[3]. The issues in tracking the maximum power point of Solar PV system, comparison of various MPPT based algorithms for both standalone and grid connected system along with the simulation results proves the idea behind the concept so that the efficiency of PV system can be improved [4]-[9]. Fuzzy and neural network based MPPT algorithm also helps in determining the maximum power point of both standalone and grid connected PV system [10]-[16]. The modified concept of variable step size MPPT, modified IC algorithms for fast changing irradiance, slope tracking method along with the simulation results satisfies the research ideas [17]-[21]. Fuzzy logic is used for many applications like motor control etc., because of simplicity and capability to handle imprecise data, Fuzzy logic [22]-[23] is used in this paper to improve the MPPT.

MODELLING OF STANDALONE PV SYSTEM

The modeling of a standalone PV system includes the PV cell model, DC-DC Boost converter equipping the MPPT algorithm which is discussed in this chapter.

PV cell model

The equivalent circuit diagram of a PV array is shown in Fig.1. The equation representing the above equivalent circuit is given as follows:

$$I_{pv} = I_{ph} - I_d - I_p = I_{ph} - I_o \left[\exp \left(\frac{V_{pv} + R_s I_{pv}}{n_s V_t Q_d} \right) - 1 \right] - \frac{V_{pv} + R_s I_{pv}}{R_p} \quad (1)$$

where

V_{pv} – PV module voltage (V)

I_{pv} – PV module current (A)

I_p – Parallel path current (A)

I_{ph} – Light current (A)

I_o – Diode reverse saturation current (A)

Q_d – Diode ideality factor

n_s – Number of cells in series

R_s – Series resistance (Ω)

R_p – Parallel resistance (Ω)

V_t – Thermal voltage (V), k is Boltzmann's constant, T_c is the cell temperature and q is the charge of an electron.

The Fig.2 represents the combined characteristics curve of photovoltaic cell representing the I-V and P-V curves. When the PV cell is open circuited, the current will be minimum and the voltage across the cell will be maximum, called open circuit voltage V_{oc} . Similarly, when the PV cell is short circuited, the voltage across the cell is minimum and the current passing through the cell is maximum called short circuit current I_{sc} . At one particular value of current and voltage, the power will be maximum which is called as Maximum power point (MPP). The





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corresponding current at MPP is called I_{mp} and voltage at MPP is called V_{mp} . Thus, it is important to analyze the ideal characteristics of the PV cell in order to determine the MPP that is later used in the MPPT algorithms.

DC-DC Boost Converter

The DC-DC Boost converter consists of a MOSFET, a diode, two capacitors (one at the input side and other at the output side of the boost converter), an inductor and a load. This converter is controlled by the Pulse Width Modulation (PWM) technique that in turn is controlled by MPPT controller as shown in Fig.3. The change in duty ratio of this converter ensures the operation of the system at MPP with corresponding voltage V_{mp} and current I_{mp} . The design of boost converter involves the specification of the components that are used. The values of the inductor (L) and capacitor (C) are calculated by using the equations below:

$$L = \frac{V_{pv} \times D}{\Delta I_L \times f_{sw}} \quad (2)$$

$$C = \frac{I_0 \times D}{\Delta V_0 \times f_{sw}} \quad (3)$$

where V_{pv} is the input voltage to the boost converter (voltage from PV module)

D is the duty cycle

f_{sw} is the switching frequency

ΔI_L is the inductor ripple current of the converter

ΔV_0 is the output ripple voltage

MPPT ALGORITHMS

The MPPT algorithm is mostly used in the controller design of the PV system. This algorithm accounts for various factors such as change in irradiance level, atmospheric temperature in order to ensure that the designed PV system generates maximum power at all times. The main objective of MPPT controller used in the design of standalone PV system is to adjust the duty cycle of DC-DC Boost converter, so that the source impedance is made equal to output impedance in order to obtain the maximum power in the system. There are several algorithms which are used to determine the maximum power point, from which P&O and Fuzzy based MPPT algorithms are used in this paper to obtain a comparative analysis of MPPT techniques in the design of standalone PV system. The two techniques are discussed in detail as follows:

Perturbation and Observation (P&O) algorithm

The P&O algorithm is the most conventional algorithm widely used in the design of MPPT controller. This algorithm compares the power calculated in previous step with the next step of calculating the power by changing the voltage or current correspondingly.

Let $V_{pv}(k)$ and $I_{pv}(k)$ be the PV module voltage and current at the present cycle respectively and $V_{pv}(k-1)$ and $I_{pv}(k-1)$ be the PV module voltage and current at the previous cycle respectively. The power $P_{pv}(k)$ is given by

$$P_{pv}(k) = V_{pv}(k) \times I_{pv}(k) \quad (4)$$

The change in V_{pv} and P_{pv} from previous cycle to present cycle is represented as ΔV_{pv} and ΔP_{pv} respectively and this relation is expressed in the form of equation as below:

$$\begin{aligned} \Delta V_{pv} &= V_{pv}(k) - V_{pv}(k-1) \\ \Delta I_{pv} &= I_{pv}(k) - I_{pv}(k-1) \\ \Delta P_{pv} &= P_{pv}(k) - P_{pv}(k-1) \end{aligned} \quad (5)$$





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- a) When the operating point is at the right side of the power curve, $\frac{\Delta P_{pv}}{\Delta V_{pv}} < 0$, the voltage is decreased by increasing the duty cycle ΔD .
- b) When the operating point is at the left side of the power curve, $\frac{\Delta P_{pv}}{\Delta V_{pv}} > 0$, the voltage is increased by decreasing the duty cycle ΔD .
- c) When the operating point is at the maximum power point, $\frac{\Delta P_{pv}}{\Delta V_{pv}} = 0$, the voltage and duty cycle does not require any change.

The above process is clearly explained in terms of flowchart in the Fig.4. The P-V characteristic curve showing the maximum power operating point (MPOP) as shown in the Fig.5. This graph can be used to find the MPOP in both P&O and IC method.

Proposed Fuzzy Logic Controller (FLC) based MPPT

Intelligent controllers are also used in the MPPT technique that results in improved performance in tracking even when the PV system has some uncertainties. The most important intelligent controllers are Fuzzy Logic Controller (FLC), Genetic Algorithm (GA) and Neural Networks (NN). The FLC is widely used in the tracking applications. The FLC method is the easiest model in terms of designing as it can work with imprecise inputs and do not require accurate mathematical model of the PV system. The FLC can be designed by fuzzy inference technique such as Mamdani method and Sugeno method. In this paper, the design of FLC is executed by using Mamdani method as in Fig.6, which explains the operation of fuzzy system using Mamdani method.

Mamdani Fuzzy Model

The Mamdani fuzzy inference technique is performed generally in four steps as follows:

- a) Fuzzification of the input variables
- b) Evaluation of rule
- c) Aggregation of the rule output
- d) Defuzzification of the output variables

By incorporating the above method, a fuzzy logic controller is designed with two input and one output. The input variables are expressed in terms of equation as below:

$$E(k) = \frac{P_{pv}(k) - P_{pv}(k-1)}{V_{pv}(k) - V_{pv}(k-1)} = \frac{\Delta P_{pv}}{\Delta V_{pv}} \quad (6)$$

$$CE(k) = E(k) - E(k-1) = \Delta E \quad (7)$$

where $E(k)$ is the error, that is the slope of the P-V curve as mentioned in the Fig.4 and provides the maximum power operating point (MPOP) for the standalone PV system. The term $CE(k)$ represents the change in error, which helps in tracking the MPOP in the desired manner to obtain maximum power in the PV system. The output variable is the change in duty cycle (ΔD), which can be positive or negative based on the MPOP lies on either right side or left side of the P-V curve. The output equation based on the duty cycle (ΔD) is given by

$$D(k) = D(k-1) + \Delta D(k) \quad (8)$$



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RESULTS AND DISCUSSIONS

Simulation results using P&O MPPT technique

The PV system is given with irradiance and temperature as inputs where it has been measured and given as input to the DC-DC boost converter which helps in increasing the output voltage to the desired level. The P&O MPPT technique is used to control the duty cycle of the DC-DC boost converter by generating gate signal by pulse width modulation (PWM). Table 1 shows the simulation parameters used in this paper. The simulation results of standalone PV system with P&O MPPT method in Fig.7 is used to analyze the performance of the system. The parameters such as PV voltage, PV current, PV power, load voltage, load current and load or output power are used in the performance analysis of the system.

The Fig. 8 and Fig.9 shows the I-V, P-V characteristics with different irradiance levels and different temperatures respectively. The irradiance level in Fig.10 shows two profiles: (a) a sudden decrease and increase in the irradiance level, (b) a gradual increase in the irradiance level. Both the irradiance profiles help in the comparative analysis of P&O MPPT and Fuzzy based MPPT methods. The Fig.11 and Fig.12 show the outputs obtained by applying P&O MPPT technique for a standalone PV system under two irradiance profiles as explained before using MATLAB/Simulink. It can be observed from the Fig.11 results obtained using irradiance profile (a), that the PV power (blue line) is not aligned properly with load power (red line), which implies that the time response is oscillating around the value of maximum power point in P&O MPPT technique. In the Fig.12, the results obtained using irradiance profile (b), that there is some sluggish response in the PV power and load power which makes the tracking of maximum power point a little slower.

Simulation results using Fuzzy MPPT Technique

The Fig.13 shows the simulation model of a standalone PV system using Fuzzy MPPT technique along with the DC-DC boost Converter. The fuzzy rule base as shown in Table.1 is used in the Fuzzy MPPT technique and the corresponding simulation results were obtained using the two-irradiance profile (a) and (b) as shown in Fig.10. The fuzzy logic controller using Mamdani method in the Fig.14 is implemented by the corresponding 5 membership functions. The input and output in FLC are shown in the Fig.15 using rule viewer.

The Fig.16 and Fig.17 shows the simulation results of a standalone PV system using fuzzy MPPT technique where two irradiance profile (a) and (b) are applied respectively. It can be observed that the oscillations in the PV power and Load power are reduced when both the irradiance profile (a) and (b) are applied. This implies that the tracking of maximum power point is rapid and the load power converges with the PV power. The Fuzzy MPPT technique can be used for stabilized output of the standalone PV system by evaluating the duty cycle of the DC-DC boost converter, also it tracks the maximum power point for the various irradiance profiles but it requires periodic tuning.

CONCLUSION

Thus, the type of MPPT technique selected to obtain the maximum power point plays a major role in increasing the utilization of solar energy without loss. The P&O MPPT helps in continuous tracking of MPP in less time, periodic tuning is not necessary but still oscillations are present in this method whereas the fuzzy MPPT has faster convergence to the MPP with less oscillations. From the simulation results of both the techniques, it is observed that for a standalone PV system, fuzzy MPPT extracts the maximum power with less oscillations with even sudden changes of irradiance, although P&O MPPT tracks the maximum power but it results in more oscillations and take more time converge when compared to fuzzy MPPT. The simulation results of the proposed system employing fuzzy MPPT of Mamdani model, reflects the effectiveness of the objective to utilize the maximum solar power at different irradiance level.





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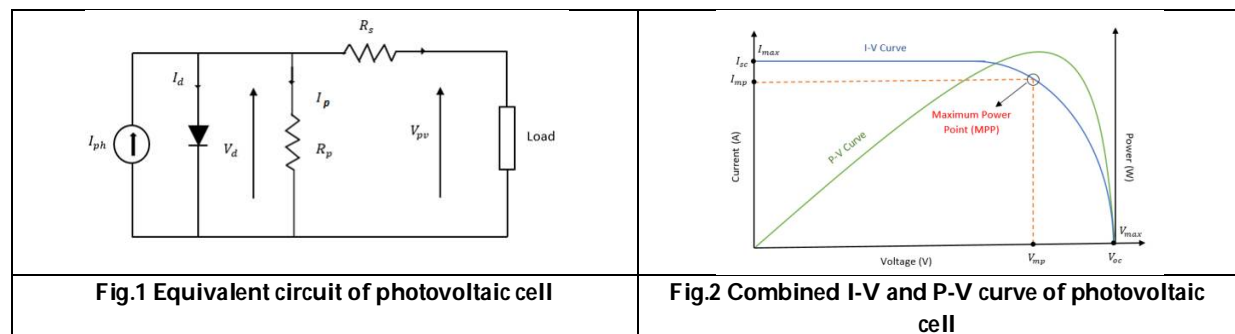
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Table.1 Rule Base used in FLC

Output	E (Input)					
		NB	NS	ZE	PS	PB
CE (Input)	NB	PS	PB	NB	NB	NS
	NS	PS	PS	NS	NS	NS
	ZE	ZE	ZE	ZE	ZE	ZE
	PS	NS	NS	PS	PS	PS
	PB	NS	NB	PB	PB	PS

Table. 2 Simulation Parameters

Parameter	Value
PV array:	
Open circuit voltage (Voc)	37.3 V
Maximum voltage (Vm)	30.7 V
Short circuit current (Isc)	8.66 A
Maximum current (Im)	8.15 A
Maximum power (Pm)	250 W
No of cells per module	60
Boost Converter:	
Inductance	4.1mH
Input Capacitance	425µF
Output Capacitance	765 µF
Switching frequency	5kHz





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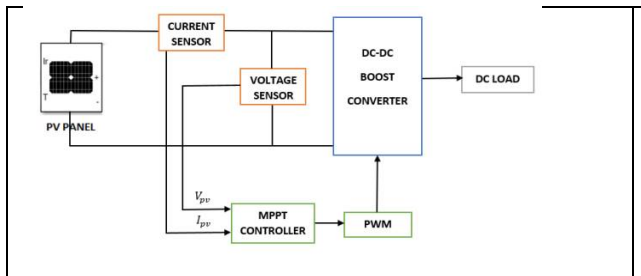


Fig.3 Block diagram of a standalone PV system with boost converter and MPPT controller

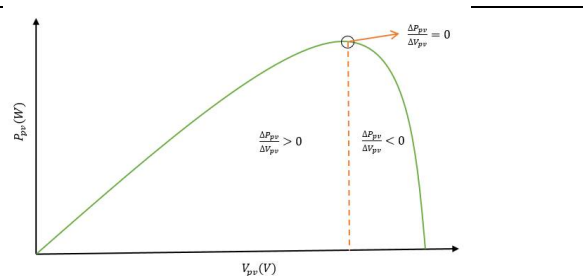


Fig.4 P-V Characteristics showing maximum power operating point

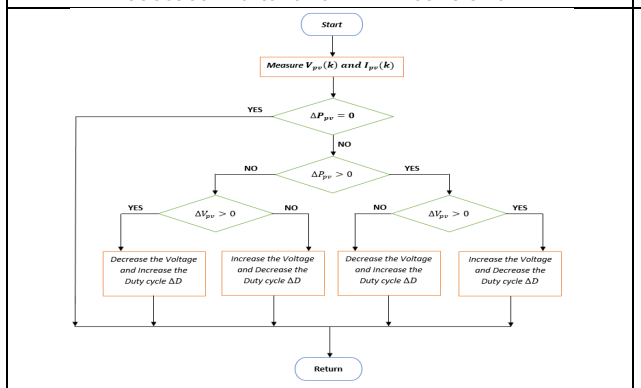


Fig.5 Flowchart of P&O algorithm

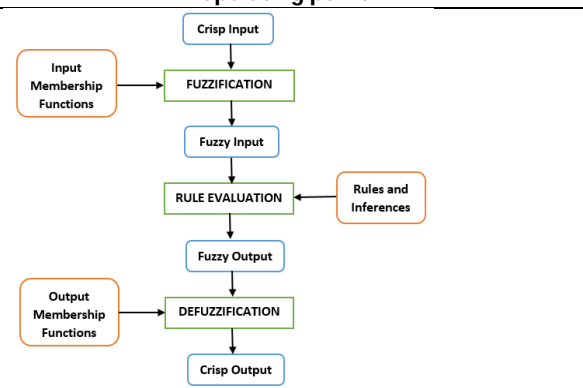


Fig.6 Operation of Fuzzy system

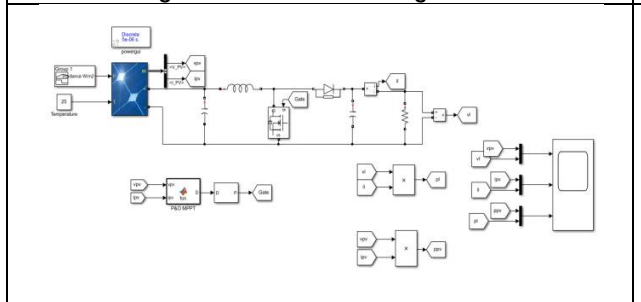


Fig.7 Standalone PV system with P&O MPPT

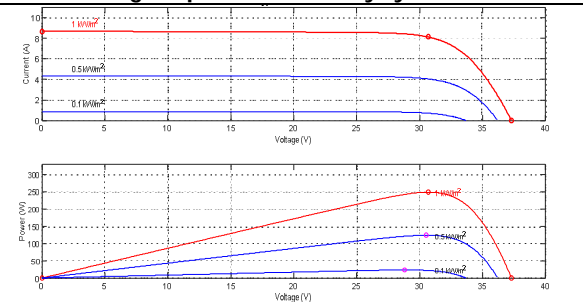


Fig.8 I-V and P-V characteristics with different irradiances

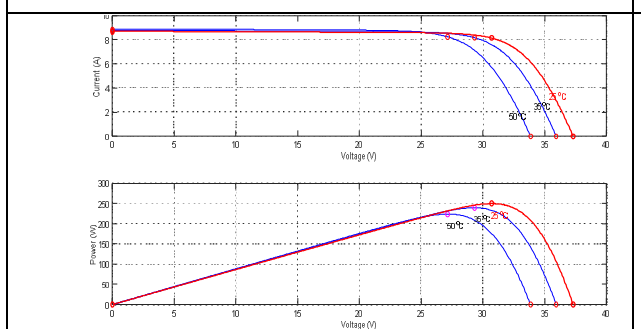


Fig.9 I-V and P-V characteristics with different temperatures

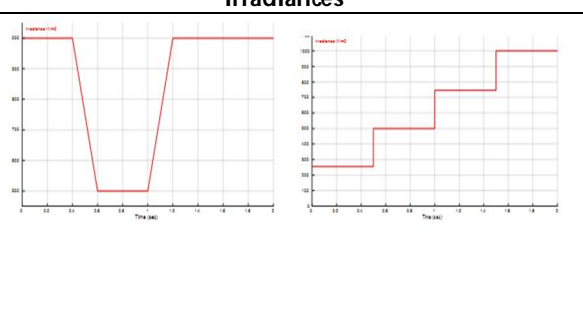


Fig.10 Irradiance profile (a) and (b)





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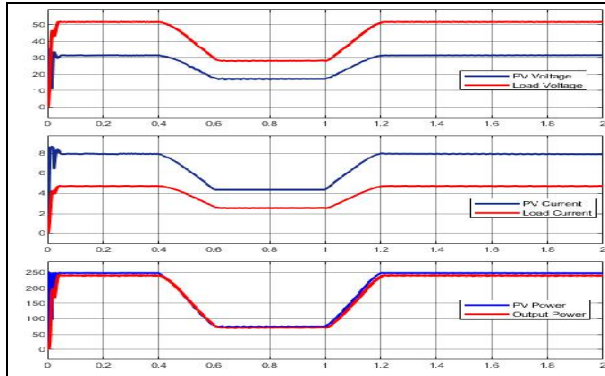


Fig.11 Output of P& O MPPT using irradiance profile (a)

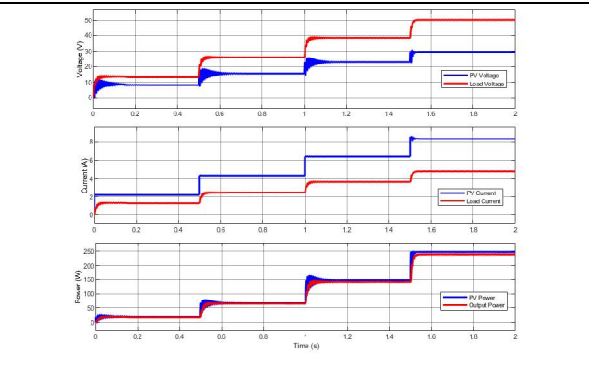


Fig.12 Output of P& O MPPT using irradiance profile (b)

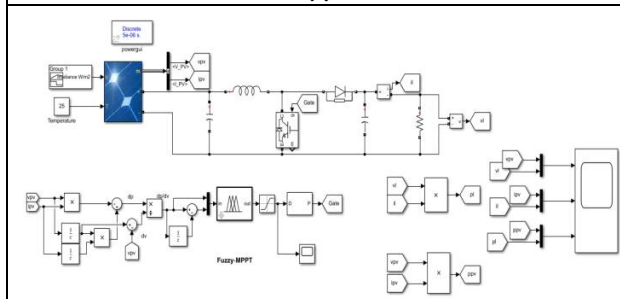


Fig.13 Standalone PV system with fuzzy MPPT

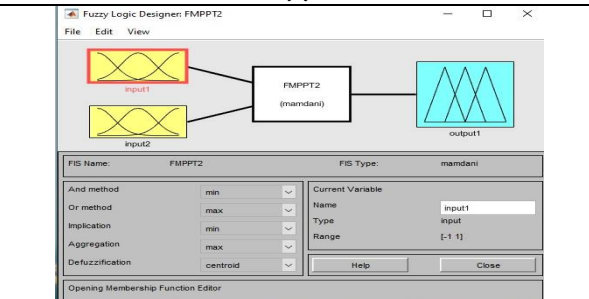


Fig.14 Fuzzy logic controller

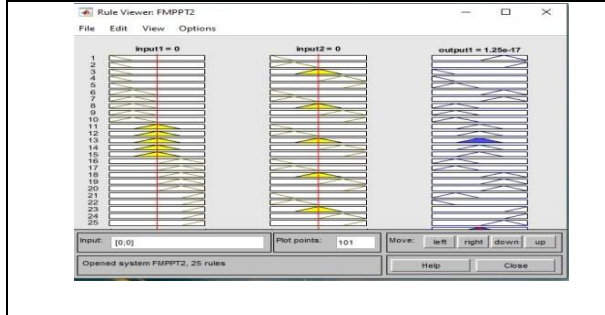


Fig.15 FLC rule viewer

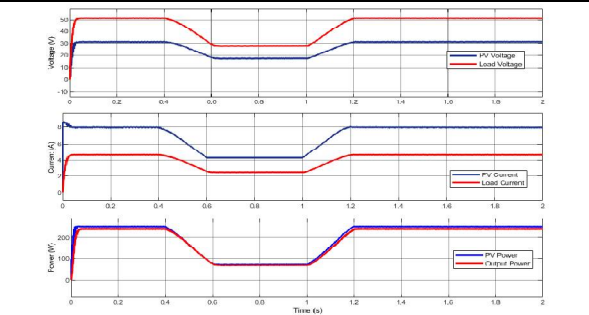


Fig.16 Output of fuzzy MPPT using irradiance profile (a)

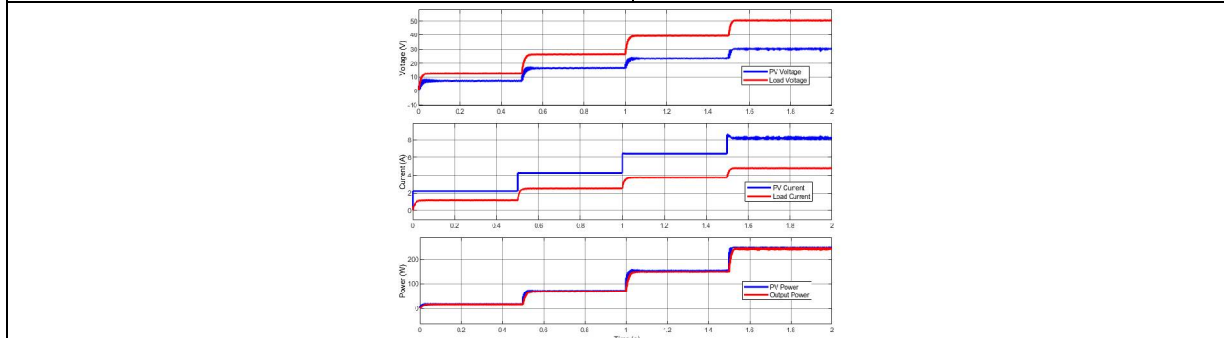


Fig.17 Output of fuzzy MPPT using irradiance profile (b)





Marine Polysaccharides: A Brief Review

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ABSTRACT

Polysaccharides are the most plentiful and complex organic compounds in the ocean. Plants starch, cellulose, pectins, inulin, gum arabic, arabinoxylans), animals (glycogen, collagen, heparin sulphate, hyaluronic acid, and so on), microbes (xanthan, gellan, dextran, scleroglucan, pullulan, curdlan, and so on), seaweeds (carrageenan, alginates), crustaceans and insects are the main sources. Natural polysaccharides of marine origin already have a broad and growing field. They're becoming more popular in the pharmaceutical and cosmetic industries because to their evident advantages over synthetic polymers, such as cost savings, safety, and chemical modification ease. Marine polysaccharides have been explored extensively as medicinal agents for a variety of ailments. This minireview covers the many types of marine polysaccharides and highlights prospective applications and uses for this vast renewable resource.

Keywords: Marine polysaccharides, sources, applications, uses

INTRODUCTION

Nature has imparted such diversity on this world, whether on land, under water, or in the air. There are both live and nonliving objects in each section. Humans have examined every facet of it and have benefited from it in every way possible [1]. Natural chemicals abound in the oceans. Exploiting the sea as a renewable supply of biocompounds can help to accelerate the development of novel biomedical systems and equipment. Marine creatures include a diversified range of chemicals with a wide range of biological characteristics and bioactivity. Recently, there has been an increase in interest in many scientific fields that explore the various applications of marine compounds, which is justified by their great biodiversity and ease of extraction and purification processes. Because of their noncytotoxic properties, biodegradability, and biocompatibility, marine biomaterials have a wide range of applications in





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biomedicine. These biological qualities have enabled the development of a wide range of novel bioactive chemicals with pharmacological capabilities, and they are a critical component of the pharmaceutical business [2]. Polysaccharides have been defined as carbohydrate compounds made up of long chain monosaccharide units linked together by glycosidic connections. Many polysaccharides, particularly for microbes, plants, and animals, can be simply manufactured inexpensively by natural products in the form of energy storage or structural biopolymers [3]. Natural polysaccharides are also nontoxic, environmentally benign, long-lasting, and cost-effective [1]. Marine polysaccharides are mostly employed in the food and cosmetics industries, but they are also widely used in pharmaceutical science, with a growing interest in using them as materials for the integration of bioactive compounds [2]. In this article algae, agar, alginate, chitosan, fucoidan and carrageenan were identified as the principal marine polysaccharides explored for the pharmaceutical sector

Algae

Algae are a varied group of autotrophic organisms that range in size from unicellular to multicellular. They are primary producers, which means they are a good source of many nutrients and have a lot of protein. Vitamins, minerals, proteins, and fatty acids are all produced by algae [4].

Uses [5]

Bio fuel	Bio diesel, Bio gas, Ethanol, Hydrocarbon, Bio electricity
Cosmetics	Anti cellulite, Anti aging, Anti wrinkle, Emollient
Fertilizer	Increase water binding capacity of soil, Fixing atmospheric nitrogen
Health food and pharmaceuticals	Pigments, PUFAs, Bioactive algal products like β -1,3-glucan
Food additives	Major phycocolloids are agar, alginate, carrageenan

Agar

United States Pharmacopoeia (1980) mentioned agar as "the dried hydrophilic colloid extract obtained from *Gelidium cartilagineum*, *Gracilaria confervoides* and related algae of the class Rhodophyceae". Agar-agar is a Malayan word that refers to jellies created from various seaweeds. Agar is a very heterogeneous material that creates highly viscous solutions and strong gels. It is one of the principal structural components in the cell walls of red seaweeds. D-galactose and its anhydride 3,6-anhydro-L-galactose make up the majority of them.

Uses

Agar is primarily employed in jellies, sweets, and jams as a gelling, stabilising, viscosity-controlling, and thickening agent. It's used as a brewing clarifying ingredient, a desert binder, and in paper sizing textiles. It is utilised as a coating agent to prevent dehydration while baking food materials in the food industry rather than as a nutrition. It is used in the dairy business to make less acidic yoghurt and soft cooked sausages, as well as in the meat industry to lower fat content. In traditional herbal medicine, it's also utilised as a laxative and anti-rheumatic. Solid agar blocks have been utilised to make tooth imprints in modern medicine. In the food sector, agar and agarose polymers are in considerable demand as thickening agents [6].

Alginate

Alginates (ALG) are a class of naturally occurring anionic polysaccharides generated from the cell walls of brown algae such as *Macrocystis pyrifera*, *Laminaria hyperborea*, *Ascophyllum nodosum* and numerous bacteria strains (*Azotobacter*, *Pseudomonas*)[7]. Alginates are copolymers primarily made up of -D-mannuronic acid (M) and its C5 epimer -L-guluronic acid (G) residues connected in an irregular block-wise fashion via a 1,4-glycosidic bond[8].





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Uses [8,9]

Food industry	Edible films and coatings
Biomedical application	Wound healing, foam dressing, hydrogel dressing
Drug delivery	Oral dosage form Alginate as a carrier for local drug delivery drugs Delay the release of the drugs, and enable the drugs to reach the target site at a fixed point and at a fixed time (by encapsulation)
Tissue repair and regeneration	Replace damaged tissues Encapsulation of pancreatic islet grafts in sodium alginate hydrogel for the treatment of diabetes.
3D bioprinting	Fabrication of structures resembled in architecture to native biological tissue. In bone and cartilage regeneration.
Diabetes control	Used to develop devices for insulin oral delivery.
Obesity control	Increase satiety Inhibits gastrointestinal enzymes, reduces glucose and cholesterol and controls lipid digestion.

Chitosan

Chitosan is a natural polymer that is made from chitin by a deacetylation process. Chitin is naturally found in the shells of fish, prawns, and shrimp, which are constantly generated as trash from fisheries and domestic rubbish, posing a threat to the environment as well as human health. It can also be extracted from bacteria and fungi using a species-specific enzyme called chitosanases [10]. Chitosan is a linear polysaccharide made up of various proportions of (β 1 \rightarrow 4) residues of N-acetyl-2-amino-2-deoxy-D-glucose (glucosamine, GlcN) and 2-amino-2-deoxy-D-glucose (N-acetyl-glucosamine, GlcNAc) residues [11].

Sources [10]

Prawns	<i>Penaeus monodon</i> (giant tiger prawn) <i>Penaeus indica</i> (Indian prawn) <i>Fenneropenaeus indicus</i>
Shrimps	<i>Penaeus carinatus</i> <i>Penaeus monodon</i>
Crab	<i>Sesarma plicatum</i>
Fungi and bacteria	<i>Aspergillus niger</i> MTCC 1785, <i>Aspergillus niger</i> MTCC 2208, <i>Aspergillus niger</i> MTCC 872, <i>Salmonella typhi</i> , <i>E.coli</i> , <i>Proteus vulgaris</i>

Applications of Chitosan [12]

Cosmetics	Increase its softness, smoothness, and mechanical strength. Used in shampoos, rinses, permanent wave agents, hair colorants, styling lotions, hair sprays, and hair tonics. Has emulsifying action. Found in creams, pack material, lotions, nail enamel, nail lacquers, foundation, eye shadow, lipstick, cleansing materials, and bath agents.
Paper industry	Can strengthen recycled paper, paper produced with chitosan has a smoother surface and is more resistant to moisture Production of toilet paper, for wrapping paper and cardboard packaging material, for food wrap and other products
Textile industry	Remove dyes from dye processing effluents
Food industry	Non toxic





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	As a non-absorbable carrier for highly concentrated food ingredients
Agriculture	Have growth accelerating and growth enhancing effects Chitinous additions to the potting mixtures/soil shows significant reduction in root knot worm infestations
Photography	As a fixing agent Acts as an aid to improve diffusion
Chromatographic separation	Used in thin layer chromatography for separation of nucleic acids Used as sorbent material to solid phase extraction of chlorophenols and phenols by using High-Performance Liquid Chromatography (HPLC).
Burn treatment	Form tough, water-absorbent, biocompatible films.
Ophthalmology	Contact lens, Ocular bandage
Drug delivery system	Preparation of dosage forms like controlled delivery system

Carageenan

Carrageenan is the generic term for a group of gel-forming and viscosifying polysaccharides extracted from particular types of red seaweeds. Rhodophaeceae [13]. *Solieria* sp., *Hypnea* sp., *Chondrus crispus*, *Iridaea* sp., *Eucheuma* sp., *Gigartina stellata*, and *Agardhiella* sp. are the most important species, which operate as structural components similar to cellulose in plants. The original source of carrageenans is *C. crispus* (Irish moss), which consists primarily of a mixture of kappa and lambda carrageenans. It grows along the North American and European shores. They're mostly made up of D-galactose and 3,6-anhydro-D-galactose sugar units, with sulphate as the major substituent and a few methyl ethers thrown in for good measure [1]. Applications of carageenan given in figure no: 1 [14].

Fucoidan

Fucoidan is a kind of sulfated polysaccharide. Fucoidan is found in a variety of marine sources, such as sea cucumbers and brown algae. The fucoidan content of a variety of algae and invertebrates has been determined, including *Fucus vesiculosus*, *Sargassum stenophyllum*, *Chorda filum*, *Ascophyllum nodosum*, *Dictyota menstrualis*, *Fucus evanescens*, *Fucus serratus*, *Fucus distichus*, *Caulerpa racemosa*, *Hizikia fusiform*. In a species of brown algae, fucoidan is composed of L-fucose, sulphate groups, and one or more tiny quantities of xylose, mannose, galactose, rhamnose, arabinose, glucose, glucuronic acid, and acetyl groups [15]. Applications of fucoidan given in figure no: 2 [18].

Uses [16, 17]

Osteoarthritis	Orally administered <i>Undaria pinnatifida</i> fucoidan successfully inhibited pain. <i>Fucus fucoidan</i> inhibits mechanical hypernociception and neutrophil migration.
Liver disease	<i>Fucus vesiculosus</i> - inhibited raised levels of TNF-alpha and IFN-gamma. Increased endogenous IL-10 production. Inhibition of hepatic stellate cell proliferation <i>Cladosiphon okamuranus</i> -Protection from damage, Increased metallothionein, Down regulation of TGFbeta 1 and SDF1
Neuronal protection	<i>Fucus vesiculosus</i> - Inhibits neurotoxic effects of amyloid Fucoidan completely blocks microglial uptake of fDNA at only 40 ng/mL, Fucoidan inhibits beta amyloid induced microglial clustering at 10 μM <i>Laminaria japonica</i> - Inhibits NO production in LPS activated microglial cells
Viruses: Influenza, Herpes and Dengue	Inhibit infection via receptor entry blocking and interference with replicative processes. <i>Undaria pinnatifida</i> has a marked inhibitory effect on the H1N1 influenza A virus Fucoidan from <i>Cladosiphon</i> shown to inhibit type 2 dengue <i>in vitro</i>
Stomach Ulcers	Inhibitory effects on <i>Helicobacter</i> infections by inhibiting adhesion to mucosal surfaces
Snake venom	<i>Ascophyllum nodosum</i> - effective inhibitor of PLA2 variants present in the venoms of crotalid snakes





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Cancer	<i>Fucus evanescens</i> - Enhanced etoposide-induced caspase dependent cell death pathway in MT-4 <i>Cladosiphon sp</i> - Down-regulation Bcl-xL Mcl-1, Decreased phosphorylation of ERK and Akt in MDA cells, increased phosphorylation of ERK in MCF-7 cells. Increased intracellular ROS, reduced glutathione (GSH)
Modulator of clotting	<i>Fucus vesiculosus</i> - had some prolongation of clotting time <i>Undaria pinnatifida</i> (5 mg/kg iv) - achieved an antithrombotic effect

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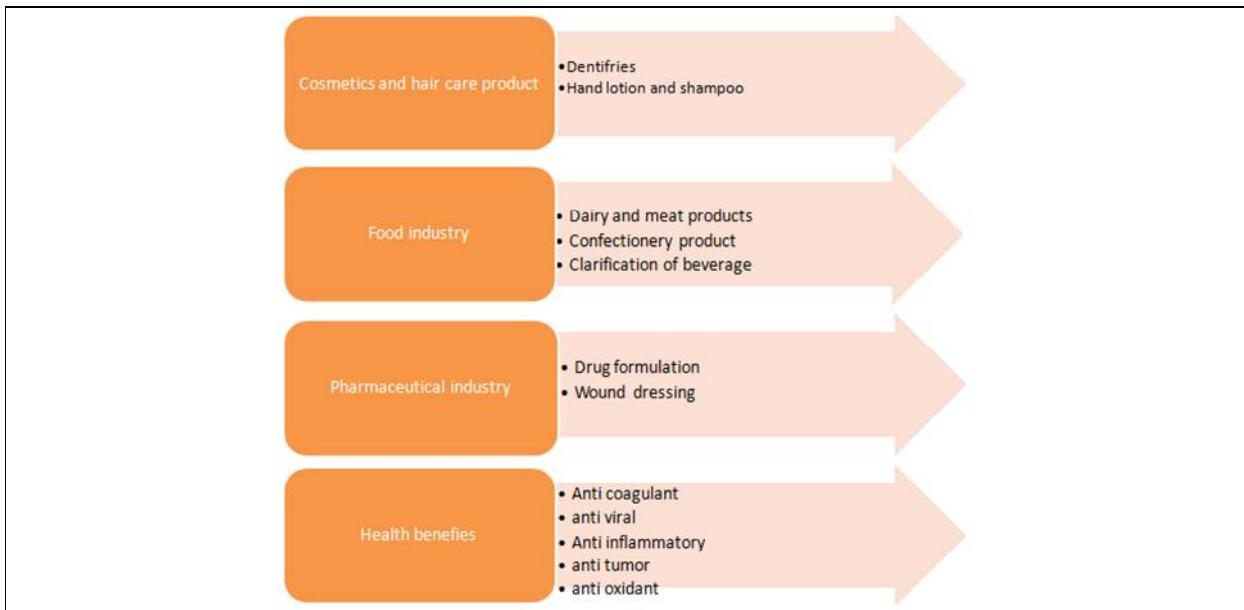


Figure 1 : Application of Carageenan

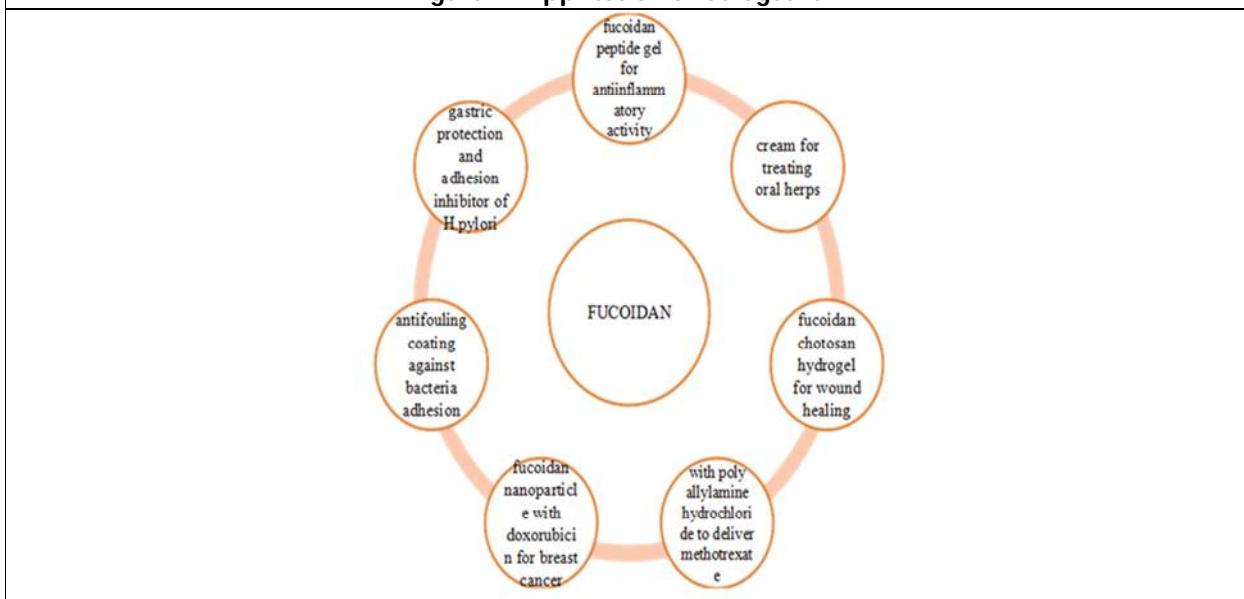


Figure 2: Applications of Fucoidan





Fastest Agricultural Data Gathering using Energy Efficient Data Transmission in Wireless Sensor Networks

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ABSTRACT

Environmental elements in agricultural structures must be monitored and controlled in order to increase energy efficiency and productivity. Real-time monitoring enables for the early detection and rectification of unfavourable circumstances, allowing for better consumption and disease protection. This paper describes an automated method for monitoring farm conditions with the goal of improving agricultural efficiency and quality. Wireless sensor networks are a captivating field of study with numerous applications. Weather, temperature, humidity, pressure, and other environmental conditions are monitored by a wireless sensor network (WSN). A WSN is made up of multiple sensor nodes that have complete control over sensing, aggregation, and data transmission to the destination. Sensors placed in agricultural areas can detect favorable environmental conditions for cultivation. The focus of this paper is on statically deploying nodes in agricultural land to detect temperature, humidity, and pressure. This paper's deployment is intended to cover the entire agricultural area. To improve energy efficiency and network lifetime, energy efficient clustering and data aggregation are also proposed. The simulation results demonstrate how this algorithm improves energy efficiency, decreases latency, and increases network lifetime to monitor the agriculture areas.

Keywords: Temperature, Humidity, Pressure, Centroid, Clustering, static deployment, data aggregation and routing.





INTRODUCTION

Electronic devices and technologies that can improve production efficiency, simplify harvest processes, and reduce environmental impacts are required in today's agricultural system. Agriculture is important in the lives of both animals and humans because it provides food. It is also the primary source of income for humans. However, in today's world, agriculture has begun to deteriorate in many countries due to a lack of labor and technological support. Agriculture is influenced by the climate and temperature of a specific location. Crop yield may be reduced due to changes in humidity, pressure, temperature, water level, and soil fertility. As a result, environmental parameters must be monitored in order to manage crop growth and improve production. There are numerous technologies available to save time, water crops, use pesticides and fertilizers, reduce cultivation costs, and so on.

Wireless sensor networks are appealing in agriculture because they can provide low-cost solutions to a variety of real-world problems. A wireless sensor network is a self-configured network that detects physical changes in the environment with no additional infrastructure required. WSN is a network of tiny devices known as sensors that are outfitted with radio frequency transceivers, microcontrollers, and power sources. Sensor nodes collaborate to monitor physical or environmental conditions, and they generate a large amount of data that must be routed from the network to the sink/base station via multiple hops. In a WSN environment, Amutha [1] discusses the use of seismic, thermal, acoustic, visual, magnetic, radar, and infrared sensors. Sensors are classified into three types: static, mobile, and hybrid. Static sensors do not move, whereas mobile sensors can move across the network to collect data, and hybrid sensors are a mix of static and mobile sensors. Sensors can range in size from the size of a dust particle to the size of a shoe box. Wireless sensor networks are used in a wide range of applications, including health care monitoring, military surveillance, greenhouse gas monitoring, underground coal mines, industrial automation, and environmental monitoring. WSNs' primary concerns include low node energy levels, node identification, hardware failure, node positions, network scalability, node deployment, and so on. WSN has a number of advantages as well. It is based on event detection and is self-configurable, flexible, cost-effective, and compact. Sneha [2] discusses how energy plays a significant role in determining the lifespan of wireless sensor networks. It is difficult to replace or recharge a sensor node's battery in an unattended and uninhabited environment. As a result, energy efficiency is critical to the lifespan of any sensor node.

Ezhilarasi discusses in [3] how nodes in a network must be aware of their neighbors in order to send a network-required message. There are several methods for locating a network node, each with benefits and drawbacks. A localization method's goal is to determine the precise location of a node, which is difficult in most real-time applications. As discussed in Ezhilarasi's paper [4], knowing the location of the sensor nodes is necessary in order to be aware of the energy consumption of the nodes, as it contributes to energy efficiency, load balancing, and network coverage. When network nodes are aware of their location, data can be transmitted to a base station with the least amount of energy and in the shortest amount of time, according to Nagarajan [5]. WSN in agriculture can aid in the monitoring of fields and crops, allowing farmers to avoid crop damage and increase yield. There are various sensors available for use in agricultural fields to detect soil moisture, water level, nitrogen level, soil fertility, pressure, humidity, temperature, and so on.

According to Hafiane [6.] the pressure sensor works by converting pressure into an analog electrical signal. For agricultural purposes, pressure is measured electronically using pressure switches and pressure transducers. Pressure transducers have a sensing element that detects a specific area and responds to the force exerted on that area by fluid pressure. The applied force deflects the diaphragm inside the pressure transducer. The internal diaphragm deflection is measured and converted into an electrical output. This enables any smart device or computer to display pressure. The presence of water in the air is defined as humidity. According to Liu [7], the amount of water vapour can affect human comfort as well as many agricultural processes. Humidity sensors can measure both air and moisture content. According to Rajakumar [8], a humidity sensor is also known as a dew sensor. The electric field is carried between them by two electrical conductors. The sensors are made up of two metal



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plates and a polymer conductor placed between two electrical conductors. Soil moisture sensors are used to determine the amount of water in the soil. Gao [9] discusses how it measures the volumetric water content of farmland. The soil moisture sensor operates at a voltage of 5V and a current of less than 20mA. The soil moisture sensor operates at temperatures ranging from 10 to 30 degrees Celsius. Rubala [10] discusses how biosensors are used to detect the presence of microorganisms and antibodies. It is used to assess plant infection. Temperature sensors are used in farmland states to measure temperature states Suma [11]. There are two types of temperature sensors: contact temperature sensors and non-contact temperature sensors. Temperature sensing is done either directly with the heating source or remotely, according to Tondwalkar [12]. Temperature can be detected using thermocouples, resistance temperature detectors, thermistors, infrared sensors, and semiconductor sensors. Thermistors are temperature sensing devices whose resistance changes with temperature and are made from agricultural semiconductor materials. In the device's operating range, a large resistance change for a very small temperature change can be observed and this makes it ideal for agricultural use. Pievanelli [13] describes the surface wetness sensor as a low-power electronic device for measuring surface moisture. It works by detecting the change in resistance across wet exposed carbon electrodes.

These sensors are used in the proposed work to detect temperature, humidity, pressure, and surface moisture in agricultural land. A static deployment strategy is used to place nodes in the agricultural field to cover and sense environmental conditions throughout the entire field. For energy-efficient data transmission, a balanced clustering and data aggregation approach is proposed. Dijkstra's shortest path routing sends data packets from cluster heads to base stations with the least amount of latency. The proposed [44] work's results show an increase in network energy efficiency, data transmission with reduced delay, data refinement to avoid duplication, and a longer network lifetime.

RELATED WORKS

Shahzadi [14] used wireless sensors to monitor crops in agricultural lands. Sensors installed in agricultural land measure water level, temperature, humidity, and pesticides. This method reduces the amount of time and effort required to grow crops, resulting in higher productivity. [15] Valente describes the use of wireless sensors to monitor soil moisture, humidity, and pressure. This method claims to reduce labor while increasing crop yield at a low cost. [16] Lakshmisudha monitored crops, watered, and fertilized the field using wireless sensors. [17] Garcia used mobile robot sensors to automatically control water pumps. When the water content of a land is low, the pump automatically turns on, and when the water content is high, the pump automatically turns off. [18] Verdouw proposed the Zigbee network, a wireless sensor network for measuring temperature and humidity. The deployed nodes monitor their surroundings and transmit data to the router. [19] Vuran and Akyildiz proposed a multi-layer approach to optimizing packet size in wireless sensor networks. It takes into account the effects of multihop routing, the broadcast nature of physical wireless channels, and error control methods. [20] Chan investigated the future architecture possibilities of integrated satellite in terrestrial networks using new radical technology. It incorporates multiple-access, multi-beam radio frequency satellite communications, wireless communications, free-space optical communications, analog transmission over optical carriers, and coherent distributed platform sensing and communications. [21] Sheriff and Gardiner emphasized the importance of addressing critical issues in the development of a fully integrated 3G mobile communication system with satellites and terrestrial links. [22] Sato developed a motion monitoring system for ski jumpers that incorporates terrestrial magnetism and acceleration sensors. These sensors are used to measure a ski jumper's in-run descending speed and take-off positions using a model of a ski jumping ramp. [23] Boria developed a sensor platform that can move both aerially and terrestrially [24]. To design and implement integrated network management, Baras proposed a satellite and hybrid communication network management centre. [25] Moraitis and Panagopulos investigate the impact of on-board base station emissions on terrestrial mobile stations. [26] Hu and Song designed and built a vehicle-mounted communication system for terrestrial networks like 2G, 3G, and ad hoc networks. [27] Sato implemented monitoring routine using terrestrial magnetic sensors. The sensors are attached to the worker's tools to ensure that the work is completed correctly and in accordance with the specified routine. [28] Ahmad demonstrated a first-order advanced energy consumption model for terrestrial wireless sensor networks. [29] Descamps prioritized driver assistance



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systems in order to improve the safety and automate the driving of future intelligent road vehicles.[30] Bachmann designed the morphing micro-air-land vehicle for surveillance and intelligence gathering. [31] Zhang proposed and tested terrestrial mobile networks for air-to-ground communications in general aviation. [32] Babbit presented a case study of gateway placement and leased line costs in satellite telephone networks. [33] Dean discussed how satellite and terrestrial components of personal communication systems can be integrated into the vision of a transparent and ubiquitous network that marketers and users have embraced.[34] Kapovits investigated the feasibility of seamlessly integrating terrestrial communication systems with satellite networks. [35] Chaudari devised a system for monitoring soil water and nitrogen levels in wheat cultivation. The WSN-based system collects shadow data in seven constrained-mobs. The spectral data is measured every 30 seconds and sent to the base station via multihop. [36] Korake demonstrated an anticipated system for monitoring environmental conditions for grape cultivation that optimises temperature and humidity measurement.[37] Shivaraj provided a brief overview of a few selected WSN implementation architectures used for environmental monitoring. [38] Kumar discusses a remote monitoring system for fluoride-affected areas that employs GIS, GPS, and GPRS technology. Remote devices can be used to monitor the fluoride sensor's status. [39] For efficient data transmission, Shen proposed the Energy Efficient Centroid-based Routing Protocol (EECRP). The nodes are randomly distributed and then arranged in the shape of a rectangle. The location of the nodes is identified during configuration when the network is deployed, and the location information of each node is loaded into the node. It employs a three-phase clustering approach. The base station is in charge of determining cluster location and formation. [40] For data transmission and load balancing, Haseeb proposed the Energy Efficient Secure IoT-based Framework (EESIF). Agriculture nodes are powered by a variety of energy sources. The dispersed agriculture sensors communicate using a single hop and have a cluster head for each area.

DETERMINISTIC NODE LOCALIZATION

The proposed work employs the D-Centroid (Deterministic Centroid) algorithm to statically deploy sensors in agricultural areas in order to monitor the appropriate environmental conditions for cultivation. To sense, aggregate, and transmit data, the nodes are deployed in predetermined locations. Sensors determine temperature, humidity, and pressure to determine the suitability of a particular area for the cultivation of fruits or vegetables in rural areas. The proposed work is subject to the following constraints:

1. The sensor nodes will be deployed deterministically based on the calculated Centroid.
2. In the sensing region, the base station acts as data collector.
3. The initial energy is the same for all network nodes.
4. The base station knows the coordinates of all the member nodes.
5. Using Hop count, each node is aware of its neighbors.
6. The sensor nodes communicate with each other using multihop.
7. The base station is monitored by a monitoring center or a remote device.

The following are the advantages of the D-Centroid algorithm over existing ones:

- i. The sensors are distributed evenly across the deployment area, with equal spacing between them.
- ii. Because the entire network is divided into grids and sensors are strategically placed throughout the grids, the network is completely covered.
- iii. Because the nodes' locations are fixed, node failures can be easily detected.
- iv. Data is transmitted to the base station via sensor nodes, which can be single hop or multihop.
- v. Because each node in the network is aware of its neighbors prior to data transmission, data delay is reduced.

As shown in Figure 1, the proposed work divides the entire network area into equal-sized squares to form a grid that runs the length of the network. This grid concept can aid in ensuring coverage across the network's area. The sensor nodes collect data from their surroundings and transmit it to the base station. The sleep-wake cycle is used to reduce energy consumption. The proposed work employs mesh topology to facilitate data transmission. There is no central coordinator node in the network. It uses multihop communication to send data to the base station. All of the sensor nodes communicate directly with the base station, which serves as an access point. The base station makes the global





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decision, and the data collected in the base station is monitored by an online monitoring centre or a remote device. The base station collects temperature, pressure, humidity, and other data from sensor nodes with minimal delay and transmits it to the monitoring centre. The D-Centroid algorithm works in three stages. The first is sensor node positioning, followed by data aggregation and finally by data transmission. In the first phase, the entire sensing area is divided into a grid, and the coordinate values of each square in the grid are passed to the D-Centroid algorithm, which computes the Centroid position for each square. For each square, the centroid is calculated using the following formula:

$$\text{Centroid}_{(x,y)} = \left(\frac{(x_1+x_2+x_3+x_4)}{4}, \frac{(y_1+y_2+y_3+y_4)}{4} \right) \quad (1)$$

The sensors are placed based on the Centroid of each square. This process will be repeated until all of the sensors are distributed evenly across the grid.

Pseudo code 1: Node Deployment

Start Procedure Node Deployment

Get inputs (l_n , b_r)

Let $\text{Region}_r = (l_n * b_r)$

Calculate No. of Splits $S = \text{Region}_r - 1$

Do Split Region_r into S equal Grids G

For each G

Calculate $\text{Centroid}_c = \left(\frac{(x_1+x_2+x_3+x_4)}{4}, \frac{(y_1+y_2+y_3+y_4)}{4} \right)$

End For

For each Centroid_c

Deploy Node_n

End For

End Procedure

ENERGY-EFFICIENT BALANCED CLUSTERING

Clustering in WSN is required when we want to extend network lifetime and reduce energy consumption. Loganathan [41] discusses how the deployed nodes are grouped to form clusters, and how cluster heads are chosen to transmit the sensed data to the base station. The cluster heads' roles can be rotated based on their residual energy. The proposed Energy-Efficient Balanced Clustering (EEBC) method selects cluster heads (CHs) from the deployed nodes based on their shortest distance to the base station. These CHs broadcast their IDs and coordinates to all nodes within their transmission range. The nodes receive this information and form clusters by joining the closest CHs. Figure 3 depict the proposed algorithm's cluster formation. Initially, the CHs are chosen based on their proximity to the base station; however, after each round, the residual energy of each CH is checked. An energy threshold E_{thrs} is defined and whenever the residual energy of the current CH reaches the threshold a new CH is selected. The new CH is selected based on the residual energy and distance to the base station. Assume that all the nodes are deployed with same initial energy, the energy threshold $E_{thrs}=84.4$ and energy of $CH=100$. If the energy level of $CH1$ falls to 84.1 after 50 rounds then the next CH needs to be selected among the members of the cluster. If a member in the cluster has energy of 91.8 and is close to the base station, it will be elected as the next CH. This process is repeated and all the members of the cluster get a chance to become the CH. This approach is energy efficient as it does not allow the energy of the nodes to drain out completely and can contribute to prolong network life.

SHORTEST PATH ROUTING ALGORITHM

To find the shortest path tree from a single source node, Dijkstra's algorithm constructs a set of nodes with the shortest distance from the source. It finds the shortest path from the source node to all remaining sensor network nodes. It works well in a weighted directed graph, with the cost of the links or edges not being less than zero. If the edge value is less than zero, the shortest path cannot be determined. Susan [43] discusses how we use Dijkstra's algorithm to transmit data packets from the cluster heads to the base station to improve energy efficiency. Since the





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D-Centroid algorithm focuses on static deployment, all nodes in the network have equal spacing, making calculating distances between them simple. The entire sensing area is represented as a weighted directed graph, with nodes serving as vertices and links between nodes serving as edges. The shortest distance between the source and the destination is zero, as is the shortest distance between the destination and the source. To indicate that the other nodes have not yet been processed, the distance between them is set to infinity. After processing all nodes, the shortest distance from source to destination is calculated. The distance between the source node and the other nodes in the network must be known in order to determine the shortest path from source to destination. The algorithm chooses a CH as the initial node for each round and assigns it a distance of 0. Following the first round, the current node will be the unvisited node that is closest to the starting point. The distance from the current node to every unvisited node that is directly connected to it is updated. This is accomplished by adding the spacing between the current node's value and the values of the unvisited nodes, and if that value is less than the current value, the unvisited node is relabeled with the sum value. If the previously recognized route is longer than the route to it via the current node, the node with the shorter distance value is marked. Following an update of the distances to each neighboring node, the current node is designated as the visited node, and the unvisited node with the smallest distance from the primary node is chosen as the present node. Nodes that have been marked as visited and have the shortest path from the start point will not be checked again. The process is repeated until the shortest distance neighboring nodes are obtained, at which point the current node is marked as visited and the process moves on to the nearest unvisited node until the destination is marked as visited. When both the initial and destination nodes are marked as visited, the algorithm can be stopped by determining the shortest path to the target from the primary node.

Pseudo code 5: Shortest path Routing

Start Procedure Dijkstra (Grid G , source u)

Create node set P

For every node e in G

Distance[e] $\leftarrow \infty$

Previous[e] \leftarrow Undefined

Move e to P

Distance[u] $\leftarrow 0$

While P is not null

$f \leftarrow$ node in P with minimum distance[f]

Remove f from P

For every nearest e of f

Weight \leftarrow distance[e] + length (e, f)

If weight < distance[e]:

Distance[e] \leftarrow weight

Previous[e] $\leftarrow f$

Return distance [], previous []

End If

End For

End For

End Procedure

SIMULATION RESULTS

The proposed work is being simulated in a 100 m x 100 m field with 100 sensors deployed. The proposed work compares EECRP [38] and EESIF [39] with parameters such as accuracy, delay, energy consumption, and network lifetime. The simulation experiments are carried out with the help of Network Simulator2 (NS2), a well-known open-source and best simulation tool for evaluating network routing and communication. Table 1 shows the simulation parameters and their default values. The simulation results are evaluated over a number of rounds.



**Poomimha and Senthil Kumar****Accuracy**

When compared to previous works, the proposed work is more accurate. In the proposed work, sensors are distributed evenly across the agricultural land to collect data from every corner. When compared to existing works, the proposed work improves accuracy by 11% and 14%, respectively. The accuracy of sensors in the sensor agricultural field can be affected by the arrangement of sensors in EECRP [39]. The GPS system locates the nodes in EESIF [40], and due to heterogeneous energy levels, the data sensed may have decreased accuracy based on the energy of the nodes to sense data. Table 2 displays the temperature readings sensed for one day using EECRP [39], EESIF [40], and the proposed work, and Figure 5 compares the proposed work's accuracy to the existing works.

Throughput

Figure 6 compares the proposed work to existing works EECRP [39] and EESIF [40] in terms of network throughput under different simulation rounds. The simulation experiments show that the proposed work improves network throughput performance by 27 and 38 percent, respectively. The robust and link-aware cluster heads that are evenly distributed throughout the agricultural land are responsible for the improved network throughput performance. Unlike other solutions that do not take signal strength measurements between sensor nodes into account, the proposed work incorporates an intelligent selection decision for choosing cluster heads, which increases the ratio of packet delivery in agricultural land due to their robust behavior. Furthermore, the proposed work's increased network throughput over existing solutions is due to data aggregation. EESIF [40] divides all agricultural land into distant areas, with CH nominated for each. The GPS system is used to determine the location. The GPS system determines packet delivery. EECRP [39] deploys sensors at random but later arranges them in a rectangle. Because the base station determines the location of the sensors, packet delivery generates a significant amount of network traffic.

Delay

Figure 7 depicts the performance of the proposed work versus the existing work in terms of delay. The experimental results show that the proposed work improves the network latency ratio by 21% in EESIF [40] and 47% in EECRP [39], respectively, when compared to existing solutions. The proposed work selects energy-efficient cluster heads for data routing to BS. The proposed work employs a hybrid data transmission mode that combines single-hop and multihop transmission based on the distance to the base station. Dijkstra's shortest path algorithm is used for multihop transmission to transmit data to the base station within a specific time period. EESIF [40] employs single hop transmission, which rapidly depletes the energy of the CHs, and due to the heterogeneous energy of sensors, node failures can occur. EECRP [39] employs hybrid deployment, with CHs communicating directly with the base station. The base station chooses these CHs based on maximum energy. Data packets from CHs located far from the base station may be delayed. Packets may be lost if the CH's transmission range does not reach the BS.

Energy

In Figure 8, the energy consumption of the proposed work is compared with EECRP [39] and EESIF [40]. It is seen from the simulation results that the proposed work improves the ratio of energy consumption with other solutions by 51% in EESIF [40] and 62% in EECRP [39]. The proposed work distributes the load of energy consumption among sensor nodes in an even manner. The proposed work selects optimal CHs based on residual energy and proximity to the base station. The rotation of CHs is based on the energy threshold in order to keep the energy of all nodes in a cluster balanced. The formation of balanced clusters can evenly distribute network load. BS controls the process of cluster head selection and cluster formation in EECRP [39]. As the cluster heads communicate directly with the base station, they consume more energy, which can lead to frequent node failures. EESIF [40] selects cluster heads based on maximum energy. The nodes are assigned different levels of energy; nodes with less energy may die as the number of rounds increases. It also necessitates a long transmission range to send data packets, which consumes more energy.



**Poomimha and Senthil Kumar****Network Lifetime**

Figure 8 shows the comparison of network lifetime of the proposed work with the existing works. The lifetime of the network is increased by 54% compared EECRP [39] and 39.6% compared EESIF [40]. In the proposed work the network lifetime is extended due to minimized energy consumption. The energy threshold is set according to the energy consumed after several rounds which allows the nodes to balance its energy. In the existing works more energy consumption is seen as a result of direct communication to the base station and high transmission range. The proposed work deploys the sensors evenly with equal distance among them which makes the transmission range of all the sensors equal which can contribute to minimize energy consumption

CONCLUSION

Many sensors are used to collect environmental data from crop plantations, and the system delivers real-time environmental monitoring and a variety of application services based on the data. The proposed agricultural environment monitoring method can work without requiring any external source of power in an agricultural environment with limited power infrastructure by using a solar cell. Environmental information can be monitored even at a remote location if the agricultural environment monitoring proposed in this paper is applied, and it is expected that this will help farmers increase crop yields and improve quality in the agricultural field through information analysis. In this paper, the static deployment of nodes in wireless sensor networks is considered, and an energy-efficient static deployment algorithm Deterministic Centroid is proposed for enhancing coverage in the agricultural areas. The entire deployment area is covered while deploying the nodes and the base station knows the location of all nodes in the network. This algorithm determines the optimal number of cluster heads based on the number of deployed nodes and generates balanced clusters to efficiently manage the network load. The distance to the base station is taken into account before transmission, the energy required for transmission is balanced across all clusters, increasing network lifetime.

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Table 1: Simulation parameters

Parameter	Value
Network size	100 x 100
No. of sensor nodes	100
Deployment	Static
Radio propagation range	300 m
Channel capacity	2 M bits/s
Initial energy	1 J
Data packets	3200 bits
Energy threshold	85 %
Simulation time	180 s





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Table 2: Readings of Temperature sensed

Time (01-06-2021)	0:00	3:00	6:00	9:00	12:00	15:00	18:00	21:00	23:30
EECRP	16	21	16	18	19	19	17	16	15
EESIF	16	20	15	18	20	19	16	16	16
Proposed work	16.5	20.8	15.7	18.3	18.9	19.1	16.8	15.7	16.4

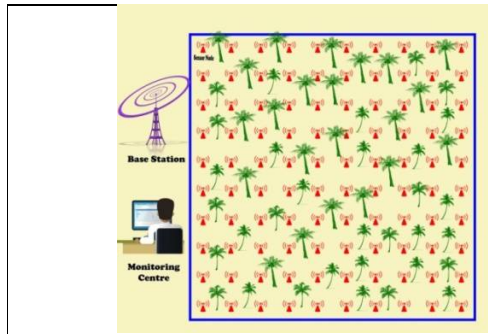


Figure 1. Node Deployment using D-Centroid

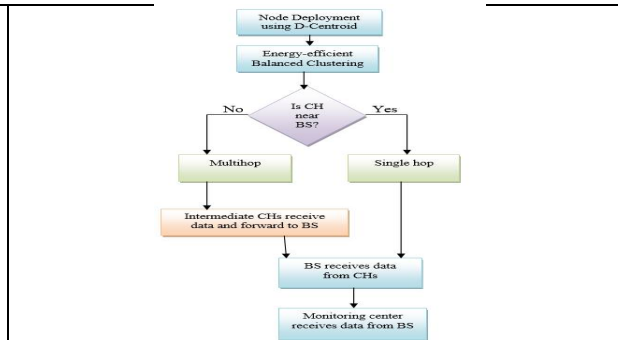


Figure 2. Flow of data from source to destination

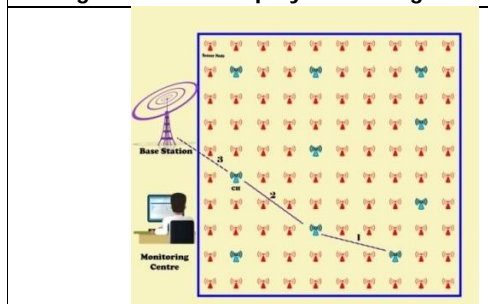


Figure 3. Shortest path routing

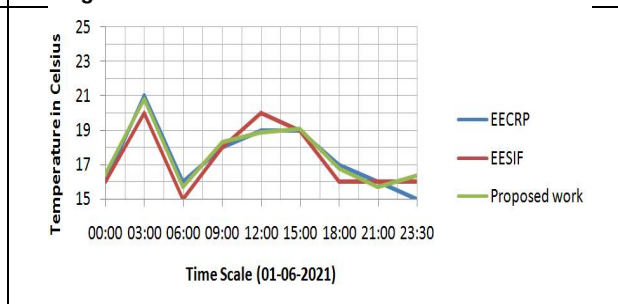


Figure 4. Comparison of Accuracy in EECRP, EESIF and Proposed work

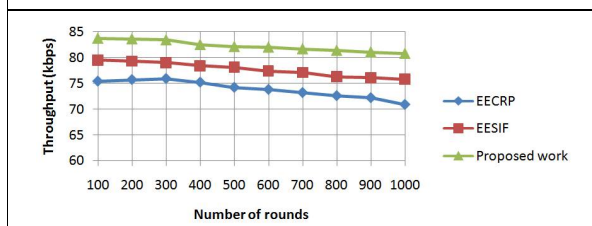


Figure 5. Comparison of Throughput performance in EECRP, EESIF and Proposed work

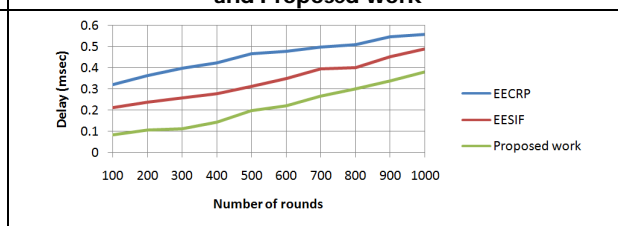


Figure 6. Comparison of Delay in EECRP, EESIF and Proposed work

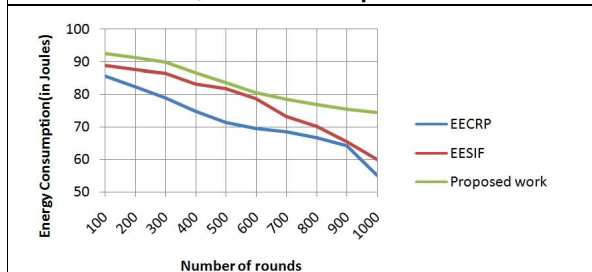


Figure 7. Comparison of Energy Consumption in EECRP, EESIF and Proposed work

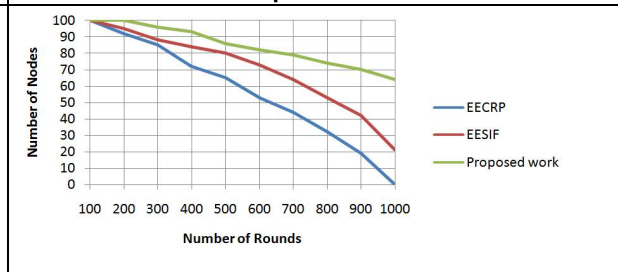


Figure 8. Comparison of Network Lifetime in EECRP, EESIF and Proposed work





RESEARCH ARTICLE

Regulatory Tools: Refuse to Receive and Refuse to File

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ABSTRACT

The Food and Drug Administration's (FDA) processes and timetables for examining submitted applications have significantly changed. When a new or generic drug application is submitted to the FDA, the FDA reviewing division conducts an initial evaluation to determine the completeness of an application. An ANDA or NDA can be refused by FDA if the agency believes that the applications are incomplete and therefore unable to be reviewed further. This article focuses on the FDA process, timeline and determinants for RTR or RTF of an ANDA and NDA respectively. RTR and RTF act as regulatory tools for efficient and effective review of applications and promote greater transparency to improve the quality of the applications. Due to the ever-increasing complexity of the applications, future applicants and sponsors with the help of Agency guidance's and interaction with FDA, must aim to submit substantially complete applications to prevent RTR or RTF decision by the FDA.

Keywords: Refuse to Receive, Refuse to File, Generics, FDA, ANDA, NDA.



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INTRODUCTION

Over the course of time FDA has developed strategic procedures and plausible timelines to review applications in a way that benefits both, the Agency as well as the applicants. With this evolution, the complexity of applications leads to the refuse to receive (RTR) and refuse to file (RTF) concept through which FDA determines completeness of an application. When the FDA receives an application for a new drug, biologic or a generic drug, the reviewing division evaluates if the application is appropriately complete to qualify for a comprehensive review. If an application is found to be deficient, the FDA can simply refuse to review it. In such cases, the agency issues a RTR or RTF letter to the company.

The following letters are issued if the application is found deficient prior to conducting a substantive review:

- Refuse to File (RTF): New drug 505(b)(1) procedure
- Refuse to File (RTF): New versions of old drugs 505(b)(2) procedure
- Refuse to receive (RTR): Generic drugs 505(j)

These actions allow FDA to notify the applicant and help companies remedy the deficiencies and avoid receiving a complete response letter. However, applicants are presented with an opportunity to correct minor deficiencies within 7 calendar days of notice of such deficiency. If the required information is not provided within this time, the agency will either RTR or RTF the application. As of yet, FDA has not made a threshold finding that an application is sufficiently complete to warrant further examination.^[1]

DISCUSSION

Refuse to receive

FDA may RTR an ANDA application if it does not comprise of certain essential information.

There are 2 types of application deficiencies (Figure 1):

Minor deficiency

If the FDA discovers deficiencies that are minor in nature and can be easily addressed, the applicant is provided with an opportunity to correct such deficiencies within seven calendar days. On successful correction of the application within seven calendar days, the ANDA submission will be received by the FDA to continue with the further review [1].

Major deficiency:

Reasons for an RTR determination [1]

a) Form 356h

If the application form is not included or signed or is missing relevant information, this suggests, the applicant has failed to attest to the information provided in the application.

b) Submission, format and organization

Electronic submissions of all applications in the eCTD format are required as of May 5, 2017. The application for an ANDA must be submitted according to the eCTD format. An application not in compliance with this requirement will be subject to a RTR determination.

c) Non-Payment of GDUFA Obligations

Failure of GDUFA fee payment at the time of submitting an ANDA application and in certain cases, a RTR may also be issued if there are unsettled fee obligations (DMF fee, facility fees etc.)

d) Absence of a U.S. Agent Designated for a Foreign Applicant

Assuming an applicant is located outside of the United States and has not appointed a U.S. representative or if an authorised representative of the applicant has failed to sign the application form.



**Shikha Tambeet al.,****e) Product quality deficiencies**

- a) Any inactive ingredient appearing in the inactive ingredient database (IID) used at a level exceeding the approved listings without an appropriate justification.
- b) Inadequate stability
- c) If the container closure system fails to package an acceptable quantity of the finished pharmaceutical product as proposed in the ANDA application.
- d) If blank and executed batch records along with reconciliation sheets are not provided.
- e) Reports of validation and verification methods not provided.
- f) Inconsistent functional scoring setups compared to the medication indicated in the Reference (RLD)
- g) Unpredictable variations in the composition of the medicine packaging that could compromise its efficacy and safety.
- h) Lack of supporting evidence to validate the exceeding qualification levels for specified identified and unidentified impurities.

f) Bioequivalence and clinical deficiencies

- a) Lack of information in case of failed in vivo BE study.
- b) An insufficient reason for one or more in vivo experiments that are not recommended by the BE advice.
- c) No uniformity requirements for in vivo BE waiver consideration have been established for Q1 and Q2.
- d) Data about the dissolution is insufficient. Research in a laboratory setting.
- e) To support a waiver of in-vivo BA or BE research for class I of BCS classification, there must be sufficient evidence or reason.

Response by the applicant**A partial response is not accepted to an RTR decision by the FDA.****• Once FDA issues a RTR determination, an applicant may either:**

- a) Try to correct all deficiencies identified and resubmit a complete ANDA that is substantially complete.
 - b) Withdraw the application under 21 CFR 314.99.
 - c) Decide to take no further action. No action for a period of one year, FDA may consider the application to be withdrawn.
- Upon resubmission of remedied deficiencies, there is a possibility that the FDA may RTR a resubmission if the application lacks an adequate and comprehensive response to address the deficiencies previously identified in the RTR letter. A subsequent RTR typically, occurs due to failure to adopt the recommendations relevant to filing (e.g., recommendations set forth in RTR guidance's and in product-specific bioequivalence guidance's).^[2]

RTR Guidance's:

Due to the complexity of the applications and stringent approaches adopted by FDA for reviewing applications, the agency has developed guidance documents that represent the agency's current thinking regarding a specific topic. These guidance documents are intended to guide the applicant for submitting a substantially complete application thereby preventing FDA from issuing a RTR. It highlights certain repetitive inadequacies that have contributed to a RTR determination.

Preventing recurrences of inadequacies previously detected by the FDA is the goal of the advice, which helps applicants prepare original ANDAs and prior approval supplements (PASS).

Criteria

1. candidate requesting approval of a new power
2. The repackaging of a drug product without the necessity of submitting an original ANDA
3. Return of a discontinued product to the market
4. Rx to OTC switch.



**Shikha Tambeet al.,****The guidance available are**

The final guideline, ANDA Filing for Industry on Refusing to Receive Standards, outlines recurrent problems that have resulted in application refusals. The preliminary advice, ANDA Filing to Receive Due to Inadequate Justification of Impurity Limits, addresses certain issues related to impurities and impurity limits that could result in an FDA refusal to receive conclusion.

Disagreement with a decision to deny to receive

When the FDA determines that an application cannot be received and issues an RTR, in certain cases the applicant may disagree with the determination made by the FDA. The applicant can proceed to challenge the decision and resolve the queries by submitting its concerns by email address provided in the RTR letter or through a teleconference. If the issue at hand cannot be resolved, the applicant can also use the dispute resolution procedure (21 CFR 314.103) and industry guidance (Formal Dispute Resolution: Appeals above the Division Level). Formal Dispute Resolution: Appeals Above the Division Level (21 CFR 314.103 and industry advice).^[1]

Reconsideration of an RTR determination

After the FDA notifies the application of an RTR determination, the applicant has seven calendar days to request a reconsideration. Justification evidence must be provided to support the allegations made in opposition to the FDA's determination by an application [2].

RTR statistics

The graph (as in figure 2) depicts that over the course of FY 2016 through 2018, the FDA received a record-breaking number of ANDAs and rejected a record-breaking number of them.

The top RTR deficiencies included [3]

1. Inadequate stability data
2. Inadequate dissolution data
3. Lack of justification for proposed limit of drug product and/or drug substance impurities or degradation products
4. Incomplete response to screening deficiencies
5. Drug product is not qualitatively and quantitatively identical to reference listed drug
6. Incomplete/Inadequate BE study data.

Refuse to file

Refuse to file is one other regulatory tool employed by the FDA for refusing to file for review new drug applications (NDA). Review of NDA's are extensive in nature which significantly require a long period of time. In order to preserve the review division's resources, applications are subject to an initial filing review to assess its completeness. Thereby, appropriately allotting resources, time and effort to applications that are determined to be substantially complete. Each new drug application (NDA) and biologics license application (BLA) that is submitted for review undergoes a preliminary examination to see if it deserves further investigation. If the submission does not meet the requirements of section 505(b) of the Food, Drug, and Cosmetic Act and 314.50, the FDA has the option of rejecting the application. As a result, the review process will not conclude with the delivery of a full response letter [4].

Filing issues are grouped into two categories:

1. Those deficiencies determined to be easily correctable during an initial review, provided the applicants can address these deficiencies within a limited period before submission.
2. Defects that cannot be corrected before filing that are extremely complex. Examples of such deficiencies include:
 - a) Substantially deficient or ineffectively organized applications that would lead to an improper, time consuming and inefficient review by all the relevant disciplines.
 - b) Insufficient information on multiple indications of an application.



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- c) When FDA and applicant previously determined the need for demonstrating effectiveness by conducting more than one trial to support the application.
- d) If a drug has the potential to lead to a drug abuse, studies relating to the consequences of drug abuse is mandatory under the drug scheduling under the “Controlled Substances Act” and the anti-dote to counteract the effect is required to support the new drug application. Failure to submit these assessment studies may lead to aRTF.
- e) The FDA will not accept submissions that are not in eCTD format after May 5, 2017, unless they are exempted from the requirement.
- f) The FDA will not evaluate submissions that are not submitted electronically and do not follow the format guidelines set forth in section 745A of the FD&C Act.
- g) Upon initial review of new molecular entity NDA's and BLA's, if minor deficiencies of the application were agreed upon for late submission during the pre-submission meeting, and if such information is not provided within 30 days of receipt of the application, the FDA may issue a refuse to file letter.

An application that includes all of the necessary indications may be approved, but the FDA may deny submission of any portions that are judged deficient for other indications [4,5].

Guidance's

Industry Guidance on NDA and BLA Submission Refusal

The guidance documents are in place to assist the prospective applicants in understanding the conditions that can potentially lead to an RTF decision by the agency. These guidance's provide the applicant an opportunity to avoid certain obvious errors before filing an application and in turn aiding the agency to preserve their time and resources for potential applications. The purpose of such documents is not to evaluate the data provided but rather assess whether the data is present at all.

FDA determination and notification

An internal filing meeting is conducted, head by the division director where a final filing determination is made. If a refuse to file determination is reached by the division director, the RTF decision will be communicated to the applicant within day 60 through a formal communication [4].

Applicant Response

Once the reviewing division of the CDER has reached an RTF decision, the applicant holds the right to request an informal conference with the FDA. FDA grants approval to conduct this meeting if the request is submitted within a 30-day time period of the RTF decision. This meeting is held to determine whether the FDA should file the application [4].

An applicant can respond in 2 ways

- a) Following the discussion with FDA, the applicant makes the recommended changes to correct the deficiencies to further allow filing of the application.
- b) Applications pending review or applicant requesting FDA to file the application without amendments tend to be a result of protest pursuits in accordance with 199 and 314.101 (a)(3). The applicant will be notified in writing and application will be filed for review.

Consequences of an RTR/RTF

If the agency determines that an application cannot be received or filed with the reviewing division, the following implications are observed:

1. Delay in approval process and rework
2. Loss of market exclusivity
3. Loss of ANDA fee: 25% loss of application fee (GDUFA Fee)
4. Failure to meet original submission deadline.
5. Negative impact on department efforts



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6. The harm to the reputation and financial situation of a company can be irredeemable
7. Production lines are affected: Delay in launch of product and availability in market.

Generics

The concept of generic drugs was modernized in 1984 under the Hatch-Waxman Act. This Act created an abbreviated mechanism for generic drug approvals, stating that pre-clinical and clinical assessment will not be necessary. A generic drug can be marketed after the patent and exclusivity protection has expired, or been waived, and when FDA scientific and regulatory issues are met. Generic drug applications are evaluated by the Office of Generic Drugs (OGD), an independent branch within FDA's Center for Drug Evaluation and Research (CDER), for safety and efficacy before approval. There are no differences between a generic and a branded product in terms of dose form or strength, mode of administration, efficacy, or intended purpose. Generic products are approved under the 505(j)-pathway providing a provision for an abbreviated review of the generic drug applications. Typically, non-clinical and clinical data are not required to support an ANDA application, however, bioequivalence studies are deemed necessary. Once approved by the OGD, the applicant may continue to manufacture the product in bulk and distribute the product at a cost lower than the brand product [6].

NDA and ANDA review process

An NDA or ANDA review by the agency typically follows the below process (as shown in figure 3):

Fee Structure

GDUFA Fees:

User fees must be paid by the industry to cover the costs of evaluating generic drug applications and facility inspections. The GDUFA program fee will be evaluated once a year. Each company and their affiliates will also be evaluated based on the program structure depending upon the number of approved ANDA's in their portfolio.

- GDUFA was signed into law in US on July 9th, 2012. It played a very important role in reducing the timeline for reviewing generic drug applications from 31 months to 10 months.
- The GDUFA is a 3-tierfee program which differentiates between certain application types, explained in figure 4.
- Each fiscal year's programme fee must be paid no later than October 1. On days when the FDA is otherwise closed (weekends, federal holidays, etc.), the fee is due the next business day.^[7]
- On the day the application is submitted, ANDA payments are required.
- FDA will automatically repay the applicant for 75% of the filing cost if it decides to RTR an ANDA for grounds unrelated to nonpayment.
- Refund requests should be sent as quickly as possible to speed up the process, according to the FDA. Refund requests should be made using FDA Form 3913, which should be emailed to CDERCollections@fda.hhs.gov. Form FDA 3913 is available at <http://www.fda.gov/downloads/AboutFDA/ReportsManualsForms/Forms/UCM492188.pdf>
- Applicants that submit a resubmitted application after FDA previously declined to accept it will be required to pay.
- In case of a dispute resolution of the RTR decision, the applicant is not required to resubmit the application even if the deficiencies were not remedied and therefore the application is not subject to re-payment of the fees [7].

PDUFA fees

Congress enacted the Prescription Drug User Fee Act (PDUFA) in 1992. The implementation of this act allows the FDA to obtain fees from companies involved in the manufacturing of drugs and biological products. This allowed the FDA to allocate adequate time and resources to review an application that has the potential to be marketed. The application fees are due at the time of submission to the FDA. Each prescription medicine listed in a human drug application that has been approved as of October 1st of that fiscal year is subject to the programme fees.



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The FDA has designed a PDUFA user cover sheet- FORM 3397 for applicants to understand whether an application fee is required, and the amount associated with the application. Digital portals are available for making payments (User Fees Payment Portal). You can also send in a wire transfer to the FDA with a bank demand draught, a US postal money order, or a cheque [8]. PDUFA user fee rates (figure 5):

CONCLUSION

Refuse to receive and refuse to file are regulatory tools employed by the FDA to reduce the gaps in the quality of applications leading to a more rapid approval of drugs and biological products. To prevent inadequate and incomplete applications from being filed and undergoing review, the responsibility to meet agreed-upon criteria lies with the applicant. The guidance drafted by FDA and pre-submission meetings conducted are a few approaches to improve the quality of the applications as well as increase effective communication between FDA and the applicants. At the outset, with the regulatory strategies and approaches in place, the number of applications issued a RTR or RTF have been significantly reduced.

ACKNOWLEDGMENTS

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Type of deficiency	Definition	No. of acceptable deficiencies	Time period for remedy
Minor	Easily identified and correctable deficiencies	Nine or fewer deficiencies	Within seven calendar days
Major	Cannot be easily remedied (Incomplete on its face)	Ten or more minor deficiencies or one or more major deficiencies	-

Figure 1: Application deficiencies [1]

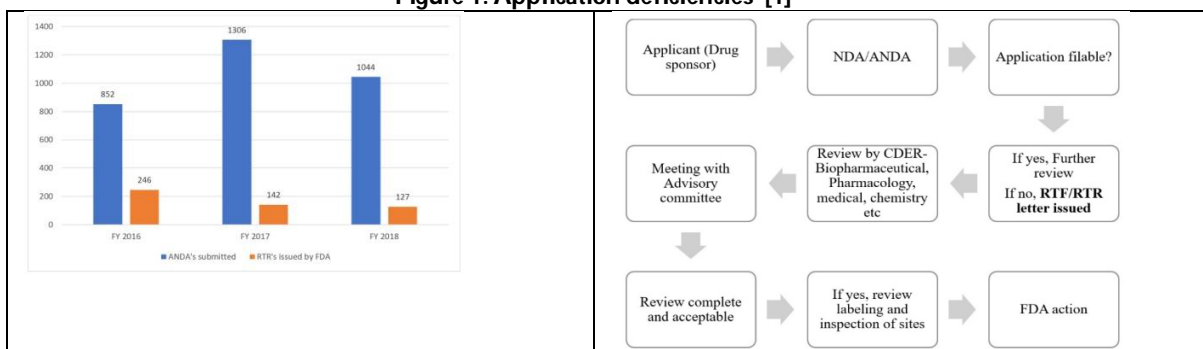


Figure 2: ANDA's submitted vs RTR's issued by FDA[3]

Figure 3: Review process of NDA/ANDA

User Fee Type		FY 2018	FY 2019	FY 2020
ANDA		\$171,823	\$178,799	\$176,237
DMF		\$47,829	\$55,013	\$57,795
Program	Large size (20 or more approved ANDA's)	\$1,590,792	\$1,862,167	\$1,661,684
	Medium Size (6-19 approved ANDA's)	\$636,317	\$744,867	\$664,674
	Small size (5 or fewer approved ANDA'S)	\$159,079	\$186,217	\$166,168
Facility	Domestics API	\$45,367	\$44,226	\$44,400
	Foreign API	\$60,367	\$59,226	\$59,400
	Domestics FDF	\$211,087	\$211,305	\$195,662
	Foreign FDF	\$226,087	\$226,305	\$210,662
	Domestics CMO	\$70,362	\$70,435	\$65,221
	Foreign CMO	\$85,362	\$85,435	\$80,221
Backlog		\$17,434	\$17,434	\$17,434

Figure 4: GDUFA II User Fee Rates[7]

User Fee Type	2020	2019	2018
Application Fee- Clinical Data Required	\$2,942,965	\$2,588,478	\$2,421,495
Application Fee- No Clinical Data Required	\$1,471,483	\$1,294,239	\$1,210,748
Program Fee	\$325,424	\$309,915	\$304,162

Figure 5: PDUFA user fee rates[8]





Effect of Silicon and Phosphorus on Growth and Yield of Wheat (*Triticum aestivum* L.) in Loamy Sand Soils of North Gujarat

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ABSTRACT

A field experiment was conducted at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during Rabi season of 2020-2021. Experimental soil was loamy sand in texture with pH 7.01 and electrical conductivity 0.19 dSm⁻¹. The soil was low in organic carbon (0.39%) and medium in available phosphorus (38.10 kg ha⁻¹) and available potassium (191.25 kg ha⁻¹). Available silicon in soils was 60.75 mg kg⁻¹. The experiment consisted of four levels of phosphorus (0, 30, 60 and 90 kg P₂O₅ ha⁻¹) and four levels of silicon (0, 100, 200 and 300 kg Si ha⁻¹). Totally sixteen treatment combinations were laid out in randomized block design with factorial concept and replicated thrice. All the plots received a uniform recommended dose of nitrogen @ 120 kg ha⁻¹. The results of the field experiment clearly indicated that among the levels of phosphorus, application of phosphorus @ 60 kg ha⁻¹ recorded the significantly highest number of effective tillers plant⁻¹ (5.06), grain yield (3808 kg ha⁻¹) and straw yield (5729 kg ha⁻¹). The highest number of effective tillers plant⁻¹ (5.11), grain (3619 kg ha⁻¹) and straw yields (5584 kg ha⁻¹) was recorded with the application of 100 kg Si ha⁻¹. Maximum number of effective tillers plant⁻¹ (6.03), grain (4304 kg ha⁻¹) and straw yields (6201 kg ha⁻¹) was found with interaction effect of 60 kg P₂O₅ ha⁻¹ with Si level at 100 kg ha⁻¹. The results of experimentation concluded that application of 60 kg P₂O₅ ha⁻¹ along with 100 kg Si ha⁻¹



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recorded higher wheat growth character and yield in loamy sand under North Gujarat Agro-climatic conditions.

Keywords: Wheat, Silicon, Phosphorus, growth, yield attributes and yield

INTRODUCTION

Wheat (*Triticum aestivum* L) is the most extensively grown cereal crop in the world, covering an area of 237 million hectares annually, accounting for a total production of 420 million tonnes (Isitor *et al.*1990). It is grown all over the world as an important source of carbohydrates along with rice and corn. It is the leading source of vegetable protein in human food, having a protein content of about 13%. Phosphorus (P) is an essential macronutrient which is essential in plant growth. It is one of the major plant growth-limiting nutrients despite its abundance in soils in both inorganic and organic forms (Gyaneshwar *et al.*, 1999). It is absorbed by plants in orthophosphate ($H_2PO_4^-$ and HPO_4^{2-}) forms (Hinsinger, 2001). In plants, phosphorus plays an important role in physiological processes viz., photosynthesis, storage of energy and its transfer, respiration and cell enlargement and cell division; biochemical reactions within the plant which include Adenosine Triphosphate (ATP) and Adenosine Diphosphate (ADP). The structure of biochemical components of living things, viz., nucleic acid (DNA and RNA), nucleotides, phospholipids and phosphoproteins are not possible without phosphorus. Phosphorus is essential for wheat from seedling to maturity. It helps in formation of quality seeds, uniform heading and faster maturity. It also helps plants to survive in winter. Wheat uptakes P about 0.5-0.6 pounds of P_2O_5 per bushel. If the soil is deficient in phosphorus, plants will suffer from deficiencies like stunted growth, purple discoloration of stem and leaves, reduced root system and poor tillering. Silicon is the second most common element in earth's crust and the eighth most common element in nature. Each kilogram of soil usually contains 50 to 400 grams of Si. However, not all Si in soil is available to plants because most of them are locked up in recalcitrant silicate minerals and only a small fraction is available for plants. The soluble fraction of Si is redox and pH dependent. Cation exchange resulting from hydrogen (H^+) pumping by the root hairs of plants leads to nutrient uptake because the H^+ ions relocate the cations (negatively charged particles) that are attached to the soil particles into the plant roots. High soil sorption of phosphorus (P) in some P deficient low pH soils reduces the efficiency of P fertilizer use and crop yields. By increasing the monosilicic acid concentration within the soil solution, plants are able to absorb phosphates (P) directly. The quantity of monosilicic acid is increased due to chemical resemblance between phosphate and silicate anions causing a competitive reaction within the soil (Matychenkov and Ammosova, 1996).

MATERIALS AND METHODS

A field experiment was conducted at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during Rabi season of 2020-2021. Experimental soil was loamy sand in texture with pH 7.01 and electrical conductivity 0.19 dSm^{-1} . The soil was low in organic carbon (0.39%) and medium in available phosphorus (38.10 kg ha^{-1}) and available potassium ($191.25 \text{ kg ha}^{-1}$). Available silicon in soils was 60.75 mg kg^{-1} . Experiment consisted of four levels of phosphorus (0, 30, 60 and $90 \text{ kg P}_2O_5 \text{ ha}^{-1}$) and four levels of silicon (0, 100, 200 and $300 \text{ kg Si ha}^{-1}$). Totally sixteen treatment combinations were laid out in randomized block design with factorial concept and replicated thrice. All the plots received a uniform recommended dose of nitrogen @ 120 kg ha^{-1} . Plant population per meter was recorded at 60 DAS. Yield and yield attributes were recorded after harvest of wheat crop.

RESULTS AND DISCUSSION

Plant population per meter row length at 60 DAS

Plant population per meter row length at 60 DAS of wheat was not significantly influenced by application of phosphorus and silicon. Among the phosphorus levels, maximum plant population per meter row length (29.31) was



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recorded with the application of 60 kg P₂O₅ ha⁻¹ and minimum plant population per meter row length (27.83) was registered with P₀. Regarding the silicon levels, highest plant population per meter row length (29.03) was observed with 300 kg Si ha⁻¹ whereas lowest plant population per meter row length (27.95) was recorded with Si₀. The interaction effect of phosphorus and silicon on plant population per meter row length at 60 DAS was found non-significant.

Plant height (cm)

It was observed that plant height was not significantly influenced by the application of different levels of phosphorus and silicon. Maximum plant height (82.26 cm) was recorded with the application of 60 kg P₂O₅ ha⁻¹ and minimum plant height (74.31 cm) was observed without phosphorus application. Whereas, highest plant height (79.03 cm) was registered with application of silicon @ 200 kg ha⁻¹ and the lowest plant height (75.46 cm) was recorded with Si₀. The interaction effect between P and Si on plant height at harvest of wheat was found not significant.

Number of effective tillers plant⁻¹

Number of effective tillers plant⁻¹ varied significantly among the different levels of silicon and phosphorus and ranged from 4.17 to 5.11. Among the various levels of phosphorus, the highest number of effective tillers⁻¹ 5.06 was recorded with 60 kg P₂O₅ ha⁻¹ and the lowest (4.17) was registered with P₀. Reason for the highest number of effective tillers from the plots that were treated with 60 kg P₂O₅ ha⁻¹ is that phosphorus enhances many physiological processes and also enhances respiration, cell enlargement and cell division. Similar results obtained by Sato *et al.* (1996) who found that in wheat phosphorus deficiency reduces plant leaf area by producing a smaller and less number of leaves. In the case of silicon application, the highest number of effective tillers plant⁻¹ (5.11) was recorded with the application of 100 kg Si ha⁻¹ but lowest number of effective tillers plant⁻¹ (4.19) was recorded with Si₀. Ahmad *et al.* (2007) who investigated the role of silicon in fertilization of wheat in different soil humidity conditions reported that silicon application considerably improved plant biomass, height and ear weight. The presented results also confirm with their findings that application of silicon to wheat increased the number of effective tillers per plant. Among the interaction effects of phosphorus and silicon, application of phosphorus @ 60 kg ha⁻¹ with Silicon @ 100 kg ha⁻¹ recorded a significantly maximum number of effective tillers plant⁻¹ (6.03). The lowest number of effective tillers plant⁻¹ (3.71) was recorded with P₀Si₀. The Si and P interaction contributes to increased rice biomass, in which Si supply may alleviate excessive P application. The results are similar to the findings of Owino and Gascho (2005).

Length of ear head (cm)

Individual application of phosphorus levels, highest length of ear head (9.79cm) was registered with application of phosphorus @ 60 kg ha⁻¹ and lowest length of ear head (8.83cm) was observed with P₀. Whereas, application of silicon @ 100 kg ha⁻¹ recorded the highest length of ear head 9.44 cm and lowest length of ear head 9.01cm was found with Si₀. The interaction effect of P and Si was found to be non-significant with respect to length of ear head of wheat.

Number of spikelet ear head⁻¹

Number of spikelets ear head⁻¹ was not significantly influenced by different levels of silicon and phosphorus application. The maximum spikelet per ear head was found with the application of 60 kg P₂O₅ ha⁻¹ (13.98) and minimum (12.68) was recorded with P₀. While application of 100 kg Si ha⁻¹ to wheat recorded maximum number of spikelets ear head⁻¹ (14.07) and minimum (13.05) was observed under Si₀. The interaction effect of P and Si was found to be non-significant with respect to the number of spikelets ear head⁻¹.

Test weight (g)

It is evident from the data that different levels of phosphorus did not differ with respect to test weight (g) of wheat grain. Application of 60 kg P₂O₅ ha⁻¹ to wheat recorded maximum test weight (40.95g); while, minimum (39.25g) was recorded with P₀. The highest test weight (40.40g) was recorded with the application of 100 kg Si ha⁻¹ and lowest (39.71g) was found with 300 kg Si ha⁻¹. The interaction effect of P and Si was found to be non-significant with respect to test weight (g).



**Sureka et al.,****Grain yield (kg ha⁻¹)**

The results presented in data illustrate that wheat grain yield was significantly influenced by phosphorus and silicon application. The maximum grain (3808 kg ha⁻¹) yield was recorded due to application of 60 kg P₂O₅ ha⁻¹. The main reason for increase in grain yield with different levels of phosphatic fertilizer might be due to more effective tillers per plant which could be the result of higher rate of photosynthesis and better crop health which ultimately increased the final grain yield. Plants showed normal growth with the application of phosphorus and resulted in improved agronomic traits which lead toward improved grain yield (Sajil *et al.* 2016). Similar findings were reported with Jain and Dahama (2006) and Sharma *et al.* (2012). The significantly higher grain (3619 kg ha⁻¹) yield was recorded due to silicon application at 100 kg ha⁻¹; while the lowest grain (2981 kg ha⁻¹) yield was recorded under Si₀. The increase in yield with Si application could be due to the improving leaf erectness by decreasing mutual shading of leaves, reducing lodging, decreasing the incidence of pathogens and preventing manganese and iron toxicity or both. Application of Si, increased water use efficiency probably might be due to prevention of excessive transpiration. In case of interaction effect, the combination of phosphorus level *i.e.* 60 kg P₂O₅ ha⁻¹ with Si level at 100 kg ha⁻¹ showed significantly highest grain yield (4304 kg ha⁻¹). The lowest grain yield (2565 kg ha⁻¹) was observed in P₀Si₀. Schaller *et al.* (2019) stated that silicon addition significantly increases phosphorus mobilization by mobilizing Fe (II)-P phases from mineral surfaces. Li *et al.* (2020) also reported that combined application of silicon and phosphorus increased the grain yield and biomass in rice.

Straw yield (kg ha⁻¹)

Application of different levels of silicon and phosphorus has exhibited a significant influence on straw yield of wheat. The lowest straw (4853 kg ha⁻¹) yield was observed under P₀. The maximum straw (5729 kg ha⁻¹) yield was recorded due to application of 60 kg P₂O₅ ha⁻¹. Early tiller formation is significant to plant health and ultimately final yield potential. The initial tillers formed by the plant have higher yield potential than late tillers or delayed tillers. When adequate phosphorus is available in soil, resulting tillers will be healthier and productive. The results are in line with the findings of Jat *et al.* (2018) and Singh *et al.* (2018). Significantly highest straw (5584 kg ha⁻¹) yield was recorded due to silicon application at 100 kg ha⁻¹; while lowest straw yield (4828 kg ha⁻¹) was recorded under Si₀. The increase in yield with Si application could be due to the improving leaf erectness, reduction in lodging and decreasing susceptibility to plant pathogens and pests and preventing manganese and iron toxicity or both. Application of Si, increased water use efficiency probably might be due to prevention of excessive transpiration. In case of interaction effect, the highest straw yield of wheat crop was observed due to combined application of 90 kg P₂O₅ ha⁻¹ and 100 kg Si ha⁻¹ (6201 kg ha⁻¹) over the rest of the combinations. Ma and Feng, (1990) described that in water culture, when P is low Si causes a decrease in Fe and Mn uptake and thus promotes P availability within the plant. From these findings, it is clear that Si application alleviated the phosphorus uptakes which resulted in the increase in biomass of wheat crop.

CONCLUSION

From the results of one year experiment, it can be concluded that for obtaining higher wheat yield crop should be fertilized with 60 kg P₂O₅ ha⁻¹ and 100 kg Si ha⁻¹ along with recommended dose of nitrogen @120 kg ha⁻¹ in loamy sand under North Gujarat Agro-climatic conditions.

FUTURE LINE OF WORK

These results are only indicative and require further experimentation to draw more consistent and reliable conclusions. Some trials need to be tested under various locations to draw location specific conclusions.

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Table 1: Effect of phosphorus and silicon on plant population per meter row length and plant height at harvest of wheat

Treatments	Plant population per meter row length at 60 DAS	Plant height at harvest (cm)
Phosphorus levels		
P ₀ -0 kg P ₂ O ₅ ha ⁻¹	27.83	74.31
P ₁ - 30 kg P ₂ O ₅ ha ⁻¹	28.57	77.57
P ₂ - 60 kg P ₂ O ₅ ha ⁻¹	29.31	82.26
P ₃ - 90 kg P ₂ O ₅ ha ⁻¹	28.81	77.96
S.Em.±	0.77	2.31
C.D. (P=0.05)	NS	NS
Silicon levels		
Si ₀ -0 kg Si ha ⁻¹	27.95	75.46
Si ₁ -100 kg Si ha ⁻¹	28.20	78.86





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Si ₂ -200 kg Si ha ⁻¹	28.80	79.03
Si ₃ -300 kg Si ha ⁻¹	29.03	78.76
S.Em.±	0.77	2.31
C.D. (P=0.05)	NS	NS
Interaction		
P x Si	NS	NS
C.V. (%)	9.40	10.25

Table 2: Effect of phosphorus and silicon on yield attributes of wheat

Treatments	No. of effective tillers/plant	Length of ear head (cm)	No. of spikelets/ear head	Test weight (g)
Phosphorus levels				
P ₀ -0 kg P ₂ O ₅ ha ⁻¹	4.17	8.83	12.68	39.25
P ₁ - 30 kg P ₂ O ₅ ha ⁻¹	4.77	8.99	13.48	39.92
P ₂ - 60 kg P ₂ O ₅ ha ⁻¹	5.06	9.79	13.98	40.95
P ₃ - 90 kg P ₂ O ₅ ha ⁻¹	4.72	9.33	13.82	40.62
S.Em.±	0.13	0.30	0.39	0.48
C.D. (P=0.05)	0.38	NS	NS	NS
Silicon levels				
Si ₀ -0 kg Si ha ⁻¹	4.19	9.01	13.05	40.34
Si ₁ -100 kg Si ha ⁻¹	5.11	9.44	14.07	40.40
Si ₂ -200 kg Si ha ⁻¹	4.89	9.36	13.57	40.29
Si ₃ -300 kg Si ha ⁻¹	4.54	9.14	13.28	39.71
S.Em.±	0.13	0.30	0.39	0.48
C.D. (P=0.05)	0.38	NS	NS	NS
Interaction				
P x Si	Sig.	NS	NS	NS
C.V.(%)	9.75	11.25	10.09	4.13

Table 3: Interaction effect of phosphorus and silicon on number of effective tillers plant⁻¹ of wheat

No. of effective tillers plant ⁻¹				
Treatments	Phosphorus levels (kg ha ⁻¹)			
Silicon levels (kg ha ⁻¹)	P ₀	P ₁	P ₂	P ₃
Si ₀	3.71	4.38	4.13	4.54
Si ₁	4.57	5.02	6.03	4.81
Si ₂	4.30	4.53	5.53	5.20
Si ₃	4.12	5.16	4.54	4.35
S.Em. ±	0.26			
C.D. (P=0.05)	0.76			
C.V.(%)	9.75			

Table 4: Effect of phosphorus and silicon on grain and straw yields of wheat

Treatments	Grain yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)
Phosphorus levels		
P ₀ -0 kg P ₂ O ₅ ha ⁻¹	2789	4853
P ₁ - 30 kg P ₂ O ₅ ha ⁻¹	3049	5037
P ₂ - 60 kg P ₂ O ₅ ha ⁻¹	3808	5729





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P ₃ - 90 kg P ₂ O ₅ ha ⁻¹	3766	5506
S.Em.±	77.00	118.66
C.D. (P=0.05)	222.40	342.72
Silicon levels		
Si ₀ -0 kg Si ha ⁻¹	2981	4828
Si ₁ -100 kg Si ha ⁻¹	3619	5584
Si ₂ -200 kg Si ha ⁻¹	3459	5417
Si ₃ -300 kg Si ha ⁻¹	3354	5296
S.Em.±	77.00	118.66
C.D. (P=0.05)	222.40	342.72
Interaction		
P x Si	Sig.	Sig.
C.V.(%)	7.96	7.78

Table 5: Interaction effect of phosphorus and silicon on grain yield of wheat

Grain yield (kg ha ⁻¹)				
Treatments	Phosphorus levels (kg ha ⁻¹)			
Silicon levels (kg ha ⁻¹)	P ₀	P ₁	P ₂	P ₃
Si ₀	2568	2579	3123	3653
Si ₁	2721	3503	4304	3946
Si ₂	3034	3007	3939	3855
Si ₃	2832	3109	3866	3610
S.Em. ±	154.00			
C.D. (P=0.05)	444.80			
C.V. (%)	7.96			

Table 6: Interaction effect of phosphorus and Silicon on straw yield of wheat

Straw yield (kg ha ⁻¹)				
Treatments	Phosphorus levels (kg ha ⁻¹)			
Silicon levels (kg ha ⁻¹)	P ₀	P ₁	P ₂	P ₃
Si ₀	3739	5087	5450	5036
Si ₁	5162	4800	6172	6201
Si ₂	5262	4819	6094	5494
Si ₃	5249	5441	5201	5292
S.Em. ±	237.33			
C.D. (P=0.05)	685.45			
C.V.(%)	7.78			





Assess the Knowledge on Nutritional Deficiencies and its Dietary Management among Mothers of under Five Children

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ABSTRACT

Nutrition is recognized as an important determinant of health and development of societies. It is estimated that each year more than half of deaths among children under five can be either directly or indirectly attributed to hunger and malnutrition in developing countries including India. Apart from the protein energy malnutrition, inadequate intake of micronutrients such as vitamin A and vital minerals (iron, calcium, iodine and zinc) are recognized to affect younger children. The present study was aimed to assess the knowledge on nutritional deficiencies and its dietary management among mothers of under five children and to find out the association between knowledge on nutritional deficiencies and its dietary management among mothers of under five children with their selected variables. Quantitative approach experimental descriptive survey design was adopted for this study. The 60 samples were selected by using Non-probability Purposive sampling technique. The study samples were residing at Namakkal District. The data tool was demographic and self structured questionnaire. The study result showed that 12% of mothers of under five children had adequate knowledge, 25% of them had moderately adequate knowledge and 63% of them had inadequate knowledge. Nurses should involve themselves in educating and counseling the mothers to gain knowledge, bring positive changes in their practices regarding nutrition for their family members especially the under five children.

Keywords: Assess, Knowledge, Nutritional deficiencies, Dietary management, mothers of under five children





INTRODUCTION

The word nutrition means 'the process of nourishing or being nourished,' especially the process by which a living organism assimilates food and uses it for growth and replacement of tissues. 'Nutrients are a substance it's essential to life which must be supplied by food. Nutritional problems like malnutrition, anemia, vitamin A deficiency iodine deficiency and obesity continues to plague large proportion of under-five children in India [1, 2]. Nutrition is a significant factor in the growth, development, and overall functioning of a child. Good nutrition provides the energy and nutrients essential to sustain life and promote physical, social, emotional, and cognitive development. A child needs adequate dietary intake to provide enough nutrients and energy for him to grow, without reducing his body's ability to stay healthy. A healthy diet, rich in calcium and other essential vitamins and minerals, will enable optimal skeletal and physical growth [3]. Nutrition is the provision, to cells and organisms, of the materials necessary (in the form of food) to support life. Many common health problems can be prevented or alleviated with a healthy diet. Nutrients are organic & inorganic complexes contained in food. There are six major classes named as carbohydrates, fats, minerals, protein, vitamins, and water. These nutrient classes can be categorized as macro or micronutrients. The macronutrients include carbohydrates, fats, protein, and water. The micronutrients are minerals and vitamins. Vitamins, minerals, fiber, and water do not provide energy, but are required for other reasons [4, 5].

Balanced diet is essential for normal activities of life. Good nutrition and proper feeding programs prevent illness and disabilities. Malnutrition continues to be an underlying cause of morbidity and mortality in children under five years of age. Children are more vulnerable to suffer from nutritional deficiencies. Socio-economic, biological, environmental and behavioral factors increase the risk and need to be identified early in order to promote health and prevent disease. Nutritionally educated mothers can bring up their children in a healthier way. Improving breast feeding techniques not only provide adequate nutrition to the infant but can also decrease the frequency of gastroenteritis and respiratory infections and reduce the number of infant deaths [6]. Children's poor diet does not only have direct negative effects on their weight and health, but also results in significant deficiencies in those nutrients playing an essential role in cognitive development. Young children depend on their families and teachers to support their well-being and promote positive development, including eating behaviors. Children's food preferences and willingness to try new foods are influenced by the people around them [7, 8].

Eating behaviors of children practice early in life affect their health and nutrition which are significant factors in childhood overweight and obesity, and may continue to shape food attitudes and eating patterns through adulthood. Child-feeding practices determine the availability of various foods, the portion sizes that children are offered, the frequency of eating occasions, and the social contexts in which eating occurs. Parents can influence children's dietary practices in many areas: availability and accessibility of foods; meal structure and environment; adult food modeling; food socialization practices; and food-related parenting styles [9, 10]. More than 3.5 million children under five die unnecessarily each year in Asia due to the underlying cause of under nutrition, and millions more are permanently disabled by the physical and mental effects of a poor dietary intake in the earliest months of life. The consequences of insufficient nourishment continue into adulthood and are passed on to the next generation as undernourished girls and women have children of their own [11].

Mother is the one who take care of the child, it is very important that she should need to have knowledge regarding care of under five and nutrition which they need, under fives are "age in-between 0-5 years of child". Healthy eating and physical activity are essential for growth and development in childhood. To help children develop healthy eating patterns from an early age, it is important that the food and eating patterns to which they are exposed - both at home and outside the home - are those which promote positive attitudes to good nutrition [12]. Nurse as Researchers plays an important role in health of mothers and their children. There is need for extended and intensive research in the area of educating the mothers especially who have under five children about nutritional deficiencies and its nutritional management. It can help and increase the health of the children also wealth of the nations because the children are the wealth of the country.





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Statement of the Problem

Assess the knowledge on nutritional deficiencies and its dietary management among mothers of under five children.

Objectives

- Assess the knowledge on nutritional deficiencies and its dietary management among mothers of under five children
- To find out the association between knowledge on nutritional deficiencies and its dietary management among mothers of under five children with their selected variables
- To develop and distribute an information booklet on nutritional deficiencies and its dietary management among mothers of under five children

MATERIAL AND METHODS

It was a quantitative approach; Non experimental descriptive survey design. The sample size for the present study was 60. The samples were selected by using Non-probability Purposive sampling technique. The data were collected with demographic and self structured questionnaire. The collected were analyzed based on formulated objectives by using both descriptive and inferential statistics.

RESULT

The above table showed that 12% of mothers of under five children had adequate knowledge, 25% of them had moderately adequate knowledge and 63% of them had inadequate knowledge.

DISCUSSION

In this study most of the mothers of under five children were had average level of knowledge on nutritional deficiencies and its dietary management. The study result was supported by many studies conducted in same aspect at various settings. A study was conducted to assess the knowledge regarding Vitamin A deficiency disorders among mothers of under five children in selected rural area of District Ludhiana, Punjab. It was concluded that majority of mothers 37(61.67%) had average knowledge and 23(38.33%) had good knowledge regarding Vitamin A deficiency disorders [13]. One more study result had indicated that majority of the mothers 41% had satisfactory knowledge level (41 mothers), inadequate knowledge about 36% (36 mothers) and 23% (23 mothers) were had adequate knowledge regarding nutrition for under five child [14]. Similar study was conducted to assess the knowledge on micronutrient deficiencies among mothers with under five children in and the finding showed that, among 50 mothers selected for the study 25 (50%) mothers have inadequate knowledge and 25 (50%) mothers have moderately adequate knowledge. None of them have adequate knowledge. Considering the association between the level of knowledge and the demographic variables, there is significant association between the knowledge and source of information at P = 0.004 level [15].

CONCLUSION

Mothers were unaware or inadequate knowledge on prevention and dietary management on nutritional problems. Education is the key to the development. Nurses need to involve more actively in the preventive, educating, and giving more education regarding nutritional problem and its home remedies. Mothers need to have adequate knowledge regarding nutrition for under fives and it is important for children's growth and development. The findings implied that there is a need for regular health education programme to be carried out by nurses. The knowledge level of the mothers can be empowered with essential health information which again emphasizes the need to strengthen awareness activities on Nutritional deficiencies and its dietary management.




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Table 1. Distribution of mothers of under five children according to their demographic variables

S.NO	DEMOGRAPHIC VARIABLES	FREQUENCY	PERCENTAGE
1.	AGE IN YEARS		
	a) 21-25 years	15	25
	b) 26-30 years	20	34
	c) 31-35 years	22	38
	d) ≥36 years	7	13
2.	EDUCATION OF MOTHER		
	a) Graduate	9	15
	b) Diploma	12	20
	c) Higher Secondary	15	25
	d) High School	10	17
	e) Primary School	14	23
3	OCCUPATION OF MOTHER		





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	a) Government	4	7
	b) Private	28	3
	c) Self employee	12	20
	d) Coolie	5	8
	e) House wife	10	17
4	RELIGION		
	a) Hindu	36	60
	b) Muslim	14	23
	c) Christian	10	17
	d) others	0	0
5	TYPE OF FAMILY		
	a) Nuclear family	40	67
	b) Joint Family	20	33
6	FAMILY MONTHLY INCOME		
	a) 5000-10,000	10	17
	b) 10,001-15,000	14	23
	c) 15,001-20,000	20	33
	d) 20,001-25,000	10	17
	e) >25,001	6	10
7	SOURCES OF INFORMATION ON NUTRITIONAL DEFICIENCIES AND ITS DIETARY MANAGEMENT		
	a) Health Personnel	22	37
	b) Family members/Relatives	16	27
	c) Mass media	22	36

Table 2. Knowledge on nutritional deficiencies and its dietary management among mothers of under five children

Level of knowledge	Frequency	Percentage
Adequate (>76%)	7	12%
Moderate (51-75%)	15	25%
Inadequate (<50%)	38	63%

Table 3. Mean, SD, and mean percentage of knowledge on nutritional deficiencies and its dietary management among mothers of under five children

Knowledge on nutritional deficiencies and its dietary management	Maximum score	Mean	SD	Mean %
	30	12.36	2.25	30.56

Table 4. Association between knowledge on nutritional deficiencies and its dietary management among mothers of under five children with their selected variables

S.NO	Demographic variables	Chi-square	Level of significance
1	AGE IN YEARS	10.562*	SIGNIFICANT
2	EDUCATION OF MOTHER	12.202*	SIGNIFICANT
3	OCCUPATION OF MOTHER	6.235	NOT SIGNIFICANT
4	RELIGION	2.568	NOT SIGNIFICANT
5	TYPE OF FAMILY	5.489	NOT SIGNIFICANT
6	FAMILY MONTHLY INCOME	6.236	NOT SIGNIFICANT
7	SOURCES OF INFORMATION	10.875*	SIGNIFICANT





Protective Role of *Bacopa monnieri* on the Hippocampus and Cerebellum Cells on Prenatally Exposed to Electromagnetic Fields

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ABSTRACT

Electromagnetic pollution has been tremendously increased in this current century. Long-term exposure to low-frequency electromagnetic waves (EMW-LF) during prenatal, affects the developing brain of newborns. Exposure to electromagnetic field (EMF) cause increased production in the cellular environment thus damaging the neurons in the brain, especially the hippocampus and cerebellum. *Bacopa monnieri* is also one of the potent herbs used as a brain tonic. *Bacopa monnieri* reveals immense potential in the amelioration of cognitive disorders, reduction of oxidative damage, and helps to improve the cognitive properties of the brain, and reduces depression and anxiety. The study aimed to assess the effect of the electromagnetic field in brain development on prenatal conditions and does *Bacopa monnieri* (BME) attenuates brain damage in the postnatal condition in Wistar rats. 18 rats pregnant Wistar rats were selected randomly and divided into three groups, Control, Electromagnetic field exposure (EMF), Electromagnetic field exposure with *Bacopa monnieri* (EBM). 80mg/kg of *Bacopa monnieri* was given to the treatment group. There was no exposure to the control group, while EMF and EBM group was exposed to 1800 MHz radiation from the 10th day until delivery. Offspring were sacrificed for biochemical and histomorphometric analysis at the end of the 32nd day. Pyramidal cells in rat cornu ammonis (CA) and granular cells in the dentate gyrus (DG) and cerebellum were estimated using the optical fractionator



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technique. The result was analyzed that EMF exposed group showed a significant decrease in the total number of pyramidal cells and granular cells in the hippocampus, also with a significant decrease in the number of cells in the grey and white matter as well as thickness of the cerebellum. Similarly, EMF exposed rats showed a significant increase in LPO and SOD levels with a concomitant decrease in CAT and GPx levels. The group pretreated with *Bacopa monnieri* (EBM) altered the histomorphometric and biochemical parameters showed evidence for a protective effect of *Bacopa monnieri*. Thus, the neuroprotective and antioxidant effect of *Bacopa monnieri* modulates oxidative stress and decreases neuronal cell loss which proved an efficient therapeutic drug.

Keywords: Electromagnetic radiation, hippocampus, cerebellum, pyramidal cells, *Bacopa monnieri*, antioxidant, lipid peroxidase (LPO), superoxide mutase (SOD), catalase (CAT), and Glutathione peroxidase (GPx)

INTRODUCTION

Our environment is contaminated by many pollutants, among this electromagnetic pollution has been tremendously increased in this current century. Pollution caused by electromagnetic fields (EMF) are emitted by electric and electronic devices like mobile phones, television, personal computers, radios, microwave ovens, etc., Besides, electromagnetic pollution cannot be sensed directly however only through its effects on the health of the population. Still, there is no clear and definitive evidence that these pollutions may cause hazards to human beings and the environment (Redlarski, G, 2015). EMF gives an alert on biological effects like altering physiological changes within an organism in biology by the production of heat alters the cellular functions. Thus, the ill effects of low-frequency electromagnetic fields (EMW-LF) on health are studied extremely since it has become unavoidable (Iagăr, A,2014). During gestational development, the fetus are much more prone to environmental pollution including EMF, since many studies have engrossed in the impact of prenatal EMF exposure on fetal growth and health outcomes of offspring (Li DK, Ferber JR, 2012)(Su XJ, 2014). To limit the exposure to wireless radiations during pregnancy and to voice their concern related to the risk of exposure, the World Health Organization (WHO) and Environmental Health Trust started a new project called "BABY SAFE WIRELESS PROJECT"⁵. Long-term exposure to EMW-LF during prenatal not only affects brain tissue function and also affects the neurogenesis in newborns (Iagăr, A,2014) (Manikonda, P, 2004).

Several studies have reported the findings such as stress, headache, tiredness, anxiety, learning and cognitive impairments, poor concentration, childhood cancer, diabetes, infertility, reduced sperm count, and other health issues(Carlo V, 2012) (Behari, J,2012)due to constant exposure to microwave radiation emitted from mobile phones (Fragopoulou, A, 2010). It has been observed that exposure to EMF causes an imbalance between free radical production and antioxidant levels in the cellular environment (Calcabrini, C, 2017). This imbalance may produce oxidative stress which may lead to many diseases and aging of cells by degrading ligands, peroxidizing lipids, disrupting metabolic pathways, denaturing proteins, and breaking DNA strands (De Grey A, 1999) (Maxwell,1995). This deleterious event during pregnancy causes oxidative stress and may induce changes in the brain morphology, especially on the hippocampus and cerebellar tissues.

In recent decades, herbal therapy is used as a traditional medicine worldwide. According to WHO, herbal medicines serve the health needs of about 80 percent of the world's population. Since new diseases are emerging in recent decades and there is a search for traditional medicines with fewer side effects. *Bacopa monnieri* is one such traditional medicine known as Bhrami, water hyssop, and neerbhrami. *Bacopa monnieri* is classified as medhaya Rasayana by Ayurveda practitioners. It is also one of the potent herbs used as a brain tonic (Srivastava, 2012) (Deepak, M, 2013) (Russo A, 2003) The constituents of bacopa act as an efficient free radical scavenger that maintains the balance of reactive oxygen species (ROS) and antioxidants(Vishnupriya, P, 2017). *Bacopa monnieri* reveals immense potential in



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the amelioration of cognitive disorders, as well as prophylactic reduction of oxidative damage, and neurotransmitter modulation (Aguiar, S,2013). It also helps to improve the cognitive properties of the brain and reduces depression and anxiety in animal models, and is used to treat conditions such as fever, inflammation, pain, asthma, epilepsy, insanity, and memory loss (Banerjee, R,2014). However, there has not been an investigation concerning prenatal exposure to electromagnetic fields and their role in oxidative stress, the histological development of the hippocampus and cerebellum in postnatal life. There were no previous studies on the antioxidant effects of *Bacopa monnieri* on EMF in relation to biochemical and histomorphometry analysis of the hippocampus and cerebellum. Hence, the present study is aimed to assess prenatal exposure to EMF and the neuroprotective role of *Bacopa monnieri* on brain development in postnatal rats.

MATERIAL AND METHODS

The study was carried out in the Department of Physiology, at Meenakshi medical college, hospital and RI. The proper institution Animal Ethical committee clearance was obtained (date 3.7.19, IAEC No: 002/2019). The pregnant rats with known one-week conception were purchased from Mass Biotech (CPCSEARegno.2084/PO/Bt/S/19/CPCSEA). Animals were housed in the animal house with temperature $22 \pm 2^\circ$ of under a 12 hours light/dark cycle with proper food and water "ad libitum"

Grouping of animals

Eighteen adult female Wistar albino rats with 10 days of pregnancy were selected and were randomly divided into three groups; Group I – Control, Group II- EMF group, Group III- EMF+BME group (EBM), each comprised of six rats.

- Group I - Control group (6)
- Group II- Exposure to EMF during pregnancy (6)
- Group III -Exposure to EMF during pregnancy and treated with *Bacopa monnieri* 80mg/kg (6)

The EMF (Group II) and EBM (Group II) rats were placed in the plexiglass jar for 2 hours at the same time every day, from the 10th day of gestation till delivery, where they were exposed to 1800Mhz frequency EMF. EBMgroup was given BME 80mg/kg (Sivasangari, K, 2020). Pregnant rats were placed in individual cages before birth. After birth pups were kept with mothers in the same cages and fed naturally. The newborns were not exposed to any procedure after birth. 14 rat pups were selected for the control group, 10 for the experimental group (EMF), and 12 rats for the EBM group. No sex differentiation on selecting the rat pups, both male and female were utilized for the study. After completing 21 days of postnatal development, they were separated from the mother and placed in separate cages. To subside from the mother's separation, the rat pups were kept for 4 days under the same laboratory conditions. When rat pups with PND of 32days, were assessed for biochemical and histomorphometric analysis in all three groups.

Bacopa monnieri extraction

The whole dried plant of *Bacopa monnieri* was purchased and got an authentication certificate from the Central Research Institute of Siddha medicine, Arumbakkam, Chennai (213-30122002). The whole plant was coarsely powdered with the mechanical grinder and sieved and stored in an airtight container. The extraction was prepared in the Aspartika biotech Pvt Ltd, Bengaluru. The air-dried plant was defatted with petroleum ether and extraction has been done by using the Soxhlet apparatus using 70% v/v of ethanol at 50° C for 48 hours. Using a rotatory evaporator, the solvent is recovered by evaporation under reduced pressure. The semi-solid mass has been lyophilized at – 40 ° C for 24 hours. The procured dry powder of the plant is being stored at -3 ° C until further use.(Patel, S,2017).

Electromagnetic field exposure procedure

A separate and specially designed room was utilized in the animal house at Meenakshi medical college and hospital, with normal laboratory conditions exclusively for EMF exposure for the application of 1800 MHz.. The EMF



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exposure system consists of a variable ultra -high- frequency oscillator signal generator (Fest night signal source lockable oscillator 350MHz – 4000MHz digital LCD ADF4351) with the constant power source (Generic D3806v) (with an output power of 300 Mw and frequency adjusted to 1800 MHz), and a plexiglass jar specifically designed for the study (30cm x 42cm x 52 cm). The frequency oscillator was connected to a half-wave Dipole antenna (GSM2DBI GSM magnetic antenna SMA 900/1800 MHz RG174). The antenna was inserted into the center of the jar, approximately 11 cm inside the jar and exposed to 1800MHz waves for 2 hours (each day at the same time). Positional averaging of electromagnetic field was calculated using a wide-ranging measuring device with a measurement of 100kHz – 2.5 GHz. (Metravi GM -197 EMF meter)(Türedi, S,2015).

Histomorphometric analysis

At the postnatal period of the 32nd day, all the newborns were kept under anesthesia (Ketalar 50 mg/kg) and sacrificed on the same day. The cerebellum and hippocampus were dissected out, and placed in formalin solution (5%, buffered). In the process of tissue preparation, paraffin blocks were prepared with the samples, and then sections 5 microns thick were prepared using a microtome, and then they were kept on glass slides. The slides were stained with Hematoxylin and eosin (H&E). For histomorphometric studies, the total number of pyramidal cells in cornu ammonis (CA) CA1, CA2, CA3, (mm²), and granular cells in the dentate gyrus (DG) (mm²), regions of the hippocampus, and the thickness of grey matter (μ), the thickness of white matter (μ), the number of cells available in grey matter (mm²), the number of cells available in white matter (mm²) of the cerebellum, and the ratio of grey matter to white matter analyzed using Olysia Software. The shrunken cells, darkly stained cells with fragmented nuclei were excluded from this study. The exact round, medium, or large distinct nucleus within clear cells was measured. The cells for measurements were selected using the random selection technique from the serial sections made for each group. Approximately 7 sections were analyzed on each brain randomly. The cell diameter was measured using ocular micrometry (using Olysia Software) under 100 × magnifications in a light microscope (Olympus microscope) and photomicrographs were taken using a Sony digital camera. (Odaç E,2013)

Biochemical analysis

Tissue homogenate preparation: At the end of 32nd day of postnatal life, rat pups were isolated and washed immediately with ice-cold saline and weighed. The brain was dissected out under ice-cold (4°C) conditions. A 10% (w/v) tissue homogenate was prepared in ice-cold 0.1 M phosphate buffer (pH 7.4). The post-nuclear fraction for the enzyme assay was obtained by centrifugation 12,000 rpm for 60 min at 40°C. A spectrophotometer (Elico, B-200) was used for subsequent assay. (Srikumar et al., 2006)

Assessment of oxidative stress parameters: Catalase activity was evaluated by the method of Sinha (1972). Reduction in hydrogen peroxide activity and the changes in absorbance were measured at 620 nm at 30-sec intervals for 3 min. The activity of catalase was expressed as μ moles of H₂O₂ decomposed /min/mg protein. Superoxide dismutase activity was assayed by the method of Misra and Fridovich 1972. The addition of 0.4ml of epinephrine and the increase in absorbance at 480nm was measured in a Shimadzu UV spectrophotometer. SOD was expressed as μ moles of H₂O₂ decomposed /min/mg protein. Lipid peroxide content was estimated by the method of Okhawaetal., 1979. In this method Butanol was added and the color extracted in the butanol phase was read at 532 nm. Glutathione peroxidase activity was assayed by the method of Rotruck et al. 1973 with some modifications, the residual GSH content was determined and the color was read at 412 nm.

Statistical analysis

The statistical analyses were performed using Statistical Package for Social Science (SPSS, version 17) for Microsoft windows. The mean cell number of the inter groups were compared using Mann Whitney U test. The data were expressed as mean and SD. ANOVA with PostHoc test /Kruskal – Walli's test was used, The p-value < 0.05 was considered statistically significant.





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RESULT

Histomorphometry analysis

Pyramidal cells in the hippocampus. The mean number of pyramidal cells in the cornu ammonis (CA), CA1, CA2, CA3 regions of hippocampus evaluated using in the EMF group was significantly lower when compared with the control group ($p < 0.05$, One-Way analysis) (Fig. 1). Similarly, there was a significant difference increase was observed between the EMF group and EBM group ($p < 0.05$, One-Way analysis), however, there was no significant between the control and EBM group ($p < 0.05$, One-Way analysis) (table 1).

Dentate gyrus: The granular cells in the DG were significantly ($p < 0.05$) decreased in the EMF group when compared with the control group ($p < 0.05$, One-Way analysis) (Fig. 1). Additionally, there was a significance between the EMF and EBM group ($p < 0.05$, One-Way analysis), which proves the protective effect of *Bacopa monnieri* in the treatment group (table 1).

Cerebellum: The thickness of the grey and white matter of the cerebellum was analyzed within the group and between the groups using ANOVA. A significant decrease in the EMF group when compared to the control and EBM groups ($p < 0.05$, One-Way analysis) (Fig. 2). In the control and EMF +BME groups, the number of cells in the grey and white matter of the cerebellum was increased when compared with the EMF group (table 2). Similarly, there was a significant difference was also observed in the EMF group when compared with control and EBM groups ($p < 0.05$, One-Way analysis). It was observed that the neuroprotective effect of BME on the Purkinje and granular cells of the cerebellum.

Biochemical analysis

The brain tissue activities of CAT, GPx, LPO, and SOD were analyzed in each group. LPO and SOD activity in the EMF group was significantly increased when compared with the control and EBM groups ($p < 0.05$). There was no significant between the control and EBM groups in terms of CAT. In addition, GPx was also increased in the EBM and control groups when compared to the EMF group. ($p < 0.05$) (Table 3)

DISCUSSION

Exposure to prenatal rats may lead to neurodegenerative diseases like Alzheimer's and Parkinson's diseases due to enhancing oxidative stress. (Jiang, D, 2-013). Prolonged prenatal exposure to EMF decreases the Purkinje fibres, Picnotic cells, and pyramidal cell in the cerebellum and hippocampus (Sonmez OF, 2010). The effect of EMF on histomorphometric analysis in relation to oxidative stress needs to be proved scientifically. The traditional medicine BME, its role on the neuroprotective and antioxidant role on EMF exposed rats also need to be analyzed. Hence, the present study planned to assess the Neuroprotective role of BME on prenatal EMF exposed rats. In our study, the histomorphometric analysis was focused on a specific area like Hippocampus and cerebellum. The histomorphometric analysis showed a significant reduction of pyramidal cells in cornu ammonis (CA) CA1, CA2, CA3, granular cells in the hippocampus in the EMF group when compared to the control group ($p < 0.05$). Similarly, in the cerebellum, the EMF exposed group showed a significant reduction in the total number of Purkinje cells with a simultaneous decrease in thickness of grey and white matter. This could be due to an increase in the LPO and SOD level with a significant decrease in the GPx and catalase, which might be due to oxidative damage in the brain tissues (Ilhan, A, 2004) and also due to alteration in mitochondrial function, formation of superoxide radical, more production hydrogen peroxide and alters the lipid peroxidation which leads to neurodegenerative diseases (Benzi, G, 1995) (Ozmen I, 2007). Oxidative stress and morphological changes in the tissues indicate free radical production by reducing SOD activity along with increased lipid peroxidation (Tayefi, H, 2010). Our study also concurs with the finding of Odaci et al (2008) and Aldad et al (2012) who insisted that harmful environmental conditions like EMF may deeply affect brain development during the prenatal period which affects the neuroanatomy and



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neurophysiology developmental changes (Odaci, 2008) and (Aldad T S et al 2012). In contrast, teratogenic changes and body mass and weight of dehydrated internal organs were not affected when exposed to short wave electromagnetic thermal radiation (Oliveira, A, 2015).

The rats pretreated with the BME showed a significant increase in the pyramidal cells in cornu ammonis (CA) CA1, CA2, CA3, and granular cells in the hippocampus could be due to the presence of Bacoside A and Bacoside B, effective saponins of *Bacopa monnieri* which may prevent the tissue damage of the brain. Similarly, the number of Purkinje cells and thickness of grey and white matter of cerebellum showed a significant increase in BME pretreated group (EBM) could be due to Bacoside II, Bacoside X, and Bacoside C which proves the neuropharmacological role on damaged brain tissues (S. K. Bhattacharya, 2000). Further, an increase in cell proliferation and neuroblast differentiation in the hippocampus and cerebellum were also observed by the administration of *Bacopa monnieri* extract. Simultaneously, the group pre-treated with BME (EBM) showed a significant increase in antioxidant levels of CAT and GPx at the same time decrease in LPO and SOD. These changes could be due to dammarane-type triterpenoid saponins of Bacosides, which act as a free radical scavenger that ameliorates oxidative stress damage caused by electromagnetic field exposure. However, the restoration of *In vivo* antioxidants vitamin C and vitamin E by Bacoside A of *Bacopa monnieri* (Anbarasi K, 2005). Antioxidant effect of *Bacopa monnieri* proved significant reversal of disturbed antioxidant status and peroxidative damage and it modulates the antioxidant activity and enhances the defense against ROS generated damage in rats. Our study also correlated with the findings of Simpson et al (2015) who insisted that the potential effect of *Bacopa monnieri* used as a therapeutic antioxidant reduces oxidative stress and improves cognitive performance and offers neuroprotection in the aging brain (Simpson T 2015)

Our study concludes that EMF causes brain tissue damage, especially on the hippocampus and cerebellum induces a reduction of the number of cells and degenerative changes in neurons. Simultaneously, it also stimulates oxidative stress with a decrease in antioxidant levels. Rats treated with *Bacopa monnieri* showed effective prevention in neuronal cell damage, restoring of the antioxidant status, and also decreasing oxidative stress status. Hence, BME proves as the novel therapeutics to treat the neuronal damage induced by electromagnetic radiation.

CONFLICT OF INTEREST

The authors confirm that no part of this work has been submitted or published elsewhere and that no conflicts of interest apply.

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Table 1: The mean ± SEM (n=6) of histomorphometry analysis of a total number of pyramidal cells (CA1, CA2, CA3) and granular cells (DG) in the Hippocampus are listed for each group of animals examined.(* represents p<0.05)

GROUPS	Hippocampus			
	Pyramidal cell number (nos)			Granular cell number(nos)
	CA1 *	CA2 *	CA3*	DG*
Control	54.3±0.4050	43.767±0.3921	28.467 ± 0.3730	75.633 ± 0.4287
EMF	26.63 ± 2.69	21.467 ± 1.748	14.950 ± 0.1875	60.950±0.2837
EMF+BME	53.033 ± 0.4380	43.53 ± 0.242	21.017 ± 0.3260	68.800 ± 0.1880

Table 2: The mean ± SEM (n= 6) of histomorphometry analysis of a number of cells and thickness in grey and white matter of cerebellum are listed for each group of animals examined.(* represents p<0.05)

GROUPS	Cerebellum - Grey matter		Cerebellum - White matter	
	Number of cells *	Thickness (µm)*	Number of cells*	Thickness (µm)*
Control	12542.467 ± 29.3268	694.433 ± .4984	3179.683 ± 7.9046	81.558 ± 0.4257
EMF	10748.683 ± 155.0748	628.533 ± 0.4800	2529.783 ± 449.159	73.895 ± 0.6351
EMF+BME	11537.850 ± 33.6322	675.367 ± 0.5931	3111.450 ± 3.0391	78.173 ± 0.5136





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Table 3: The mean ± SEM (n= 6) of glutathione peroxidase (GPx), Catalase (CAT), Lipid peroxidase (LPO), and superoxide mutase (SOD) listed for each group of animals examined.(* represents p<0.05)

GROUP	GPx (min/mgprotein)	CAT (min/mgprotein)	LPO (min/mgprotein)	SOD (min/mgprotein)	P VALUE
Control	3.5833 ± .10525	5.4433 ± .14977	1.4950 ± .03354	1.8867 ± .02716	0.000*
EMF	1.6433 ± .04842	9.1050 ± .24447	4.0150 ± .06350	2.7600 ± .07607	0.000*
EMF+BME	2.9050 ± .07302	6.1667 ± .04080	2.3433 ± .06339	2.3650 ± .08205	0.001*

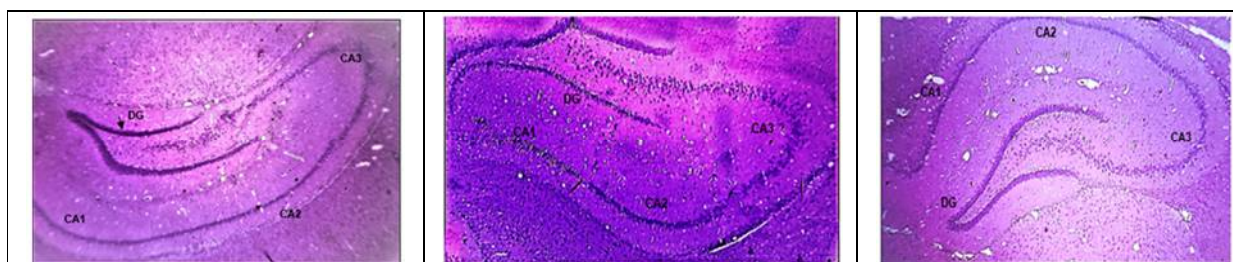


Figure 1: In the histology of the hippocampus, neuronal cell loss of the EMF group was observed in CA1, CA2, and CA3 in the surrounding dentate gyrus (DG). The CA3 is characterized by large and densely packed pyramidal neurons (black arrows) with apicobasal projections in the control group. The EMF group presents with reduced neuronal cells with the DG and cornu ammonis of pyramidal cells. The EMF+BME group showed increased cellularity within the DG and pyramidal cells.

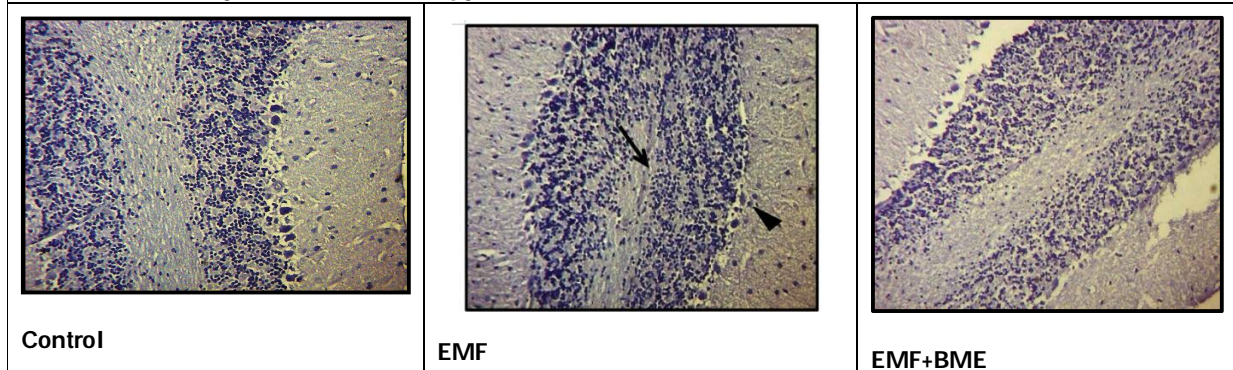


Figure 2: the figure shows the histology of the cerebellum. The control group cerebellum had a relatively normal intact layer. The cerebellum in the EMF group had degeneration characterized by severe thinning of the medullary layer (arrow mark) and internal granular layer with loss of Purkinje cells. The degenerate cerebellum and Purkinje cells (arrowhead) were improved and demyelination was reduced in the BME+EMS group.





Distributed Cooperative Positioning based on RSSI Localization Algorithm in Underwater Wireless Sensor Network

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ABSTRACT

Sensors in water are commonly deployed in regions that cannot be effortlessly accessed by humans. UWSNs comprise erratically disbursed sensor nodes, sparse nodes, and nodes that are without difficulty affected by way of water fluidity. Anchor nodes that help to position can improve the location accuracy of sensor networks. Proposed a weighted centroid-ranging set of rules that are based on received signal power indicators (RSSI) and time distinction of arrival (TDOA). This set of rules uses the gap parameter and signal energy among anchor nodes as a connection with correct the predicted distance between unlocated nodes and anchor nodes. Positioning set of rules reduces positioning mistakes in an uneven node distribution through the use of RSSI values to optimize the single hop value within the DV-Hop algorithm. A cell anchor node-assisted RSSI localization scheme in underwater wireless sensor networks (UWSNs) is proposed, which targets to improve region accuracy and shorten location time. First, to improve location accuracy, the multimode cooperative role and monitoring shows benefits at high adaptability, high detection performance, and is significantly beneficial in the army, and ocean development.

Keywords: Under Water wireless Sensor, RSSI Localization, Global Positioning System.





INTRODUCTION

With the speedy improvement of communication and sensor technology, underwater wi-fi sensor networks (UWSNs) have ended up a quick-growing area. The site suffers negative stability due to the high attenuation of underwater electromagnetic waves, the low propagation pace of the generally used acoustic waves, and the complicated underwater surroundings which include the effect of ocean different factors. Due to the big attenuation of electromagnetic waves in water, most underwater detections had been found out through transmitting acoustic alerts. UWSNs have a huge variety of packages, such as pollution monitoring, off-shore oil exploration, and oceanography records series. In UWSNs, localization is an essential difficulty, because best the data associated with the location of the sensor node may be meaningfully interpreted by way of information users [1]. The result identifies the factors affecting transmission in actual surroundings. A positioning set of rules in [2] reduces positioning errors in an uneven node distribution with the aid of the use of RSSI values to optimize the single hop cost inside the DV-Hop algorithm.

UNDERWATER DISTRIBUTED COOPERATIVE IN POSITION METHOD

The underwater cooperative position network, the discontinuity, and uncertainty of the drawer node verbal exchange, the positioning overall performance of the entire underwater dispensed cooperative node community can be improved by the fabricated from the local cooperative function of the unlocated underwater node

DISTANCE FINDING METHOD IN RECEIVED SIGNAL STRENGTH ALGORITHM

A ranging set of rules based totally on received signal energy can convert the signal electricity acquired through an unlocated node and sent with the aid of manner of an anchor node in a distance. The longer the transmission distance is, the extra the sign loss might be and the smaller the RSSI fee obtained with the aid of way of the unlocated node.. The parameters in the model can be calculated via the real distance among anchor nodes and by the set of rules size distance

THREE-DIMENSIONAL UNDERWATER MODEL

Wireless sensor networks on land typically require dimensional planar positioning, while UWSNs in unique underwater environments require Three-dimensional positioning. Such requirements cannot be met with the aid of conventional positioning algorithms. Hence, studies should keep in mind how anchor and ordinary nodes ship and acquire indicators within the Three-dimensional underwater environment [5]. As proven in Figure 1, alerts in a UWSN diverge in a spherical shape while nodes communicate. Anchor nodes broadcast alerts to unlocated nodes within the conversation variety. The alerts are transmitted in a three-dimensional space, whose coverage area is a sphere and the communicate diameter is the radius. In three-dimensional underwater surroundings, unlocated nodes receive the facts of anchor nodes with the strongest sign. As proven in Figure 2, the sensor nodes on this model are geared up with stress sensors to gain their very own depth information. Node intensity may be directly transformed into the Z-axis of node coordinates. The coordinates of unlocated nodes are (x, y, z), and the coordinates of 3 anchor nodes are A (z1, y1, z1), B (z2, y2, z2), C (x3, y3, z3), . . . , N (Xn, Yn, Zn). Based on the distance among unlocated nodes and an anchor node, the following equations may be acquired

$$(x-x_1)^2 + (y-y_1)^2 + (z-z_1)^2 = r_1^2$$

$$(x-x_2)^2 + (y-y_2)^2 + (z-z_2)^2 = r_2^2$$

$$(x-x_n)^2 + (y-y_n)^2 + (z-z_n)^2 = r_n^2$$

THE GLOBAL POSITIONING SYSTEM (GPS)

The Global Positioning System Is unavailable in the underwater environment, because of the sturdy attenuation of radio waves in water [6]. The underwater node cannot at once locate itself via the GPS. Second, due to the huge propagation delay in underwater acoustic channels, the fee of preserving clock synchronization is high and underwater nodes are typically clocked asynchronous [7]. Third, the transmitting power intake of the underwater



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sensor node is numerous times or even loads of instances the receiving strength consumption to store energy, the underwater sensor node has to lessen message transmission in the course of the localization process [8].

PERPENDICULAR INTERSECTION

By comparing the received RSSI values on a node, this scheme completed the locating of nodes, the usage of the geometric relationship among the node, and the mobile beacon's trajectory. In this scheme, the error of decided projection inside the localization method led to the mistake of the node region. To improve place accuracy, Pratap et al [9]. Adopted a piecewise polynomial curve fitting method to reduce the error of figuring out projection. Zhao et al. [10] applied the polynomial curve fitting approach and the by-product method to lessen the mistake of decided projection.

SUPPORT VECTOR REGRESSION (SVR)

Interpolation approach to estimate the projection of sensor nodes on the linear trajectory of the cellular anchor node. The proposed approach will increase the accuracy of the nonlinear regression model of noisy measured information and synchronously decreases the estimation blunders resulting from the discreteness of measured statistics. The SVR-based interpolation method achieves development in place accuracy by decreasing the mistake between the determined projection and the actual projection. Second, we develop a curve matching technique to achieve the perpendicular distance from sensor nodes to the linear trajectory of the cell anchor node. Compared with existing schemes that require the anchor node to journey as a minimum of two trajectories, the proposed scheme handiest wishes one trajectory to find sensor nodes, and the area time is shortened with the reduction inside the number of trajectories. Finally, simulations show that, in comparison with current schemes, the proposed scheme can achieve more correct sensor node location in less time.

THE TRAJECTORY OF THE MOBILE ANCHOR NODE

As shown in Figure (v) The mobile anchor node begins at factor x_1 , moves along a linear trajectory, and ends at factor x_m . In the entire system, the cell anchor node moves at a uniform velocity and periodically pronounces its real-time region message at a set transmission strength. The period of the trajectory is L , the c programming language among adjacent broadcast factors is ΔL , and the quantity of broadcast points at the trajectory is

DETERMINING THE PERPENDICULAR DISTANCE FROM A NODE TO THE TRAJECTORY

In this paper, to decide the perpendicular distance from a node to the trajectory, we lay out a three-step method, as proven in Figure 6. First, to set up the reference RSSI curve library, we calculate the RSSI value of the printed point on n reference trajectories. Then, as it should be evaluating the similarities between curves, we extract the components to be as compared from the anticipated curve and reference curves and pick the function points at the extracted components, so that it will get the characteristic factor vectors for comparison. Finally, to pick the characteristic point vector with the very best similarity, we examine the similarity among the characteristic point vectors. The distance corresponding to the chosen feature point vector is determined because of the perpendicular distance from the node to the trajectory.

CONCLUSIONS

A three-dimensional UWSN positioning algorithm primarily based on-changed RSSI values is proposed to cope with the hassle of UWSN positioning algorithms being vulnerable to water have an impact on and at risk of risky positioning and large positioning mistakes. Unlocated node screens the acquired sign strength of the anchor node and then plays weighted correction to lessen the impact of the water environment and improve ranging accuracy. Combined with a Three -dimensional underwater environment, the accuracy and stability of the positioning set of rules are stepped forward, and the error of the underwater positioning set of rules is decreased. The is simulated with other associated positioning algorithms via experiments in this paper, a singular cellular anchor node assisted RSSI localization scheme for UWSNs is proposed. After one cell anchor travels alongside the deliberate linear



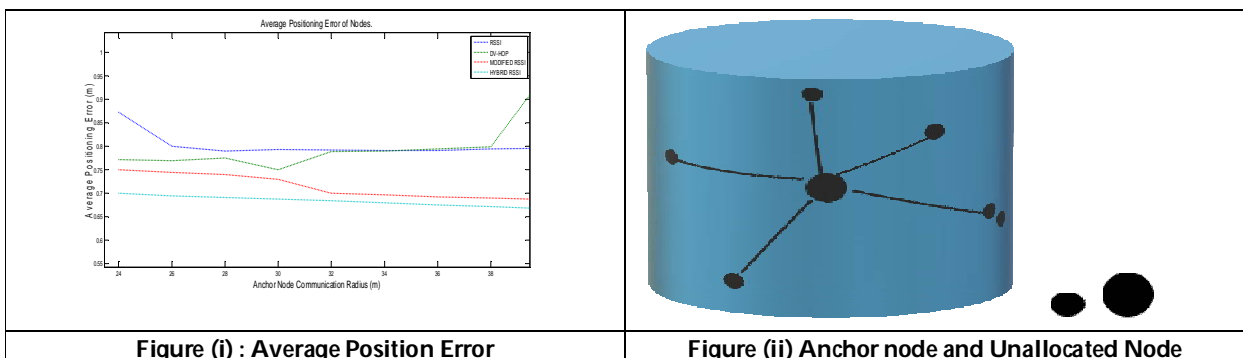


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trajectory on the water surface, all underwater sensor nodes in the area near the trajectory can discover their positions. We design an SVR-based interpolation method to improve the method of determining node projection in existing strategies. This approach will increase the accuracy of the nonlinear regression model of noisy measured data and decreases the estimation blunders caused by the discreteness of measured statistics, which greatly reduces the mistakes of the decided projection after which improves the place accuracy of the underwater sensor node. Compared with existing schemes that require the anchor node to travel at least two trajectories, the proposed scheme best wishes one trajectory to locate sensor nodes, and the region time is shortened with the reduction within the variety of trajectories. The SVR-primarily based interpolation technique, and the curve matching approach. In the future, we goal to decorate the curve matching method to reduce the error among the obtained perpendicular distance and the actual perpendicular distance, so one can similarly enhance the locate.

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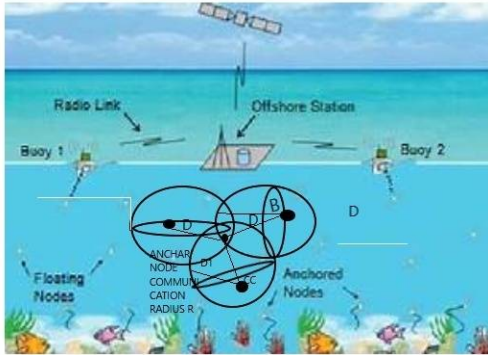


Figure (iii): Sensor nodes Sending and Receiving Signals

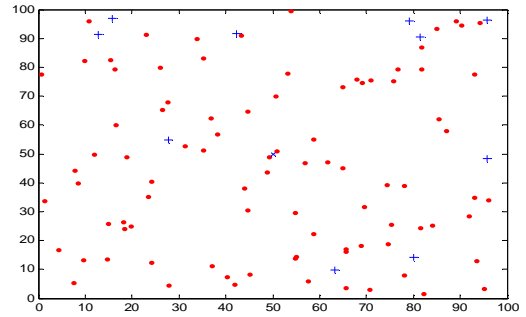


Figure (iv) Three dimensional node distribution

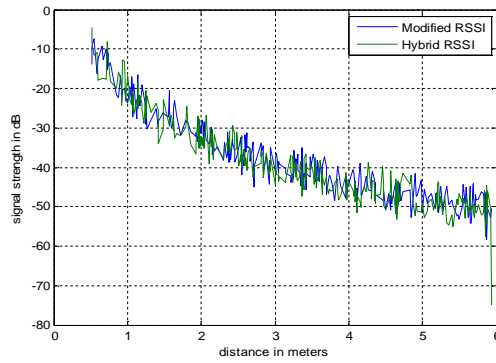


Figure (v) Signal Strength





A Descriptive Study to Assess the Knowledge of Care Givers Regarding Care of Client with End Stage Renal Disease on Hemodialysis

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ABSTRACT

End stage renal failure is a serious and growing health problem. A care giver requires adequate Knowledge and awareness on End stage renal failure and hemodialysis to reduce the progress of the disease and promotion of client health status. The current study was aimed to assess the knowledge of care givers regarding client with end stage renal disease on hemodialysis and find out the association between knowledge of end stage renal disease on hemodialysis with their selected variables. Quantitative pre experimental research design was selected for this current study. 50 care givers were chosen by convenience sampling technique. The data were collected by using demographic and self structured knowledge questionnaire.: The study result revealed that mean and SD was 6.25 ± 2.26 . 22% of care givers had adequate knowledge, 54 % of care givers had moderately adequate knowledge and 24% of care givers had inadequate knowledge. The study result concluded and suggested that awareness programs should be create and conducted for caregivers of client with end stage renal failure on hemodialysis in order to improve or enhance their knowledge on causes of renal failure, dietary pattern, and treatment like hemodialysis and the follow up care in home.

Keywords: Assess, Knowledge, care givers, End stage renal disease, Hemodialysis



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INTRODUCTION

Chronic kidney disease is viewed as part of the rising worldwide noncommunicable disease burden. Hypertension, diabetes mellitus, and obesity are among the growing non-communicable diseases and are important risk factors for chronic kidney disease [1]. Diabetes and hypertension are the leading causes of chronic kidney disease in all developed and many developing countries but glomerular nephritis and unknown causes are more common in countries of Asia and sub-Saharan Africa. These differences are related mainly to the burden of disease moving away from infections towards chronic life style related diseases, decreased birth rates, and increased life expectancy in developed countries [2]. Prevalence is higher in urban populations than in rural populations in developing countries. The worldwide hypertension prevalence, when age-specific and sex-specific adjustments are made to take into account changes in the world population, is projected to increase to 1.56 billion by 2025 [3].

The incidence and prevalence of end-stage kidney disease differ substantially across countries and regions. More than 80% of all patients receiving treatment for end-stage kidney disease are estimated to be in affluent countries with large elderly populations and universal access to health care [4]. Caregiver is a word normally used to refer to unpaid relatives or friends of a disabled individual who help that individual with his or her activities of daily living. Giving home care to a dialysis patient also requires a lot of learning. Almost 70 % of patients and 80% percent of caregivers are extremely interested in learning more about how kidney disease affects the patient's daily activities [5,6]. Caregivers' needs are often neglected and under-prioritized in the medical management of chronic kidney disease. Informal caregivers can experience stress from the added responsibilities of managing the patients' medical treatments, dietary requirements, clinic appointments and psychosocial issues. An assessment has to be conducted to identify the learning needs of the patient and family members. Hence the researcher would like to assess the knowledge regarding post dialysis home care among caregivers of hemodialysis patients [7,8].

Care giving is a day-in and day-out responsibility. Caregivers spend a substantial amount of time interacting with their care recipients, while providing care in a wide range of activities. It is important for the nurses to recognize and respond to the tremendous emotional impact that chronic illness and its treatment can have on families in an era where it is possible to sustain life for years with the use of life support technology. The caregiver's role has changed over the years. There is an urgent need for additional services to assist them in shouldering the burden of care which can be given through counseling, education, social and psychological support [9,10,11]. Many factors that affect patient outcomes of client with End-stage renal disease (ESRD), it may occur outside the formal medical care system and in the home environment, such as medication adherence, diet and fluid restrictions, and making arrangements for consistent attendance at dialysis treatment appointments. In the dialysis facility, renal care professionals are responsible for monitoring the care of patients, but in the home family members often assume this function [12].

Caregiving is a growing public health issue. Caregiving ranges from helping with activities such as managing finances, grocery shopping, and housework to assisting with aspects of personal care such as medication management, meal preparation, and activities of daily living [13]. So that Nurses as a health educators in the position to teach the client as well as their care givers regarding homecare management on end stage renal failure on hemodialysis

Statement Of The Problem

Assess the Knowledge of Care Givers Regarding Care of Client with End Stage Renal Disease on Hemodialysis

OBJECTIVES

- Assess the knowledge of care givers regarding care of client with end stage renal disease on hemodialysis



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- To find out the association between knowledge of care givers regarding care of client with end stage renal disease on hemodialysis with their selected variables
- To develop and distribute pamphlet on end stage renal disease and hemodialysis

MATERIAL AND METHODS

Quantitative approach, Non experimental descriptive survey design was selected for this study. The sample size for the present study was 50 caregivers of client with end stage renal disease on hemodialysis. The samples were chosen by using Non-probability convenience sampling technique. Demographic and self structured, pretested questionnaire were used for collecting the data from samples. Descriptive and inferential statistical analyzes were used.

RESULT

The above table showed that 22% of care givers had adequate knowledge, 27 %of care givers had moderately adequate knowledge and 12 % of care givers had inadequate knowledge.

DISCUSSION

The current result revealed that most of the client with end stage renal failure on hemodialysis had average level of knowledge. They care givers are in need to improve or update their knowledge regarding the available treatments are not able to cure disease, instead of that providing care may offer or extend life expectancy, symptom relief and improve the quality of life.

Bhosale et al., (2019) conducted a similar type of study and revealed that the mean knowledge score of caregivers of hemodialysis subjects during the pre-test was 39.48%, whereas it had improved up to 82.50% during the post-test as an effectiveness of structured teaching programme. Hence, health education programs and on-going teaching both can further improve the knowledge of caregivers [14]. One more study conducted among 100 caregivers of hemodialysis patients, no one possessed excellent knowledge, 19% were having good knowledge, half of the caregivers (50%) had average knowledge, 29% had poor knowledge and 2% of the caregivers' knowledge was deemed very poor regarding post dialysis home care. The relation of caregiver with patient, caregivers' age, gender, education, occupation, type of family and income showed no significant impact on the knowledge of caregiver regarding post dialysis home care [15]. The knowledge score test indicates that out of 60 chronic renal failure patients, 22 (36.33%) have good knowledge and 38 (63.33%) have average knowledge on self-care. The result revealed that mean value of knowledge score in pre-test is 52.66% and standard deviation (SD) is 3.702 and mean value of knowledge score in post-test is 80.00% and standard deviation (SD) is 3.661. The Chi square test revealed that there is significant association between educational statuses, source of knowledge and duration of hemodialysis [16].

One more study was conducted on same aspects and the result showed that 50% of the samples had good knowledge 45% had average knowledge and 5% had a poor score and 78.3% had good practice 21.7% had average practice in the pre-test. Following the administration of the self-instructional module the post-test revealed that the knowledge and practice improved to 100% [17]. The above results are revealed that majority of caregivers had inadequate or average level of knowledge regarding End stage renal failure on hemodialysis. The supportive studies were recommended that educational programme helps the care givers to enhance their knowledge and really helpful for the patients and their family.



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CONCLUSION

The vital role of nurses is act as Health educator and creates awareness, increase the understanding about End stage renal failure. There is necessary to improve their awareness and practices to make appropriate decisions towards caring their loved ones to support their health promotion and help for better quality of life.

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Table: 1. Distribution of Care Givers According to Their Demographic Variables

S.NO	DEMOGRAPHIC VARIABLES	FREQUENCY	PERCENTAGE (%)
1.	AGE IN YEARS		
	e) 21-30 years	5	10
	f) 31-40 years	25	50
	g) 41-50 years	15	30
	h) ≥51 years	5	10
2	EDUCATION OF THE CARE GIVERS		
	f) Graduate	5	10
	g) Diploma	20	40
	h) Higher Secondary	2	4
	i) High School	8	18
	j) Primary School	14	28
3	RELATIONSHIP		
	a) Parents	3	6
	b) Spouse	25	50
	c) Son	6	12
	d) Daughter	9	18
	e) Others	7	14
4	RELIGION		
	e) Hindu	28	56
	f) Muslim	8	16
	g) Christian	14	28
	h) others	0	0
5	TYPE OF FAMILY		
	c) Nuclear family	28	56
	d) Joint Family	22	44
6	FAMILY MONTHLY INCOME		
	f) 5000-10,000	6	12
	g) 10,001-15,000	12	24
	h) 15,001-20,000	14	28
	i) 20,001-25,000	15	30
	j) >25,001	3	6
7	SOURCES OF INFORMATION ON END STAGE RENAL FAILURE AND HEMODIALYSIS		
	d) Health Personnel	24	48
	e) Family members/Relatives	15	30
	f) Mass media	11	22

Table: 2. Level of knowledge regarding end stage renal disease on hemodialysis among care givers

Level of knowledge	Frequency	Percentage
Adequate knowledge	11	22 %
Moderate knowledge	27	54 %
Inadequate knowledge	12	24 %





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Table: 3. Mean, SD, and Mean Percentage of Knowledge Regarding End Stage Renal Disease on Hemodialysis Among Care Givers

Knowledge regarding End stage renal disease on hemodialysis among care givers	Maximum score	Mean	SD	Mean %
	40	6.25	2.256	15%

Table: 4. Association between Knowledge Regarding End Stage Renal Disease on Hemodialysis Among Care Givers

S.NO	Demographic variables	Chi-square	Level of significance
1	AGE IN YEARS	10.365*	SIGNIFICANT
2	EDUCATION OF THE CARE GIVERS	12.562*	SIGNIFICANT
3	RELATIONSHIP	5.132	NOT SIGNIFICANT
4	RELIGION	3.452	NOT SIGNIFICANT
5	TYPE OF FAMILY	4.865	NOT SIGNIFICANT
6	FAMILY MONTHLY INCOME	2.365	NOT SIGNIFICANT
7	SOURCES OF INFORMATION	11.562*	SIGNIFICANT





An Efficient Node Mobility in Ad Hoc Networks

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ABSTRACT

This study describes an enhanced process for a mobile wireless ad hoc network's optimized and effective node management architecture. The new technique is based on network optimization and route maintenance. The proposed solution is designed to address the issue of node movement during the routing process. NS-3.5 was used to estimate the performance of Mobility Models utilizing parameters such as Packet Delivery Ratio (PDR), Average Latency, Throughput, and so on.

Keywords: MANET, Mobility models, Mobility sample, NS-3.5, Performance constraint Bonn Motion.

INTRODUCTION

Because of its ad hoc nature, such as dynamic (often changing) network architecture, shared medium partial bandwidth, and multimode features, the major concern in an ad hoc wireless network is ad hoc routing. An effective mobility management plan is required. While new dialogue or direction-finding algorithms are being considered, node mobility has been commonly used for simulation functions. In a network, node mobility refers to the ability for nodes to move freely in any direction. The topology is self-motivated and erratic, and this free node can purpose linkages between nodes to alternate rather regularly. The Ad-Hoc wireless network's typical operation requires access to data in the free moving node. In an ad hoc network, creating and maintaining links between nodes is a daunting task and a hot issue of discussion. As a result, the node management system must be improved.

There are two learn directions in Mobility Management. Designing a new Mobility Model that predicts a new era of mobility is one method. Another way to improve mobility is to play with routing protocol characteristics like interruption, jitter, and throughput. The migration of nodes, connected failure, bit error rate degradation, and an increase in routing overhead, among other things, has an impact on network routing methods. When the velocity of cellular nodes increases, the number of cell nodes below any transmission fluctuates [1–3]. The focus of this paper is on improved node mobility patterns in wireless ad hoc networks. This paper seeks to define an effective node



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movement pattern for Wireless ad hoc networks using Random Waypoint, one of the most efficient node mobility management techniques. The final reason for designing a mobility structure is to visualize movement samples of people in motion and determine how their velocity, position, and acceleration change over time. It's perfect for mobility fashions to examine a real-looking movement sample of centered practical software. When it comes to determining protocol performance, motion patterns are crucial. It is critical to choose an acceptable underlying mobility management model when assessing a wireless ad hoc network protocol [4, 5]. The node in the Random Waypoint model, for example, works in a different way than the occupation cluster or group. The Random Waypoint Model is no longer useful for determining the reasons why nodes in a network tend to move together. As a result, a mechanism will be developed to increase the knowledge of mobility management models and their impact on protocol performance. This paper is organized as follows: Sect. 2 discusses the issue statement. Sect. 3 details the proposed model, whereas Sect. 4 details the methods used. Sect. 5 discusses the findings and discussions, while Sect. 6 wraps up the study.

Problem Statement

The node movement pattern is the most serious issue in wireless ad hoc networking, and it has a significant impact on available throughput, PDR, and quality of services (QoS). The objective of mobility models is to represent a common workstation node movement pattern technique so that the mobility model may be analyzed for these purposes. As a result, node mobility is critical in assessing the overall performance of ad hoc wireless networks. The Random Waypoint mobility model is the most widely used mobility model. As a result, the next section explains the mobility model. It has been proven that modeling a human's movements or transportation means is no longer appropriate. As a result, new transportation models are desperately needed.

Random Waypoint Mobility Model Applied

The Random Waypoint Mobility Model (RWP) is made up of pauses in between route and speed transformations. A node begins to evolve by settling in one location for an extended period of time (recess time). When this component completes, the node chooses an arbitrary location inside the simulation zone and distributes a velocity between [least-speed, utmost-speed]. Then, at the selected speed, it travels to the recently chosen vacation destination. When the node first appears, it takes a break for a set amount of time before resuming the procedure. However, because its overall performance is unaffected by past actions (memory-free), it produces impractical or unrealistic displacements. A node is used to accompany the visiting sample. This mobility management model's utilization is graphed. Topology interchange is constantly prompted by RWP mobility [1-7]. The halt time and maximum speed have an impact on the nodes' mobility behavior. A community topology becomes distinctively stable when the maximum speed is short and the break time is increased. On the other hand, when the maximum velocity is high and the break time is short, the topology is highly self-motivated. The Random Waypoint mobility management paradigm has two simple issues: unexpected flip and surprising give up [7-8]. On every occurrence, a sharp turn occurs; there is a path alternate inside the range. Every time there is a sudden give up, it is a transaction of velocity. This factor has nothing to do with the previous speed. Allowing the prior pace and course to influence the longer time pace and route is a common way to alleviate these problems [9–11]. The majority of studies have characterized the nodes' individual mobility models. In wireless ad hoc networks, however, a single node's routing consideration is uncommon because most of the nodes' traffic exhibits unity property.

Proposed Model

The proposed problem of obtaining more practical mobile nodes can be handled after enhancing the mobility model. Aside from the aforementioned limitations and constraints, the mathematical hypothesis and comprehensive analysis of this model are provided. We want to find a way to deal with the unpredictable migration of nodes that can cause the link to break. In this paper, we present our node movement approach in actual contexts such as university campuses and shopping malls. Our key goals are to increase random waypoint performance in terms of delay, latency, throughput, and reliability while also lowering overhead by determining the optimum path for sending packets to their destinations. When it comes to evaluating wireless network protocols, the mobility model is





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crucial. Wireless mobility models within the network differ from those in other networks. The network's connectivity and capacity are constantly reliant on the nodes' movement. The wireless mobility models, in contrast to earlier presented models that require Base Stations (BSs), demand cooperation from two or more communication nodes [5-7]. Despite the fact that other presented models and ad hoc wireless mobility models have unique models, there are some similarities between the two categories. The Random Waypoint Model is one of the most widely used ad hoc wireless models for ad hoc wireless modeling, having been implemented in numerous network simulators. In many mobility models, node movements are self-regulating; this has to be described in the previous few research works. In group mobility models, however, node movements are obsessed with one another. As a replacement for the ad hoc wireless network, a new mobility model is proposed in this study. A real-life configuration is used to test and analyze the mobility model. To begin with, people gravitate toward certain destinations rather than choosing on a destination at random. Second, there are several stumbling blocks in the setup. Third, the human instinct is to walk through a pathway and choose the quickest path; they do not walk along unorganized paths [12-15]. The graph contradicts the developed enhanced mobility model. Every node in the movement sample from a supply point to a rest point must find an appropriate passageway through the environment. The use of a direction discovering technique allows for barrier-free node moments. For the rapid beam meeting point search computation, this technique employs a ray launching approach that contains an optimized line algorithm (Fig. 1).

The Path Finding Algorithm

A route can also be a collection of nearby elements that shape adjacent portions, with no section overlapping an obstruction in the environment. This fact is satisfied by the following algorithm.

- The starting and ending positions are initialized in the first step. We build a tracing line between the source and the rest point after initializing the source and target locations.
- Now we'll look at the interesting objects. If the first object is struck, draw a second tracing line from the striking or hitting location to the rest, or destination, place.
- Otherwise, we'll add a rest point to the path and call it a day.
- We'll now examine the obstruction strike's first edge.
- Add a hit position to the path if there is a strike.
- Otherwise, return your attention to the first striking object.

The opening role and, as a result, the authentic function are initially interchangeable. Using this beam, we initiate a beam from supply to a rest location and search for the primary obstruction strike. Now we'll add the most important strike aspect to the trail and see how we can overcome this difficulty. To do so, we appear to have touched the main region at some point of this barrier. Assume a footing is gained on this edge and the unique strikes the meeting point. To shorten the ultimate direction length, we choose the strike side's nearest facet. We repeat this process until the barrier is removed. The beam from the node role to the rest spot does not appear to hit the barrier's fringe.

RESULTS AND DISCUSSIONS

The proposed technique is simulated and analyzed using the NS-3.0 simulator [1]. The basic hardware and operating system used in simulation work is UBUNTO 14.04 LTS. Table 1 shows the setup that is currently in use. BONNMOTION 2.0 is a key technical tool for assessing the current status of mobility [11-14]. We created mobility scenarios for RWP and an upgraded mobility model using NS-3.0 to integrate into TCL scripts based on the results shown below. With the help of a traffic scenario generator script, unsystematic CBR traffic acquaintances can be grouped across mobile nodes. For a simulation length of 300 seconds, we used the random waypoint model and enhanced mobility model for the node, with a stop time of 15 3 s and speeds ranging from 0 to 100 m/s, with a minimum speed of 5 m/s and a maximum speed of 20 m/s. The performance constraint is demonstrated in Table 1 below. The positions of nodes, their mobility, and the traffic between them are arbitrarily placed for each simulation session. The NS-3.5 arbitrary variables are used by BONNMOTION to account for the nodes' unsystematic dwellings





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and actions, as well as the site visitors. The main factor is to include the non-systematic variables; as otherwise, it may result in extensive simulations with no useful findings.

Average End-to-End Delay

This includes all possible setbacks caused by buffering during route-finding latency, such as waiting in line at the boundary queue, re-transmission set-backs at the MAC, and broadcast and switch times. It is defined as the time it takes for an information packet to be sent from a supplier to a rest point across an ad hoc network [11, 13, 14].

Delay D = Get Hold of Time – Dispatch Time.

Packet-Delivery-Ratio (PDR)

The proportion of records packets carried to the rest location compared to those produced at the beginning is known as PDR. It is calculated by dividing the number of packets acquired through the rest spot by the number of packets acquired through the supply range [11, 13].

Throughput

It is a popular type of message that is efficiently delivered in terms of the number of bits transmitted per second [13, 14].

Throughput = Total Received Packets/Total Simulation Time (Kbits/s)

RESULT AND ANALYSIS

We consider ourselves above the usual concert constraint in terms of overall performance evaluation. The simulations in Figures 2, 3, and 4 examine the typical overall performance in terms of end-to-end delay, throughput, and packet transit ratio. The results conflict with the results of the two mobility models we chose, the Random Waypoint Model and the Enhanced Mobility Model. The outcome will show overall performance for mobility fashions in comparison to the DSR procedure, which was chosen under a certain mobility model, as shown in Figs. 2, 3, and 4.

Dynamic Source Routing (DSR)

The DSR protocol is a wireless network direction-finding protocol. Rather than relying on the routing desk at each intermediate device, supply routing is used. Dynamic Source Routing (DSR) can be defined as an independent routing protocol for wireless networks. Every supply in Dynamic Source Routing chooses the best path to send its packets to certain destinations. Path finding and path preservation are the two most important components.

Packet Delivery Ratio (PDR)

The PDR refers to the total amount of data packets communicated by distinct sensor nodes, as well as the number of packets lucratively carried to the targeted or sink node. In Fig. 2, the proposed mobility model has a PDR of 0.18 in RWP and 0.21 at nodes 20 and 0.27 in RWP and 0.30 at nodes 30. PDR has returned to the rising stage at node 30. However, at nodes, 50 PDR is 0.37 in RWP and 0.22 in PDR, indicating that PDR is lower than RWP. When comparing the proposed model to the Random Waypoint Model, it can be seen that PDR's performance improves between nodes 20–40. It's slightly reducing at node 50, but when the node grows, it'll grow even more.

Throughput

The ratio of correctly transmitted data packets, measured in bits per second, is known as throughput. It should be remembered that greater throughput figures suggest better performance. The suggested mobility model throughput at nodes 20 is 0.15 bits/s for RWP and 0.3 bits/s for the proposed mobility model, as shown in Fig. 3. At nodes 30, RWP throughput is 0.22 bits/s, whereas the proposed mobility model throughput is 0.33 bits/s. In comparison to the Random Waypoint Model in the upgraded model, we can see that the throughput increases consistently as the number of nodes increases.





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End-to-End Delivery

The amount of time it takes for a packet to reach at its destination location after leaving its source is known as the End-to-End delay. Figure 4 shows that the end-to-end delays for RWP and the suggested mobility model at node 20 are 0.220 bits/s and 0.219 bits/s, respectively. At nodes, 30 end-to-end delays for RWP and 0.169 for the proposed mobility model are 0.178 bits/s and 0.169 bits/s, respectively. Here, we can see that the time it takes for a packet to travel from its source to its destination is the same or slightly shorter.

CONCLUSION

In his manuscript, A wireless ad hoc routing system like DSR is used in this article for a node that we saw right here. RWP and proposed mobility models were also evaluated here. We found that the performance of mobility models might vary dramatically depending on which ad hoc protocols are used. The results of our research show that ad hoc network direction-finding protocol performs better with different mobility models. The mobility model, according to our findings, exaggerates the protocol's performance. The performance of the mobility models should be estimated using a wireless ad hoc network protocol (such as DSR routing protocol in our experiments) since it is the most closely analogous to a predictable real-world scenario. End-to-end latency, throughput, and PDR are the three criteria for which we have performed a comparison in this work. For the sake of this comparison, we used DSR as the routing protocol.

On set constraints such as packet delivery ratio, end-to-end delay, and throughput for a node movement sample, the suggested mobility model outperformed the random waypoint mobility model. It's worth noting that, while comparing two models, our suggested model's throughput and PDR performs better at 20, 30, 40, and 50 nodes. However, in the situation of End-to-End Delay, our pattern performs similarly, if not slightly better. Based on these performance parameters, we may conclude that using our small organization model will produce superior results. The result also shows that a previous deployment of a wireless ad hoc network in a real-life setting is insufficient to study its performance using a specific mobility model. Performance is influenced by the preference for mobility patterns.

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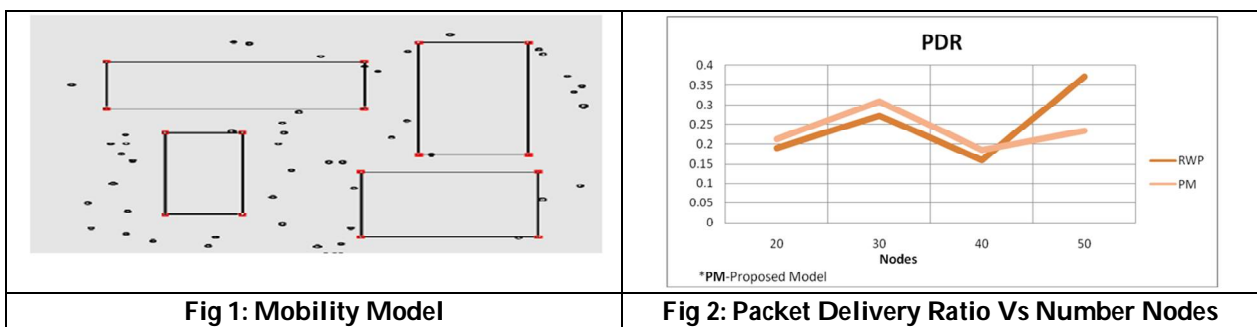


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Table 1

Constraints	Value
Type of channel	Wireless channel
Simulator	NS 3.5 (Version 3.5)
Protocols	DSR- Routing Protocol
Time Duration for Simulation	400s
Amount of nodes	20,30,40,50
Range of Transmission	250m
Movement management Model	Random-Waypoint
MAC Layer Protocol	802.11
Break Time (s)	15 ± 3 s
Utmost speed	35
Least speed	0.5
Packet Rate	4 packets
Type of traffic	CBR (Constant Bit Rate)
Data Payload	512 bytes/packet
Max of CBR connections	(10,20,40,60,80)
Size on an environment	(700m * 700m)





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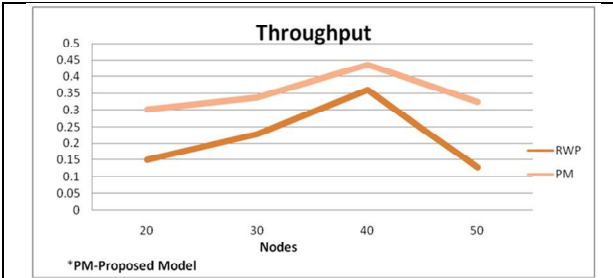


Fig 3: Throughput Vs Number Nodes

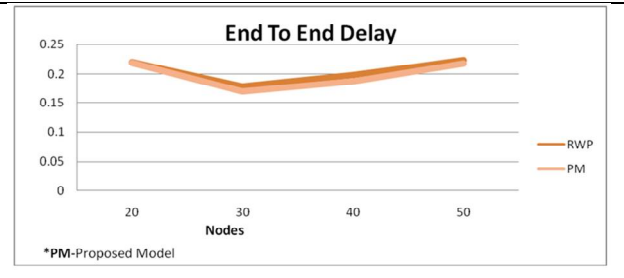


Fig 4: End to End Delay Vs Number Nodes





Partial Permutation of Cement by Chicken Eggshell Powder in Concrete

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ABSTRACT

To find out alternate source of raw material for concrete making, this study aims at using raw chicken Eggshell powder without incineration as partial replacement for Ordinary Portland Cement. Cement was replaced by means of Eggshell powder correspondingly 5%, 10%, 15%, 20%, 25%, and 30% by weight. Concrete compressive strength results at the age of 28 and 56 days shows 5% as optimum and gradual decrease in compressive strength beyond addition of 5% Egg shell powder in nominal M20 mix was noticed. However, an attempt was made by testing concrete having 5% Egg shell powder 10%, 20% and 30% next additives (fly ash, micro silica, saw dust ash) in view of improving the strength beyond 5%. From this study, it is clear that Eggshell powder can be considered as a useful supplementary material in sustainable concrete production.

Keywords: Ordinary Portland cement (OPC), egg shell powder (ESP), saw dust ash (SDA), fly ash (FA), micro silica (MS).

INTRODUCTION

Energy plays a fundamental role in the growth of developing countries like India. In the circumstance of low availability of non-renewable energy resources coupled with the requirements of large quantities of energy for building materials like cement, the importance of using industrial waste cannot be under estimated. For the production of one tonne of Ordinary Portland Cement, about 1.1 tonnes (2444 pounds) of earth resources like



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limestone are needed. Further while manufacturing 1 tonne (2222 pounds) of Ordinary Portland Cement an equal amount of carbon dioxide is released into the atmosphere. The carbon dioxide emissions act as a silent killer in the environment in various forms. In this backdrop, the search for cheaper substitute to ordinary Portland cement is a needful one. Egg production in India is growing at a compounded growth rate to over 114 billion at 2020, a considerable increase from about 16 billion eggs produced in the year 1986. Egg after its effective consumption results as an Eggshell waste. This symbolizes the total quantity of Eggshell production and its effective utilization as raw materials. If these are dumped as waste on open land they induce microbial actions over years and results in pollution and cause unexpected diseases for living natures which possess potential threat to the environment.

This study focuses towards the use of Eggshell waste in effective way as a substitute for natural sources of calcium (CaCO_3 , CaO , $\text{Ca}(\text{OH})_2$), to conserve resources from rock and soil and to reduce global climate warming. The most important element of chicken eggshell is calcium carbonate which can be used in various material applications such as animal feed, pet food, bio-catalyst in biodiesel production, pharmaceutical and cosmetic products, printing ink, paper, glaze decorations and also as a source of calcium oxide. It is commonly acknowledged that calcium oxide acquires a major role in the hydration reactions fairly than being inert filler. Calcium contents in the shells can be renewed in to calcium oxide by incineration and the resultant burnt lime can be used as a liming agent. The by-product of eggshell symbolizes approximately 10-11% of the total weight of a chicken egg, on an average of 5 gram (0.18 OZ) to 6 gram (0.21 OZ). The vital point is CaCO_3 contributes about 51% in Eggshell powder approximately and it seems intimately with cement. Therefore, persistent efforts are taken to utilize Egg Shell Powder as an alternative for cement in concrete. Also to enhance the utilization of eggshell powder, silica rich admixtures like saw dust ash; fly ash and micro silica are tried [7].

MATERIALS USED

For this study, Ordinary Portland cement, Eggshell powder, fly ash, micro silica and saw dust ash were used [10]. The potentialities of materials were done by standard basic tests and the same were discussed in succeeding texts.

Cement: Ordinary portland cement of grade 53 confirming to IS: 12269-1987 was used for this study to cast the specimen. The physical characteristics and properties of cement are listed in Table 1 and Table 2.

Egg Shell Powder: Required raw chicken eggshells were collected from SKM Egg products private limited, Erode, India. The quality of lime in Eggshell was suitably influenced by the presence of unwanted impurities, so Eggshells were thoroughly washed with potable water to remove impurities and dirt's and then dried in natural sunlight in at most care condition. The chemical properties of Eggshell powder are evaluated and tabulated in Table 3.

Saw Dust Ash: Saw dust is a by-product obtained from cutting, drilling, tooling and grinding of wood and it is shown in Figure 2. Saw dust is an organic waste having a soluble carbohydrate which severely affects the setting and hardening property of ordinary Portland cement. Saw dust ash (combustion to about 500°C - 600°C in an electric furnace [9]) which is a well-known material suitable for cement replacement. The chemical composition of saw dust ash is presented in Table 4.

Fly ash: Fly ash is the ash obtained by burning of fine coal powder during production of electricity in thermal power plants and it is shown in Figure 3. It is chemically rich in alumina, iron and silica [2]. The chemical properties of fly ash are presented in Table 5. Egg shell powder replacement resulted in the minor loss of SiO_2 in cement and was balanced by fly ash addition.

Micro silica: Micro silica is obtained as by product of silicon and Ferro-silicon production which is shown in Figure 4. Though it is amorphous having low percentage of impurities, it is said to have filler effect [3]. Micro silica in presence of lime be the suitable material binds aggregate together and $\text{Ca}(\text{OH})_2$ [1]. The chemical properties of micro



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silica are presented in Table 6. A feasible study was made using SiO₂ rich micro silica to obtain stable proportion better than conventional mix.

Fine Aggregate: Concrete mixes were prepared by using river sand as fine aggregate and it is conformed to Zone III as per IS: 383–1970 [4]. Properties of fine aggregate are given in Table 7.

Coarse Aggregate: Blue granite stone with a nominal maximum size of 0.78 in. (20 mm) was used as Coarse aggregate which is conformed to IS: 383 – 1970 [4]. As like fine aggregate, the standard tests were carried out and the same are given in Table 8.

Water: Potable tap water available in the laboratory with pH value of 7.0 ± 1 and conforming to IS: 456 – 2000 was used for mixing concrete and curing the specimens at room temperature.

Testing and Evaluation

M20 grade concrete was designed as per IS: 10262 – 1982 [5] and materials required for one cubic meter is presented in Table 9.

Compressive strength testing

For moulding concrete cubes, metal mould of 5.90 in. (150 mm) X 5.90 in. (150 mm) X 5.90 in. (150 mm) size were used. During casting, the freshly prepared concrete mix were poured in to mould in three layers of which each layer is tampered evenly with required blows such that the layers are well compacted. The concreting of cube specimens is shown in Figure 5. The compressive strength determination was the primary objective to evaluate the optimum percentage of addition of egg shell powder in concrete mixtures [6]. Figure 6 shows the testing specimen under compression. Based on compressive strength testing it was confessed that the mix of 5% egg shell powder 95% cement as optimum. New combinations of silica rich admixtures along with regular 5% addition of eggshell powder were made with respect to cement concrete in varying proportions of 10%, 20% and 30%. This concerns a chance to find suitable mix, offering needed hardened strength and is discussed in succeeding texts.

The specimens were tested at the age of 28 days and 56 days for compressive strength evaluation as per IS: 516 – 1959. The results evaluated from testing are presented in Figure 9 and Figure 10. From the graph, various results of proportioned mixes are altogether compared with control concrete of strength 3.989 ksi (27.5 N/mm²). Accordingly it is concluded that (20% MS + 5% ESP + 75% OPC) for cement replacement in concrete ie. MS20% proposes excessive strength of 4.173 ksi (28.77 N/mm²). Also FA20% mix shows reasonable strength of 4.11 ksi (28.34 N/mm²) similar to control mix. Results of proportioned mixes are on the whole compared with conventional mix such that MS20% (20% MS+ 5% ESP + 75% OPC) replacement in concrete proposes excessive strength of 6.889 ksi (47.5 N/mm²) than a conventional concrete of 6.599 ksi (45.5 N/mm²). Comparatively an additional excessive strength of 6.657 ksi (45.9 N/mm²) was obtained in FA20% (20% FA + 5% ESP+ 75% OPC). In other term, 5% and 4% of development was obtained for (5% ESP + 20% MS + 75% OPC) specimens when compared to control concrete at the age of 28 and 56 days.

Split tensile strength testing

Steel moulds of 5.90 in. (150 mm) diameter and 11.8 in. (300 mm) height were used for casting cylinder specimens. After 24 hours of casting, specimens were de-moulded and cured in water tank having potable water. Casted specimens were cured for 28 days and 56 days. The split tensile strength was evaluated by placing cylinder specimens horizontally on test platform; ensured that load along the longitudinal axis of cylinder symmetrically. At referred rate of loading, the strength and the obtained results for all set of specimens was shown in Figure 7 and Figure 11, Figure 12. For 28 days cured FA cylinder specimens, increase in strength was noticed parallel to increase in percentage from 10% to 30% in 5% ESP mixed OPC. Although MS specimen shows superior in strength at 20% as 0.35 ksi (2.45 N/mm²) then it reduces about 0.34 ksi (2.31 N/mm²) towards further percentage increment to 30% replacement along with 5% ESP replaced OPC.



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Flexural strength testing

Mould of size 19.68 in. (500 mm) X 3.94 in. (100 mm) X 3.94 in. (100mm) are used for casting prism specimens. The fresh concrete mix of defined proportions filled in steel moulds ensures well compaction. After demoulding, specimens were cured for 28 days and 56 days. Prism specimens after required period of curing are subjected to two points loading symmetrically were shown in Figure 8 and the obtained results are shown in figure 13 and figure 14. The mixes of all proportions show gradual decrement in flexural strength as the percentage addition of FA, MS and SDA increases. The maximum flexural strength of 1.01 ksi (7.0 N/mm²) is obtained at MS20% mix which is equal to conventional concrete. Comparatively flexural strength of 0.88 ksi (6.07 N/mm²) for FA20 and 0.87ksi (5.99 N/mm²) for MS20% were obtained. Gradual increase in flexural strength was observed as the FA proportion increases. At FA30% mix, a comparatively higher value of 1.43 ksi (9.85 N/mm²) is obtained. In MS20% a value of 1.42 ksi (9.80 N/mm²) is obtained which is notable with all the other mixes. In a way, identical strength was obtained for (ESP 5% + MS 20% + 75% Cement) specimens when compared to control concrete at the age of 28 days. At the age of 56 days it was found that, ESP 5% + MS 20% + 75% cement specimens show strength reduction of about 7% compared to control concrete.

CONCLUSIONS

By methodical investigation the following conclusions were arrived.

1. The optimum percentage of addition of raw Eggshell powder for cement concrete was found as 5%.
2. In combination with admixtures, compressive strength of concrete having 5% eggshell powder, 20% micro silica and 75% of OPC at the age of 28 and 56 days was increased by about 1.04 times. This is due to better core filling effect between the particles [8].
3. As split tensile strength concerns addition of admixtures does not own any noticeable strength.
4. Due to the homogeneity in concrete mixture, flexural strength development was found over concrete having 5% Eggshell powder, 20% Micro silica and 75% of OPC.
5. In general, concrete of MS20% shows better strength compared to MS10% and MS30%. Whereas results of SDA mixes are not appreciable and it tends reduction towards higher concentration. Obviously FA20% mix intends better strength against FA10% and FA30%.
6. By the experimental observation it was found that the use of eggshell powder as CaCO₃ without incineration itself showed improved mechanical characteristics. If it is used after incineration as CaO there may be a remarkable overall performance in all the mechanical aspects.

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Table 1 – Physical Properties of Cement

Description	Tested Values
Standard Consistency	33%
Initial Setting Time	29 min
Final Setting Time	550 min
Compressive Strength	7.83 ksi (54 N/mm ²)
Fineness Modulus	3.2%
Specific Gravity	3.12

Table 2 – Chemical Properties of Cement

Chemical Composition	Cement
CaO	62.1%
SiO ₂	22.5%
Al ₂ O ₃	5.7%
Fe ₂ O ₃	3.01%
MgO	0.5%
SO ₃	4.11%
K ₂ O	1.3%
Na ₂ O	0.18%
Insoluble Residue	0.6%
Specific Gravity	3.12

Table 3 – Chemical Properties of Egg Shell Powder

Chemical Composition	Egg Shell Powder
CaO	52.2%
SiO ₂	0.08%
Al ₂ O ₃	0.03%
Fe ₂ O ₃	0.02%
MgO	0.01%
SO ₃	0.36%
K ₂ O	Nil
Na ₂ O	0.15%



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Others	0.62%
Insoluble Residue	Nil
Specific Gravity	2.4
Loss on ignition	46.53%

Table 4 – Chemical Properties of Saw Dust Ash

Composition	Saw Dust Ash
CaO	12.8%
SiO ₂	52.3%
Al ₂ O ₃	9.09%
Fe ₂ O ₃	15.1%
MgO	0.07%
SO ₃	0.66%
K ₂ O	9.89%
Na ₂ O	0.09%
Insoluble Residue	Nil
Fineness Modulus	1.89
Specific Gravity	2.19

Table 5 – Chemical Properties of Fly ash

Composition	Fly ash
CaO	1.02%
SiO ₂	59.3%
Al ₂ O ₃	34.6%
Fe ₂ O ₃	5.87%
MgO	0.38%
SO ₃	0.1%
K ₂ O	0.01%
Na ₂ O	1.28%
Insoluble Residue	Nil
Specific Gravity	3.13
Loss on ignition	1.9 %

Table 6 – Chemical Properties of Micro silica

Composition	Micro silica
CaO	1.2%
SiO ₂	91%
Al ₂ O ₃	0.6%
Fe ₂ O ₃	0.2%
MgO	1.4%
SO ₃	0.6%
K ₂ O	2.1%
Na ₂ O	0.1%
Insoluble Residue	Nil
Specific Gravity	2.2





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Table 7 – Physical Properties of Fine Aggregate

Description	Tested Values
Fineness Modulus	3.64
Water Absorption	0.51 %
Specific Gravity	2.63

Table 8 – Physical Properties of Coarse Aggregate

Description	Tested Values
Fineness Modulus	6.0
Water Absorption	0.3 %
Specific Gravity	2.68

Table 9 – Material required for 1m³ of Concrete

Grade	Cement	FA	CA	In terms	Water	In terms
M20	383.16	652.35	1181.77	(Kg/m ³)	191.58	litres
	23.91	40.72	73.77	(lb/ft ³)	50.61	Gallon

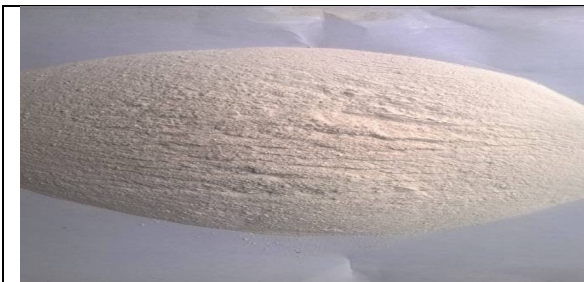


Figure 1 – Egg Shell Powder



Figure 2 – Saw Dust Ash



Figure 3 – Fly ash



Figure 4 – Micro silica



Figure 5 – Casting of Cube specimens



Figure 6 – Testing of Cube specimens





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Figure 7 – Testing of Cylinder specimens



Figure 8 – Testing of Prism specimens

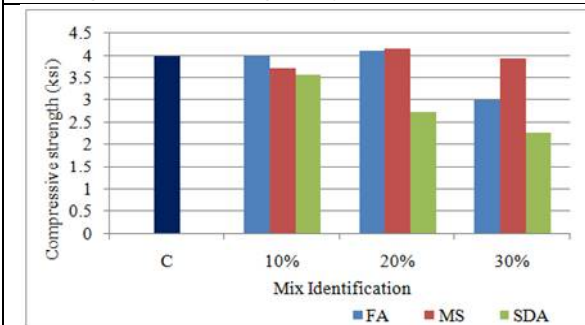


Figure 9 – Compressive Strength of Cube Specimens at the age of 28 days

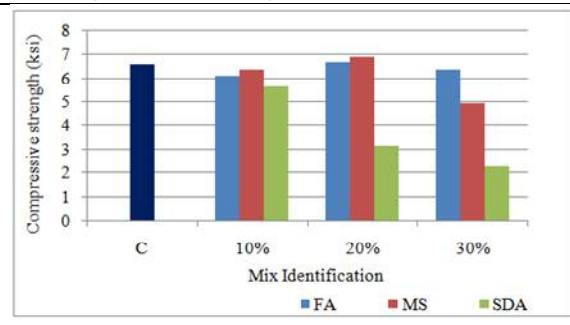


Figure 10 – Compressive Strength of Cube Specimens at the age of 56 days

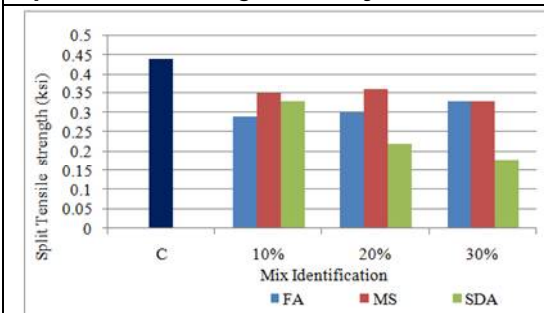


Figure 11 – Split Tensile Strength of Cylinder Specimens at the age of 28 days

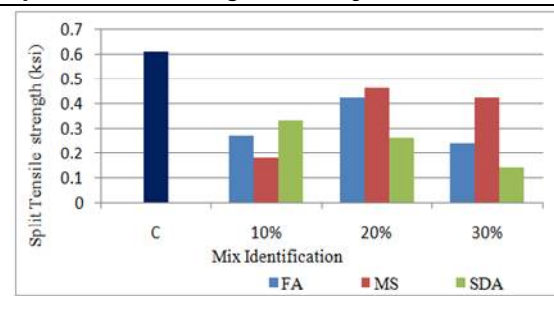


Figure 12 – Split Tensile Strength of Cylinder Specimens at the age of 56 days

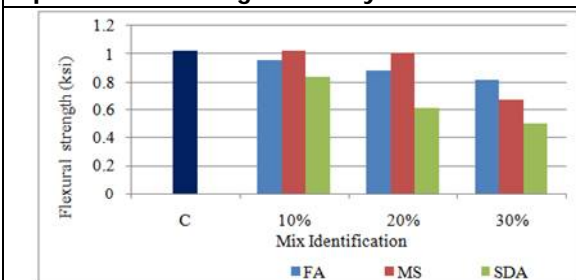


Figure 13 – Flexural Strength of Prism Specimens at the age of 28 days

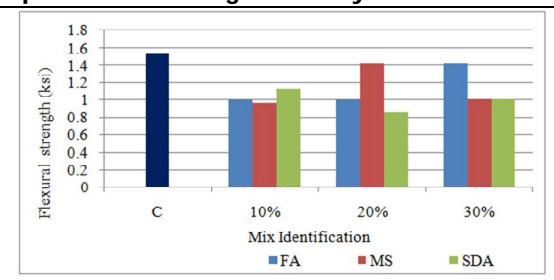


Figure 14 – Flexural Strength of Prism Specimens at the age of 56 days





Detection and Discrimination of Leaf Diseases in Turmeric using Image Processing Techniques

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ABSTRACT

The tremendous monetary possibility of the harvest can be enough settled by the way that around 20-30 million individuals devour turmeric in India consistently next to those in different nations of the world which may incorporate more than 2 billion customers. Its development is profoundly work escalated and offers work to about 2.0 million families occupied with development, exchanging and business in turmeric all through India. Turmeric an antiseptic powder is utilized as medication for specific illnesses and furthermore utilized as a clean. During development turmeric is a lot of influenced by illness and furthermore method for to recognize sicknesses early tainted stage utilizing computerized picture preparing and design acknowledgment procedures, such as rhizome decay infection, leaf spot illness, leaf smear sickness and dry decay illness that bring about extraordinary misfortune for the ranchers. It happens in a destructive structure and if not controlled, causes far reaching harm and even absolute pulverization of the whole turmeric manors with no early signs of the infections. The point of this paper is to consider and recognize different illnesses in the turmeric plants and furthermore system to distinguish sicknesses early contaminated stage utilizing advanced picture handling and example acknowledgment strategies.

Keywords: Turmeric leaf diseases, segmentation, classification



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INTRODUCTION

Turmeric is prominently known as Manjal in Tamil and furthermore regularly known as Haldi or Hardi in Hindi. The natural name of *Curcuma longa* is known as Turmeric. It is local to southern Asia. The Turmeric is ordered into numerous assortments in light of its size. Around 100 assortments of turmeric are developed all through the world. Among these assortments, around 40 assortments of turmeric are developed in India. Tamil Nadu, Uttar Pradesh, Bihar, Maharashtra, Karnataka, West Bengal, Andhra Pradesh and Kerala states are broadly developed in the Turmeric. In Tamil Nadu, the most well known development assortments are Erode nearby and Salem neighborhood, PTS-10, BSR-1, Roma and Suguna. Among these assortments of Erode nearby, and Salem nearby, the variety PTS-10 Turmeric is considered for this examination work. In turmeric development, sicknesses are quite possibly the most significant issues that lessen the gather amount of the Turmeric. The significant illnesses that taint the Turmeric plants are Rhizome Rot Disease, Leaf Spot Disease, Leaf Smear Disease, Dry Rot Disease and Bacterial wither Disease. The contamination of such infection causes the adjustment in the shading and presence of the Turmeric leaves. The Turmeric cultivators can't perceive such changes at a prior stage, to start the preventive activities. However, they can picture such changes just at the developed phase of diseases, after which conclusion can't save the Turmeric plant. This is an inadequacy of the most recent innovation in the field of agribusiness.

In the proposed research work, the Rhizome Rot Sickness, Leaf Spot Disease, Leaf Blotch Disease, Dry Rot Sickness and Bacterial shrivel Disease are recognized utilizing advanced picture handling strategies by exploring the infinitesimal change in the shading and presence of the Turmeric leaves. The measurable based examination and histogram based investigation are used to recognize the contamination of sickness and length of such contamination of Turmeric and for those infections. At last, neural network based classifier calculation is created to confirm the exactness of order made by before referenced models among solid and contaminated Turmeric leaves. The primary rationale of this exploration work is to help the agriculturists who develop Turmeric plants on business premise, to recognize sicknesses which contaminate Turmeric plants at the initial stage, so preventive measures could be taken at a proper time. It additionally means to empower them to capture the negative impact of such infections and to get a decent gather at the end. The goal of the examination work is to build up an picture handling procedure which could distinguish the disease of the Rhizome Rot Disease, Leaf Spot Disease, Leaf Blotch Infection, Dry Rot Disease and Bacterial shrivel Disease in Erode nearby, Salem neighborhood, PTS-10 assortment of Turmeric utilizing the RGB shading parts through measurable investigation, histogram examination and neural organization based calculations.

Rhizome Rot Disease

The sickness is soil-borne and rhizomes borne and happens with the beginning of the storm. This infection generally happens during the long periods of June to September. The contamination begins at the collar district of the pseudo stem and advances upwards as well as downwards. The collar locale of the influenced pseudo stem becomes water drenched and the decaying spreads to the rhizome bringing about delicate decay. The tips of lower leaves which progressively spreads to the leaf cutting edges. In beginning phases of the sickness, the center segment of the leaves stay green while the edges become yellow. Afterward, the yellowing spreads to all leaves of the plant from the lower area upwards and is trailed by hanging, shrinking and drying of pseudo stems. The illness is soil-borne. The parasite duplicates with development of soil dampness with the beginning of south west rainstorm. The organism can get classified as two types: (a) in infected rhizomes saved for planting and (b) through resting structures like chlamydospores and oospores that arrive at the dirt from tainted rhizomes. More youthful fledglings are the most defenseless to the microbe. Nematode pervasion irritates rhizome decay illness. Temperature above 30° C and high soil dampness are the significant inclining factors preferring the sickness. Water clogging in the field leads to the immediate decaying of the turmeric plant. At a later stage root contamination is additionally took note. Foliar side effects show up as light yellowing.

Leaf Spot Disease

Sickness is soil-borne seen on the leaves from July to October. Side effect shows up as earthy colored spots of different sizes on the upper surface of the youthful leaves. The spots are sporadic fit as a fiddle and white or dark in



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the middle. Afterward, spots may mix and structure an unpredictable fix covering nearly the entire leaf. The focal point of spots contains organic product, head molded, and fruiting structures. Illness is soil borne and enters the plant flotsam and jetsam. The infection spreads through downpour sprinkles during irregular showers. The frequency of the infection is extreme in turmeric become under uncovered conditions leads to the decaying of the turmeric plant.

Leaf Blotch Disease

Illness manifestation shows up as little, oval, rectangular or unpredictable earthy colored spots on one or the other side of the leaves which soon become messy yellow or dull earthy colored. The leaves likewise turn yellow. In serious cases the plants present a singed appearance and the rhizome yield is decreased. Soil and seed borne and make due in soil on contaminated plant flotsam and jetsam. High soil dampness, temperature 25° C and leaf wetness.

Dry Rot Disease

The illness causes root decay and rhizome decay coming about in average dry decay of rhizomes from October onwards. The influenced rhizomes show up delicate and contracted to begin with, later evaporate and turn out to be hard. Foliar yellowing and evaporating of foliage which are the ordinary side effects of development of the yield during October - November would be vague from the manifestations of the illness influenced clusters. At the point when contaminated rhizomes are cut open, the tainted zones ordinarily show up as dull earthy colored and dim. The microbe is facultative parasites and lives as a saprophyte on the natural issue in the dirt for quite a long while. It spreads from weak plants. The illness is supported by 35° C soil temperature, 15-20 percent soil dampness and alluvial or sandy soils.

Steps for Plant Disease Detection

Various steps are followed in image processing to detect the leaf disease. They are: - Image acquisition, image preprocessing, image segmentation, feature extraction and classification. The step by step process of plant disease detection is given in figure 1.

Image Acquisition

In Image securing step, pictures of plant leaves are procured to play out certain procedure on picture in Image handling system. The pictures can be obtained through an advanced camera or can be downloaded from a validated plant picture webpage. The obtained pictures and their highlights are put away in a picture database. The picture information base comprises of solid set and ailing arrangement of images. The productivity of picture information base relies upon distinction of pictures so the pictures should be of high quality. The proficiency of information base characterizes the energy of the system. The pictures are adjusted into gadget autonomous shading space.

Image Pre-Processing

The pre-processing techniques are accomplished to make the image applicable for further processing. The image is resized in reprocessing step of plant disease detection. The pre-processing of images consists of image enhancement, color conversion and removal of noise. In Image enhancement the quality of image is enhanced to increase the visuality. In color space conversion, the RGB image is converted into grayscale using various color models such as CIELAB, YCbCr and HSV. For the purpose of noise removal, various filters are used. The RGB image is converted into CIELAB, YCbCr and HSV because RGB is device dependent color space and image processing system needs images in device independent color space models. After performing the resizing, color space conversion and enhancement, Histogram equalization methods are used to designate intensities.

Image Segmentation

In Image Segmentation the image is segmented into various parts based on the similarity between various features. The parts having same features are grouped together. Image can be analyzed easily with segmentation. Image



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segmentation can be Local segmentation in which a specific part of the image is considered and Global segmentation in which the whole image is considered.

Feature Extraction

Feature extraction steps retain the various image features that are passed to classifier as its input. Classifiers easily classify the image data into clusters by using features. Features can be grouped into two classes:

Local features - Geometric features such as concave/convex, Endpoints, branches etc. belongs to the category of local features.

Global features - Topological features such as connectivity, number of holes etc. belong to the category of global features

Classification

Classification is of two types supervised classification and unsupervised classification. In the supervised classification the set of classified classes are known in advance but on the other side in unsupervised classification the learning set of classes are not known. Classifiers are used for the purpose of classification. Techniques for classification are: - Artificial Neural Network, Decision Tree, Support Vector Machine (SVM), Fuzzy Measure etc.

Noise in Images and De-Noising Filters

Noise

Noise creates undesirable information in digital images that may affect the quality of the digital image. Noise can occur when the image is transmitted from one computer to another through a transmission medium. It is good to de-noise an image before detecting the features or necessary information in a digital image. There are various types of noises such as, Gaussian Noise, Speckle Noise, Impulsed Valued Noise (Salt and Pepper Noise), Quantization Noise, Periodic Noise, Photon Noise (Poisson Noise), Poisson Gaussian Noise, Structured Noise, Gamma Noise, Rayleigh Noise, White Noise, Brownian Noise (Fractal noise) and many more.

Filters for De-Noising Digital Images

The noise in digital images may cause problems in detecting various features of digital images. Usually the features observed in noisy image and an image that has no noise will be different from each other. So it is always better to remove the noise using various filters to properly extract and observe the features of a digital image. In Image processing, variety of filters are available to de-noise the digital image such as, Mean Filter, Median Filter, Gaussian Filter, Weiner Filter, Kuan Filtering, Wavelet Transform for de-noising, Bilateral Filtering, Morphological Filtering, Homomorphic Filtering and many more.

CONCLUSION

Detection of plant diseases at early stage is necessary because diseases reduce the production of crops. Image processing methods helps in detecting the diseases automatically whereas the manual detection is not an easy task as it requires lot of money, time and effort. The review given in this paper provides informational knowledge in the field of agriculture that can be used by researchers to detect the diseases at early stage. Biotic and abiotic factors affect the crop production and lead to plant diseases. The plant diseases are detected by extracting the features of plant images and classifying these features that helps in detecting the condition of plant as healthy or unhealthy. Early disease detection increases the crop production. This paper present various image processing methods applied by various researchers in the field of agriculture for feature extraction, segmentation and classification. Various image processing methods applied on different plants are described. There are various image processing techniques available for the detection of plant leaf diseases which consists of some basic steps such as, image acquisition, image pre-processing, image segmentation, feature extraction and image classification. Various types of filtering techniques can be used to de-noise the image so that the diseases can be detected efficiently and clearly because noise creates problems in identification of diseases.





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Table 1: Summarized Survey of Various Segmentation Techniques in Plant Disease Detection

S.No	Author	Segmentation Techniques	Year
1	Aditya Sinha And Rajveer Singh Shekhawat	Histogram Threshold and K-Means Segmentation	2020
2	Ch.Usha Kumari, S. Jeevan Prasad And G.Mounika	K-Means Clustering	2019
3	Gayatri Kuricheti And Supriya P	K-Means Clustering	2019
4	Aakrati Nigam, Avdhesh Kumar Tiwari And Akhilesh Pandey	K-Means Clustering	2020
5	Haridas D.Gadade and Dr.D.K.Kirange	Threshold segmentation	2020
6	Vijai Singh	Genetic algorithm	2017
7	K. Suganya Devi, P. Srinivasan and Sivaji Bandhopadhyay	HSV color space segmentation	2020





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Table 2: Some Feature Extraction Techniques are summarized as follows:

S.No	Author	Feature Extraction Techniques	Year
1	Vijai Singh	1. Color 2. Texture	2017
2	Dr.j.vijayakumar	Histogram based Color	2017
3	Aakrati Nigam, Avdhesh Kumar Tiwari and Akhilesh Pandey	PCA Algorithm	2020
4	Gayatri Kuricheti and Supriya P	GLCM Texture analysis	2019
5	Ch.Usha Kumari, S. Jeevan Prasad and G.Mounika	GLCMs	2019
6	Aditya Sinha and Rajveer Singh Shekhawat	Texture Feature	2020
7	Haridas D.Gadade and Dr.D.K.Kirange	1. Shape 2. Color 3. Texture	2020

Table 3: Summarization of Classifiers:

S.No	Author	Classifiers	Year
1	Vijai Singh	Minimum Distance Criterion and Support Vector Machine	2017
2	Dr.j.vijayakumar	Back Propagation Neural Network	2017
3	Haridas D.Gadade and Dr.D.K.Kirange	Support Vector Machine	2020
4	Gayatri Kuricheti and Supriya P	Support Vector Machine	2019
5	Ch.Usha Kumari, S. Jeevan Prasad and G.Mounika	Neural network	2019
6	K. Suganya Devi, P. Srinivasan and Sivaji Bandhopadhyay	K-Nearest Neighbor (KNN) and Support Vector Machine (SVM).	2020
7	Mehmet Metin Ozguven and Kemal Adem	Faster R-CNN classifier	2019

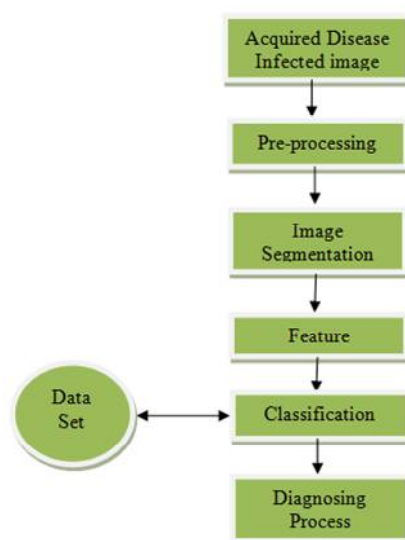


Figure 1. Step By Step Process of Plant Disease Detection





Fatigue Life Prediction of Endless Band Saw Blade TIG Welds

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ABSTRACT

In wood cutting industries saw blade are joined at the shop floor using Brazing or Tungsten Inert Gas (TIG) welding. This shop floor fabricated endless band-saw blade loops have higher heterogeneity in the welded joint due to introduction of filler material in to the joint. Although it does not influence significantly the results of the tensile testing, but lowers the fatigue life of the welded blades by up to 12% than the fusion-welded band saw blades. Electric Resistance Welding processes though produce most durable blade joints but require high initial investment. Therefore this paper aims to optimize the process parameters in TIG welding to maximize the tensile strength of the butt welded joint of the C67 steel band saw blade. To achieve the objective of the research work, Response Surface Methodology has been employed. A central composite design with three input process parameters viz. Welding current, Shielding gas flow rate and Weld root gap, is selected to design the experimental runs and an empirical relationship has been developed. The optimized value of the Tensile Strength, predicted by design Expert software is 585.194 MPa for 37.195 Amp Welding current, 10.831 L/min Shielding gas flow rate and 0.868 mm Weld root gap. Tensile strength of confirmatory experiment specimen is found to be 562.75 MPa. Also the fatigue life of the optimized joint is predicted for minimum 10^6 numbers of revolutions using S-N curve and Goodman diagram. The safe endurance stress for infinite life cycle (10^6 revolutions) was found to be 270.0MPa.

Keywords: C67 steel, TIG, Design Expert Software, Response Surface Methodology, Goodman Diagram, S-N curve.





INTRODUCTION

A band saw blade (Figure 1a.) is a continuous band of toothed long sharp metal band stretched between two or more wheels of band saw machine (Figure 1b.) are used for cutting material in wood working and lumbering. For metal cutting industries endless band-saw blades are mass produced by butt fusing the two ends using the electrical resistance welding process. To ensure high productivity and quality of processing, fusion is achieved by intermediate to direct melting [1]. However, in wood cutting industries blade rolls in large quantities are procured and joined at the shop floor as per machine specification using Brazing or in some industries Tungsten Inert Gas (TIG) welding. Broken saw blades are also re-joined using the same method at the shop floor. The failure mostly occurs in the weld joint and the surrounding heat-affected zone [2]. This shop floor fabricated endless band-saw blades (or blade loop) have higher heterogeneity in the welded joint due to introduction of filler material in to the joint. Although it does not influence significantly the results of the tensile testing, but lowers the fatigue life of the welded blades by up to 12% than the fusion-welded band saw blades [3]. On the other hand Electric Resistance Welding processes though produce most durable blade joints but require high initial investment [2].

Welding defects such as pores formation, residual stress, cracks are the most prominent cause to reduce tensile strength; leading to lower fatigue life [4]. Welding current (RMS), Aspect ratio (Welds width vs. Metal thickness) and Argon Shielding gas flow plays a significant role on mechanical properties and microstructure [5-9]. Lower the aspect ratio (Weld root gap to base plate thickness ratio), much higher is the chances of crake formation [10]. Stress developed due to velocity-dependent blade tension, thermal gradients, raise in temperature [11] and cutting forces together with blade vibration [12] directly effects upon the static and dynamic life of blade [13, 14]. The fatigue failure in dynamic loading (Low cycle and high cycle fatigue failure) due to neck fracture and interfacial crake present and also mis-orientation, irregular carbides in the welds [15, 16] has been already established and is predicted by using: Gerber's parabola, Walker's model and Smith-Watson Topper's model; for different R ratio (minimum to maximum stress ratio, $R = \sigma_{min}/\sigma_{max}$) 1, 0.5, 0.1 and 0.05 in air at 30 Hz cyclic loading [17].

Lots of optimization technique such as Taguchi method, Kriging model, Genetic Algorithm, RSM (Response Surface Methodology) etc. has been successfully used to optimize the parameters for a specific mechanical property [18, 19]. However, research work particularly focused on the optimization of welding parameters for joining of the band saw blade using any of the above-mentioned optimization techniques incorporating fatigue failure analysis is rear to find. Therefore, this paper represents the results of the experimental research work which leads to the optimization of TIG welding process parameters for the maximum Tensile Strength of the welding joint of C67 band saw blade (Figure 1a.) having the dimensions of 50 mm x 1.0 mm and the optimized weld joint is tested up to the point of fatigue failure (at R=0.1)[17] to predict its dynamic stress limit for fatigue life of 1 million of revolution using Goodman model.

MATERIALS AND METHODS

To achieve the objective of the research work, Response Surface Methodology (RSM) has been employed. A central composite design (CCD) with three input process parameters is selected to design the experimental runs to determine the effect of process variables on the response variable tensile strength of the weld joint. The process parameters and their respective levels (effective range) are detailed in Table 1. The selected CCD comprising 20 experimental points in random order is shown in Table 2. The value of alpha (α , the maximum allowable range) is taken as 1.68179 for rotatable CCD. Finally, the experimental data have been utilized to fit second-order polynomial equation.





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Experimental Setup

Manual TIG arc welding has been performed on C67grade saw steel blade sample (Figure 2a.) with 2% Thoriated non-consumable electrode Tungsten using 1.6 mm ER70s-2 filler wire. TIG arc welding machine of model TORNADO TIG 315 AC/DC, make-Ador Frontec Limited has been used with Argon as shielding gas on DCEN mode (direct Current, electrode is connected to negative terminal and the work piece is at positive terminal). For each of the twenty experimental runs, the value of input process parameters viz. Welding current, Gas flow rate and Weld root gap are kept as depicted by the CCD Table 2. At room temperature, the measured ultimate tensile strength of the blade is found to be 1,352 MPa. Chemical composition of the blade material and the filler material are shown in Table 3 & Table 4 respectively.

Tensile Strength (at 2% offset) of each welded sample are evaluated as response parameter, values of which are shown in Table 2. The Tensile test specimens are prepared as per ASTM A370 standard (Figure 2b.). Effect of the process parameters on the Tensile Strength of the weld joints are analysed and optimized for maximum Tensile Strength using Design Expert (V 11) software. A confirmatory experiment is performed with the optimized process parameters and the corresponding weld joint is evaluated for tensile strength. The optimized weld joint is tested using uni-axial dynamic fatigue testing machine (Make: INSTRON 8801) up to fatigue failure (at R=0.1) to predict its dynamic stress limit for fatigue life of 1 million of revolution using Goodman model.

Evaluation and Interpretation of ANOVA Results

ANOVA (Analysis of variance) is performed on the experimental results to find the significance of the selected process parameters. The ANOVA results have been reported in Table 5. ANOVA result shows that the model is significant and Lack of fit of the model is not significant, which implies that the model can be used to estimate the effect of the model terms on the response variable. Model terms A (Welding current), C (Weld root gap) and C² term (square of Weld root gap) have P-value less than 0.05 and thus are found to be significant. From the model, the following empirical relationship in terms of actual factors is obtained.

$$\text{Tensile Strength} = -3903.158 + 104.822 A + 298.803 B + 2122.833 C + 1.548 AB - 12.927 AC - 72.403 BC - 1.484 A^2 - 13.553 B^2 - 494.365 C^2 \quad \text{---- (Equation I)}$$

Where A, B & C denotes the actual model terms (Table 2.).

From the regression equation (Equation I) it can be seen that, effect of welding current on Tensile Strength is positive but its interaction with other terms have negative effect on Tensile Strength. The overall effect of the welding current can be seen negative on the response variable, from the main effect curve (Figure 3a.). From the 3D surface plots (Figure 4.) it can also be seen that lower levels of welding current yields high Tensile Strength [22]. During experimentation, it is observed that high welding current tend to burn hole in the base metal plates, lowering the joint strength. This effect is particularly prominent in band saw blades due to its low thickness.

Similarly, from Equation i the effect of parameter Gas flow rate of Shielding gas and Weld root gap could be seen to be positive on the response but their interaction terms with other parameters have negative coefficient, except the interaction term Welding current & Gas flow rate. From the main effect plot of Gas flow rate (Figure 3b.) it can be observed that with an increase in Gas flow rate, the Tensile Strength of the weld does not increase much. ANOVA results (Table 5.) also indicate this parameter as not significant. However 3D surface plots (Figure 4.) involving these parameters suggest, the maximum Tensile Strength is achievable with 10 to 12 L/min of gas flow. On the other hand from Figure 3c. it can be seen that, Tensile Strength increases up to 0.87 mm of Weld root gap, then decreases rapidly with increase in gap. 3D surface plots (Figure 4.) also shows the optimum Weld root gap is between 0.75 to 1 mm. It is also already mentioned by B M Patchett and D G Bellow, 1984 [10] that as the aspect ratio (ratio of Weld root gap to thickness) of weld bed approaches to unity, Tensile Strength of the weld also approaches its maximum value. The nominal thickness of the Band saw blade used in the experimentations is 1 mm and the maximum Tensile Strength of





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the weld is achieved nearer to 1 mm of Weld root gap (Figure 3c.), is in agreement with already published literature [10]. ANOVA results (Table 5.) also show Weld root gap and its square interaction term have significant effect on Tensile Strength.

Optimization of the Process parameters

The selected process parameters are optimized for maximum tensile strength of the weld using inbuilt Numerical Optimization analysis of the design Expert software. Among the various optimal solution suggested by the software, the solution shown in Table 6. is selected for confirmatory experiment, based on its desirability value (maximum desirability) and closeness of the suggested values of the parameters to available machine settings.

Confirmatory Experiment

Confirmatory experiment has been conducted on the basis of the optimal solution presented in Table 6. The process parameters are rounded to nearest value acceptable by the TIG machine. The actual input values of the parameters and the value of the tensile strength (response) obtained is listed in Table 7. The optimized (maximum) tensile strength is found to be 562.75 MPa (σ_t at 0.02% offset). Load vs Elongation curve of this specimen is shown in Figure 5. The Tensile Strength of the optimal sample (confirmatory experiment sample) is found to be in well agreement with the predicted value by the software (Table 6.).

Fatigue Life Analysis

To predict the endurance limits for higher fatigue life (Number of cycles > 1000), dynamic fatigue test were conducted on the optimal sample having tensile strength 562.75 MPa (at 0.2% offset) as shown in Figure 5. In the fatigue testing, the values of mean stress (σ_m) and stress amplitude (σ_a) applied were kept at 232.136 MPa and \pm 189.930 MPa respectively (R-ratios 0.1) with 0.032 sec of cycle time (31.25 Hz) [17]. The Fatigue failure of the sample occurred at 94,420 cycles. The applied cyclic stress curve is shown in Figure 6.

Initially, the point representing mean stress ($\sigma_m = 232.136$ MPa) and stress amplitude ($\sigma_a = 189.930$ MPa) were plotted in Goodman diagram. The ultimate stress ($\sigma_{ut} = 595.840$ MPa) of the sample is plotted in the Mean Stress axis. A straight line (upper line in Figure 7) is drawn connecting these two points and extended towards the Stress Amplitude axis direction. This line intersects the axis at 311.154 MPa, which is the Endurance Stress ($\sigma_{en\ 0.94\ L}$) at 94,420 cycles [23]. In the S-N curve (Figure 8.), the Endurance Stress ($\sigma_{en\ 0.94\ L} = 311.154$ MPa) value from Goodman diagram at 94,420 life cycle and the point corresponding to 75% of Tensile Stress of the sample ($\sigma_t = 562.755$ MPa) at 1,000 life cycle is plotted. These two points are joined by a straight line and the line is extended to 10^6 life cycles to predict the Endurance Stress ($\sigma_{en\ 10\ L}$) at 10^6 life cycles. It is also called as infinite life cycles [23]. The predicted value is found to be 252.5 MPa.

This predicted value of the Endurance Stress ($\sigma_{en\ 10\ L}$) from S-N curve is again plotted in the Goodman diagram against zero (0) mean stress. A straight line (the Blue line in Figure 10) is drawn to connect this point to the point corresponding to the ultimate stress ($\sigma_{ut} = 595.840$ MPa). This line represents the required Goodman line for maximum 10^6 life cycles. The Goodman line equation is given below (Equation ii).

$$\bar{\sigma}_a/252.50 + \bar{\sigma}_m/595.84 = 1 \text{----- (Equation ii)}$$

Any value of applied mean and alternating stress below the Goodman line corresponding to 10^6 cycles (Blue line in Figure 10.) will provide minimum 10^6 life cycles. The value of the life cycle can also be predicted for a given value of applied mean and alternating stress using the above mentioned procedure.

CONCLUSIONS

From the interpretation of the above results the following conclusions can be made.





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- i. The weld strength of TIG welded C67 carbon steel band saw blade (with 2% Thoriated non-consumable Tungsten Electrode using 1.6 mm ER70s-2 filler wire) is significantly affected by Welding current (Amp), Weld root gap (mm) and Square term of the factor Weld root gap (mm²).
- ii. From the model, the following empirical relationship in terms of actual factors is obtained: Tensile Strength = $-3903.158 + 104.822 A + 298.803 B + 2122.833 C + 1.548 AB - 12.927 AC - 72.403 BC - 1.484 A^2 - 13.553 B^2 - 494.365 C^2$
Where A, B & C denotes the actual model terms Welding current (Amp), Shielding gas flow rate (L/min) and Weld root gap (mm).
- iii. The optimized value of the Tensile Strength, predicted by design Expert software is 585.194 (MPa) for 37.195 Amp Welding current, 10.831 L/min Shielding gas flow rate and 0.868 mm Weld root gap. To verify the results, a confirmatory experiment was run with the following input parameter values: 37 Amp Welding current, 11 L/min Shielding gas flow rate and 0.87 mm Weld root gap. The Tensile strength of the welded specimen obtained was 562.75 MPa.
- iv. Cyclic stress in terms of stress amplitude and mean stress up to Fatigue life of 10⁶ cycles have been investigated and their correlation has been developed using Goodman diagram. The safe endurance stress of TIGwelded joint for infinite life (10⁶) was found to be 270.00MPa from Goodman diagram.
- v. The Goodman line equation obtained from the fatigue analysis is $\sigma_a/270.00 + 6m/562.75 = 1$

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Table 1. Selected process parameters for the CCD [1, 10]

Factor	Name	Units	Type	Factor Levels					
				- α	-1	0	+1	+ α	Std. Dev.
A	Welding Current	Amp	Numeric	35	37	40	43	45	2.53
B	Gas Flow Rate	L/min	Numeric	8	8.8	10	11	12	0.9782
C	Weld root gap	mm	Numeric	0.5	0.7	1	1.3	1.5	0.2534

Table 2. Experimental design table with the value of response variable.

Run		Factor B (Gas Flow rate, L/min)	Factor C (Weld root gap ,mm)	Response (Tensile Strength, MPa)
1	40	10	1	556
2	43	8.8	0.7	392
3	37	11	0.7	572
4	40	10	1	603
5	40	10	1	575
6	40	10	1	570





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7	37	8.8	1.3	489
8	40	10	1	537
9	37	11	1.3	521
10	43	11.2	1.3	356
11	43	8.8	1.3	387
12	43	11	0.7	534
13	45	10	1	517
14	35	10	1	538
15	37	8.8	0.7	522
16	40	10	1	482
17	40	12	1	541
18	40	10	1.5	394
19	40	10	0.5	488
20	40	8	1	483

Table 3. Chemical composition of C67 Band Saw Blade [20]

Elements	C	Si	Mn	P	S
Weight [%]	0.65-0.72	0.15-0.35	0.60-0.90	< 0.045	< 0.045

Table 4. Chemical compositions of ER70s-2 filler [21]

Elements	C	Si	Mn	Zr	P	S	Ti	Al
Weight [%]	0.15	0.45-0.7	0.90-1.4	0.02-0.12	0.25	0.035	0.052-0.15	0.052-0.15

Table 5. ANOVA Table.

Source	Sum of Squares	Degrees of Freedom	Mean Square	F-value	p-value	
Model	73634.75	9	8181.64	4.13	0.0186	significant
A-Current	15574.99	1	15574.99	7.86	0.0187	significant
B-Gas flow rate	5362.1	1	5362.1	2.71	0.1309	
C-Weld root gap	13913.8	1	13913.8	7.03	0.0243	significant
AB	218.15	1	218.15	0.1102	0.7468	
AC	1080.6	1	1080.6	0.5457	0.4771	
BC	4774.87	1	4774.87	2.41	0.1515	
A ²	2486.83	1	2486.83	1.26	0.2887	
B ²	5109.74	1	5109.74	2.58	0.1393	
C ²	27610.77	1	27610.77	13.94	0.0039	significant
Residual	19803.8	10	1980.38			
Lack of Fit	11228.97	5	2245.79	1.31	0.3873	Not significant
Pure Error	8574.83	5	1714.97			
CorTotal	93438.55	19				





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Table 6. Optimal Solution

Welding Current, Amp	Gas Flow rate, L/min	Weld root gap, mm	Tensile Strength, MPa (Predicted)	Desirability
37.195	10.831	0.868	585.194	0.918

Table 7. Parameter value of the Confirmatory Experiment and the corresponding Tensile Strength.

Run	Factor A (Current, Amp)	Factor B (Gas Flow rate, L/min)	Factor C (Weld root gap, mm)	Response (Tensile Strength, MPa)
1	37	11	0.87	562.75

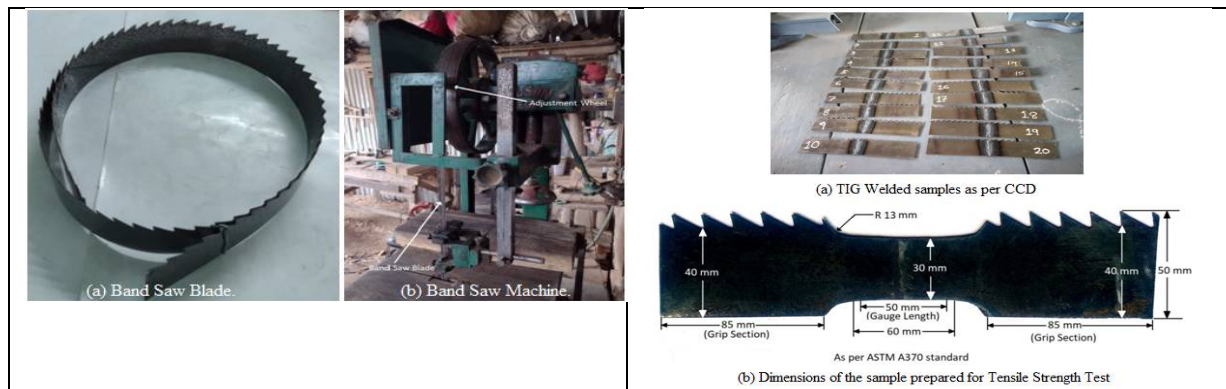


Figure 1. (a) Band Saw Blade and (b) Band Saw Machine.

Figure 2. (a) TIG Welded samples as per CCD and (b) Dimensions of the sample prepared for Tensile Strength Test.

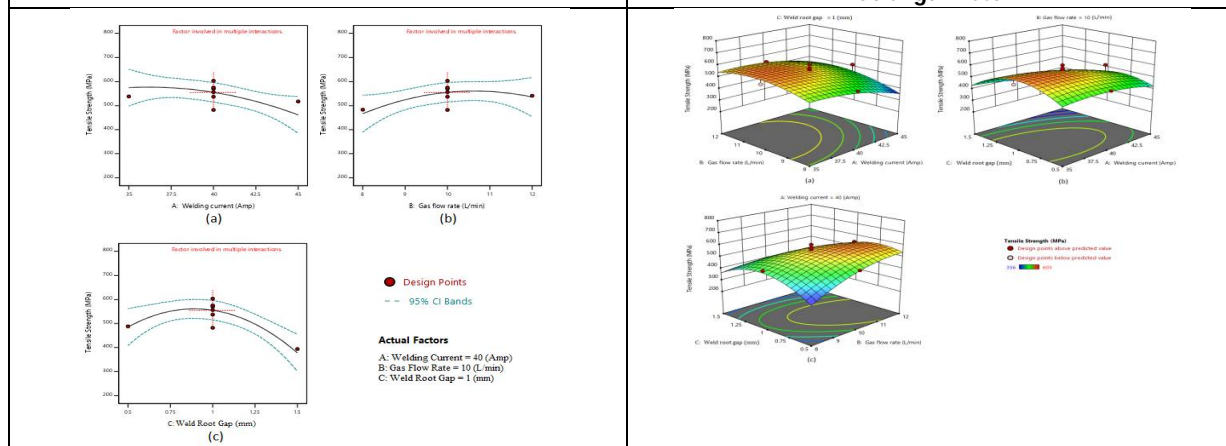


Figure 3. Main effect plots of the process parameters.

Figure 4. 3D surface plots showing the interaction effect of the process parameters on Tensile strength of the weld joint.





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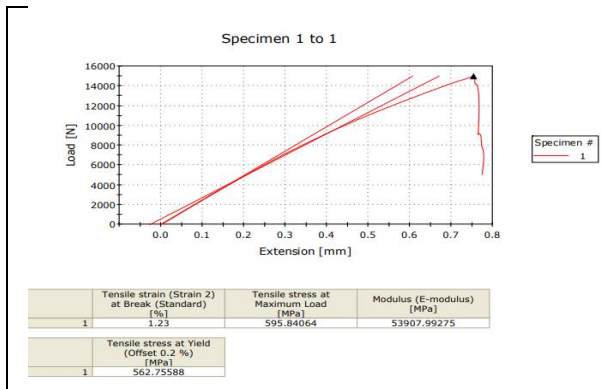


Figure 5. Load vs. Elongation curve of the optimal sample

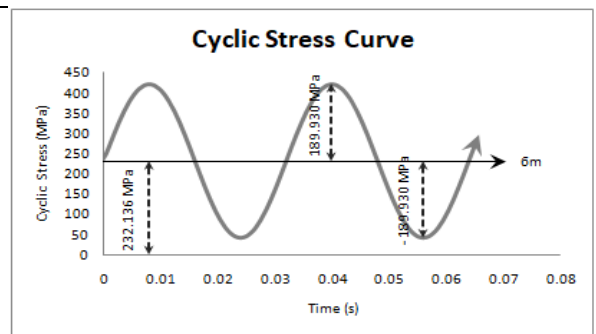


Figure 6. Sinusoidal curve of dynamic load vs time at optimal settings

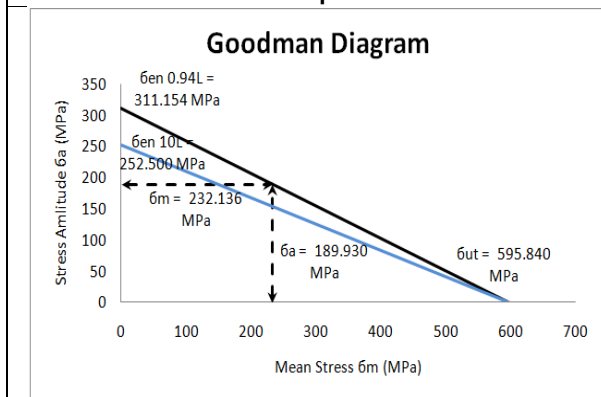


Figure 7. Goodman diagram for fatigue life 0.94420 L & 10 L cycles

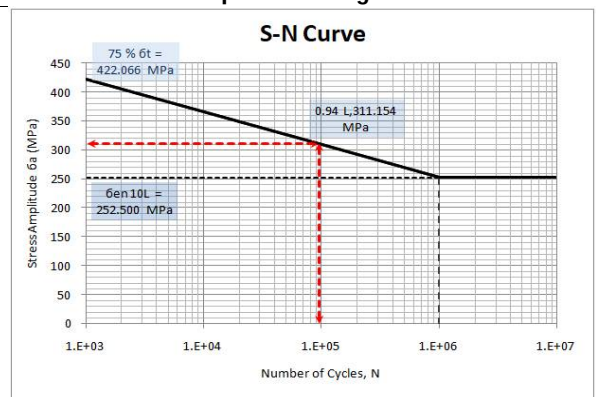


Figure 8. S-N curve of optimal sample





To Evaluate the Variation and Correlation of the Thickness of Gingiva and the Underlying Bone Type in Periodontitis Patients: An Approach through Cone Beam Computed Tomography

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ABSTRACT

Gingival thickness and bone type influence implant therapy and periodontal therapy. The purpose of this study is to evaluate the thickness of gingiva and underlying bone type in HU in maxillary and mandibular teeth and their association. 1680 sites were taken from 60 periodontitis patients (30 males and 30 females) with age groups between 35-44 years were assessed with cone beam computed tomography scans. A point was marked at the crest of the alveolar bone at which gingival thickness (mm) was recorded. Soft tissue assessment was done at a distance from the outer bony crest to the gingival surface corresponding to the alveolar crest. The area below the apex of each tooth from where Hounsfield units (HU) of bone was calculated with the help of CBCT scans for maxillary and mandibular teeth. Mean gingival thickness was 1.03 ± 0.24 mm and 890.97 ± 91.28 HU was the mean underlying bone type (HU) corresponds to 11 tooth number and similarly corresponds to 12,13,14,...17 and also for all four quadrants. A significant correlation was seen between gingival thickness and underlying bone type in HU except for a few teeth. CBCT facilitated the estimation of the exact thickness of gingiva and underlying bone type. In addition, an association was there between the thickness of gingiva and underlying bone type



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INTRODUCTION

Periodontal disease is a chronic host-mediated inflammation of periodontal tissues is a disease that results in loss of attachment and alveolar bone destruction [1]. The 2017 Classification World Workshop consensus report stressed that the degree of alveolar bone loss was used to assess disease progression and severity [2]. While clinical examination alone can diagnose periodontal disease, the information on bone levels and density given by radiographs has a key impact on risk assessment, diagnosis, and treatment results.[3] Intra- and extraoral imaging offer a 2D image of the 3D structures, which results in distortion of pictures and blurring of anatomical components which leads to the loss of critical information.[4] 3D CBCT scanning was found to be more successful in evaluating the periodontium's hard and soft tissues [5].

Direct measurements, [6] probe transparency,[7] ultrasonic devices, [8] and conebeam computed tomography(CBCT) are used to measure gingival thickness [9]. All other techniques lack accuracies compared to CBCT which is a noninvasive and reliable method in measuring the periodontium's hard and soft tissues which enhances the treatment outcome. Similarly, digital image analysis of microradiographs,[10] dual-energy X-ray absorptiometry, [11,12] and ultrasound [13] can be used to measure bone density. One of the most effective medical imaging methods for acquiring data on both the structure and density of bodily tissue is computed tomography (CT). Cone-beam CT (CBCT) is one of the three-dimensional radiography techniques used to evaluate the variance and connection of gingiva thickness and underlying bone type in periodontitis patients. The study's null hypothesis is that there is no link between soft tissue thickness and the quality of underlying bone in the maxillary and mandibular teeth.

MATERIAL AND METHODS

A cross-sectional study was designed with a sample size of 1680 sites were taken from 60 periodontitis patients (30 males and 30 females) according to the criteria of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions in the age group of 35-44 years. The present study was conducted in the Department of Periodontology, Faculty of Dental Sciences, SGT University after approval from the ethical committee of the university. Inclusion criteria were having Interdental CAL of $\geq 2\text{mm}$ and probing depth $\leq 4\text{mm} - \geq 5\text{mm}$ in non-adjacent teeth with a minimum of one tooth missing, not undergone any periodontal treatment within the past 12 months, not having any sign of apical pathology, not undergone antibiotics therapy within past 6 months, also not having anti-inflammatory drugs within the past 3 months, and otherwise systemically healthy. Subjects were excluded if they were Completely Edentulous, pregnant, diabetic, smoker, on hormone contraceptives, on calcium channel blockers, and on immunosuppressive drugs. All subjects participating in the study had signed an informed consent form to willingly participate in the study. Appropriate medical and dental history was recorded for evaluation of the subject.

METHODOLOGY

After a clinical examination, each patient was assigned for scaling in the first visit and after 21 days CBCT scans were taken for which he/she seated with cheek retractors in their mouth, and they were asked to keep their tongue at the lower level so that all the soft tissue was positioned away from the gingival margins. Their heads and chin were stabilized for CBCT scan. (Figure 1,2) A point was marked at the crest of the alveolar bone at which gingival thickness (mm) was recorded. The area below the apex of each tooth from where Hounsfield units (HU) of bone was calculated with the help of Planmeca Romexis® dental imaging software (Planmeca, Helsinki, Finland) which is a





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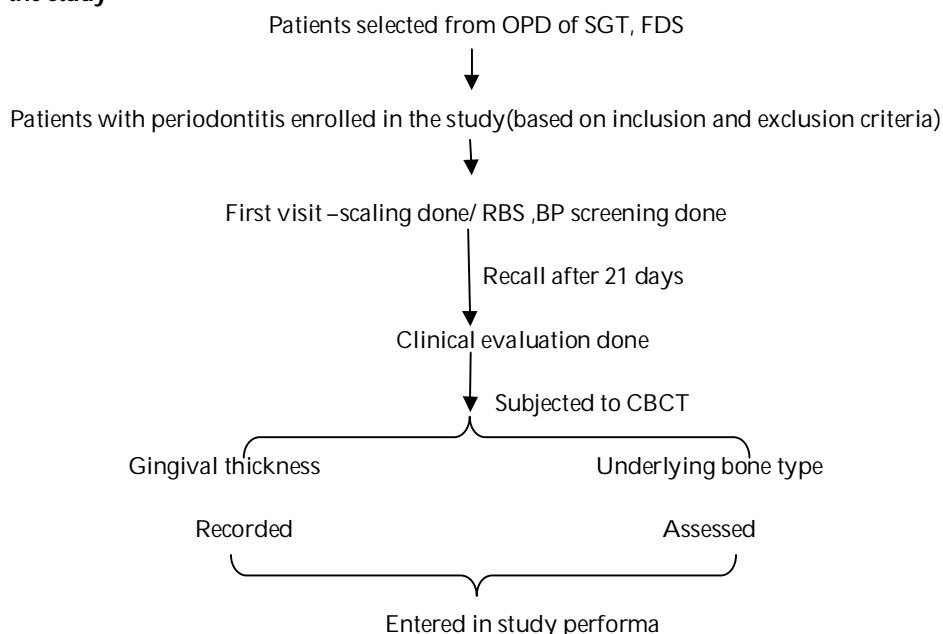
CBCT software.(Figure 3) All scans were made by ProMax 3D Mid ProFace device (Planmeca, Helsinki, Finland) at 90 kV and 8.0 mA for 13.5 s (voxel size: 200 µm; greyscale: 15 bit; focal spot: 0.5 mm; field of view: 160 x 100 mm).All the readings were recorded.

All the measurements in the scan were re-done by the principal investigator after 1 month to check for Intraexaminer variability and also done by an MDS in Oral Medicine and Radiology to evaluate inter-examiner variability.

Statistical analysis

Data will be analyzed using Statistical Package for the Social Sciences Software.

Summary of the study



RESULTS

Table 1 shows mean gingival thickness and mean underlying bone type (HU) among patients according to tooth number. In which 1.03±0.24 mm was the mean gingival thickness and 890.97±91.28 HU was the mean underlying bone type (HU) corresponds to 11 tooth number and similarly corresponds to 12,13,14,...17 and also for all four quadrants. And it was also seen that gingival thickness was more in posterior teeth as compared to anterior teeth. While underlying bone type (HU) minimum HU was recorded among maxillary molars and maximum HU was recorded among mandibular anterior. In Table 2 shows Spearman's Correlation between gingival thickness and underlying bone type (HU). The correlation was weak to moderate between Gingival thickness and underlying bone type (HU) but it is statically significant for all except a few teeth i.e. 15, 34,35,37. A comparison between Intra and inter-examiner for evaluation of gingival thickness and underlying bone type among patients at different tooth levels was 0.894 and 0.869 respectively which shows perfect agreement between inter and intra examiner.

DISCUSSION

Earlier assessment of the periodontal disease was mainly done with conventional methods. Despite the usefulness of 2D imaging modalities and less radiation exposure they still underestimate the 3D architecture of osseous defects. Hence, viewing the 3D structures in undistorted form undoubtedly enhances the diagnostic potential. CT has been



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used for a long time in the field of medical science but its usage in dentistry is restricted to maxillofacial trauma. Due to high cost and excessive radiation dosage hinder its usage in daily routine.[14]CBCT is a new imaging modality introduced for the maxillofacial region image analysis. CBCT provides high-quality images for the diagnosis of 3D structures and has become an important tool in the field of dentistry.[15]CBCT provides volumetric image acquisition taken at different points in time that enhances its visualization accuracy with high resolution of images of jaws and teeth, and can be restructured three-dimensionally.[14]Knowledge about the thickness of gingiva and bone type in HU has been critical for the success of numerous therapeutic procedures in implantology and esthetic dentistry. Various techniques were there for the evaluation of these structures either directly or indirectly.[6,16,17,18] Aranyarachkul et al.[19]have demonstrated that cone-beam CT (CBCT) could be an alternative diagnostic method for bone density evaluation, especially since the reported radiation dosage is much less than that for CT. Evaluation of both soft and hard tissue can be done with the help of CBCT.

The present study sample size consisted of 1680 sites obtained from 60 periodontitis patients (30 males, 30 females) with ages between 35-44 years. A similar study was conducted by Esfahanizadeh et al.[20]in which they have taken Sixty patients with a mean age of 37.5 ± 10.1 years. In the present study age criteria i.e. 35-44 years was in accordance with the WHO age standardization criteria 2001 in which age was 35-39 and 40-44 years.

In the present study, CBCT scans were taken with cheek retractors in their mouth, and they were asked to keep their tongue at the lower level so that all the soft tissue was positioned away from the gingival margins. This was in accordance with Januário et al.[15] in which they had taken CBCT scans with the help of lip retractors to avoid contact between lip and facial gingiva.

In the present study Soft tissue assessment was done at a distance from the outer bony crest to the gingival surface corresponding to the alveolar crest which was in accordance with a study conducted by Amid et al.[21] in which they determined facial bone thickness (BT) and gingival thickness (GT) at the crestal level and at 2, 4, and 6 mm apical to the cement enamel junction (CEJ). In the present study, bone type was determined in Hounsfield units of bone below the apex of each tooth. This was in accordance with a study conducted by Sahrman et al. [22]who evaluated three sites one at the apex and two on the mesial and distal side of the implant. The underlying bone type was determined according to Misch's classification. Similarly Vaishnavi Rajaraman, et al.[23] took the bone quality according to Misch classification.

Stein et al.[24] conducted a study in which all the measurements were evaluated by one examiner and re-measured after 1 week to check the intra-examiner variability, and they also evaluate inter examiner variability by another examiner this is similar to the present study in which the principal investigator re-measured after 1 month and inter-examiner variability was checked by another examiner from Oral Medicine and Radiology department. In the present study mean gingival thickness was calculated for maxillary right central incisor, lateral incisor, and canine was $1.03 \pm 0.24, 0.95 \pm 0.17, 0.89 \pm 0.15$ respectively. While maxillary left central incisor, lateral incisor, and canine were $1.02 \pm 0.21, 1.02 \pm 0.14, 1.03 \pm 0.13$ respectively. And similarly for mandibular right central incisor, lateral incisor, and canine $0.84 \pm 0.19, 0.80 \pm 0.17, 0.78 \pm 0.17$ respectively. While mandibular left central incisor, lateral incisor, and canine $0.86 \pm 0.19, 0.80 \pm 0.17, 0.79 \pm 0.16$ respectively these results were in accordance with Kaya et al.[25]

The mean gingival thickness for maxillary right first premolar, second premolar, first molar, and second molar was $1.10 \pm 0.15, 1.23 \pm 0.17, 1.42 \pm 0.23, 1.64 \pm 0.33$ respectively. While maxillary left first premolar, second premolar, first molar, and second molar was $1.10 \pm 0.09, 1.20 \pm 0.1, 1.45 \pm 0.25, 1.66 \pm 0.30$ respectively. And similarly, for mandibular right first premolar, second premolar, first molar, and second molar $1.06 \pm 0.13, 1.23 \pm 0.12, 1.46 \pm 0.23, 1.70 \pm 0.27$ respectively were and while mandibular left first premolar, second premolar, first molar, and second molar $0.99 \pm 0.16, 1.23 \pm 0.08, 1.38 \pm 0.11, 1.63 \pm 0.16$ respectively. These results were in accordance with Alkanet al [26]. Similarly, bone density was evaluated for each tooth which was in accordance with Bone density classification by Misch. No records were found regarding the comparison of the thickness of gingiva and underlying bone type in HU. So, it is quite difficult to find a resemblance with other studies. In the present study, a significant weak to moderate association was seen for tooth



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between gingival thickness and underlying bone Type (HU) but it is non-significant for tooth numbers 15,34,35,37. This may be due to unpredictability of maxillary sinus dip in second premolar region and mental foramen lies in 34,35 region and in 37 region mandibular canal lies near the root apex this was in accordance with Oliveira et al.[27] And there is no significant difference between males and females when we compare the gingival thickness and underlying bone type (HU).

Intra and inter-examiner for evaluation of gingival thickness and underlying bone type among patients at different tooth levels had a k-value 0.894 and 0.869 respectively which shows perfect agreement between inter and intra examiner. While Fu et al.[9]also demonstrated good intra- and inter examiner reliability for all measurements taken.

CONCLUSION

Although the results may justify the use of CBCT a novel, non-invasive, and powerful method to obtain clinical data regarding the dimensions and relationship of several structures of the periodontium. The results of this study focus mainly on the finding that CBCT may facilitate the estimation of exact bone type in HU at the surgical site which helps the clinician to interpret and plan the osteotomy before treatment. This method will also certainly aid clinicians in the planning and execution of several procedures in dentistry with increased predictability.

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Table 1 Showing mean gingival thickness and mean underlying bone type(HU) among patients according to tooth number

Tooth Number	N	Gingival Thickness		Underlying bone type (HU)	
		Mean	Std. Deviation	Mean	Std. Deviation
11	60	1.0300	.24044	890.967	91.2831
12	60	.9505	.16872	859.433	98.8303
13	60	.8973	.15495	825.133	80.9462
14	60	1.1025	.14875	796.483	87.4597
15	60	1.2365	.17290	708.733	81.8460
16	60	1.4153	.22675	352.717	113.9616





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17	60	1.6372	.33157	175.750	129.1130
21	60	1.0167	.21333	890.433	83.8557
22	60	1.0165	.14254	856.050	92.0299
23	60	1.0302	.12605	798.217	88.4329
24	60	1.1020	.09860	729.483	89.1881
25	60	1.2057	.10787	604.583	124.8896
26	60	1.4533	.24915	355.150	299.3484
27	60	1.6632	.30454	200.000	314.1404
31	60	.8560	.19077	1082.600	104.3227
32	60	.8037	.17443	1026.133	100.4880
33	60	.7917	.15599	969.050	95.1770
34	60	1.0593	.12633	923.883	93.4142
35	60	1.2330	.12258	876.467	96.7468
36	60	1.4620	.23218	813.567	101.5185
37	60	1.6977	.26916	767.633	102.0405
41	60	.8417	.19265	1072.117	97.2479
42	60	.8043	.17015	1010.017	88.7486
43	60	.7847	.16821	967.617	89.2878
44	60	.9905	.15870	924.733	89.1435
45	60	1.2318	.08464	879.500	90.1047
46	60	1.3840	.10668	838.717	87.8192
47	60	1.6315	.15787	787.000	89.3170

Table 2 shows Spearman's Correlation between gingival thickness and underlying bone type (HU) among patients corresponding to tooth number

Tooth Number	N	Spearman's Correlation	P-VALUE
11	60	0.398	0.002*
12	60	0.329	.010*
13	60	0.358	.005*
14	60	0.297	.021*
15	60	0.201	.124
16	60	0.264	.042*
17	60	0.305	.018*
21	60	0.438	0.001*
22	60	0.399	.002*
23	60	0.378	.003*
24	60	0.509	.001*
25	60	0.468	.001*
26	60	0.363	.004*
27	60	0.339	.008*
31	60	0.416	0.001*
32	60	0.375	.001*





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33	60	0.311	.015*
34	60	0.234	.072
35	60	0.207	.113
36	60	0.255	.049*
37	60	0.251	.053
41	60	0.415	0.001*
42	60	0.408	.001*
43	60	0.340	.008*
44	60	0.314	.015*
45	60	0.280	.031*
46	60	0.285	.027*
47	60	0.281	.030*

*Significant



Figure 1 Patient wearing plastic lip retractor.



Figure 2 Patient positioned for CBCT scan wearing the plastic lip retractor in an inverted position to avoid hitting the chin stabilizer.



Figure 3 Image of the CBCT scan showing the gingival thickness and underlying bone type in HU.





Effect of Macro and Micronutrients Fertilization on quality Parameters of Hybrid Chilli in Sandy Clay Loam Soil of Cuddalore District, Tamil Nadu.

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ABSTRACT

Chilli (*Capsicum annum* L.) is a remunerative vegetable, spice cum cash crop of the Indian subcontinent. It is a hot and tasting tropical berry belonging to the Solanaceae family. A field experiment was conducted at farmers field in Vanniyarpalayam village, Kurinjippadi taluk, Cuddalore district, Tamil Nadu with chilli hybrid mahyco sierra as test crop, during Feb 2020 – May 2020 to evaluate the response of hybrid chilli to macro and micronutrients fertilization in sandy clay loam soils of Cuddalore Dt., Tamil Nadu. The experimental soil was sandy clay loam with a pH of 5.7, EC of 0.26 dsm⁻¹. The available N, P, K and B content of soil were 196 (Low), 9.5 (Low), 232 (Medium) kg ha⁻¹ and 0.074 mg kg⁻¹ (Low) respectively. The treatments consisted of application of inorganic fertilizers like Complex fertilizer (17:17:17) @ 0.5% foliar spray, DAP @ 0.5% foliar spray and Borax @ 0.5% foliar spray were applied in different combinations. The experiment was laid out in randomized block design and replicated three times. The experimental findings revealed that among the different treatments tried, the highest value of quality attributes regarding ascorbic acid content (358.13 mg 100 g⁻¹), Capsaicin content (0.76 %), Total soluble solids (15.23 %), chlorophyll 'a' (0.164 mg g⁻¹), chlorophyll 'b' (0.186 mg g⁻¹) and total chlorophyll contents (0.350 mg g⁻¹) were recorded from the application of (RDF + Complex fertilizer 17:17:17 @ 0.5% foliar spray + DAP @ 0.5% foliar spray + Borax @ 0.5% foliar spray). By considering all the benefits, T8 (RDF, Complex fertilizer 17:17:17 @ 0.5% foliar spray, DAP @ 0.5% foliar spray and Borax @



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0.5% foliar spray) would greatly benefit the farmers to realize higher productivity and profitability by hybrid chilli in sandy clay loam soils of Cuddalore district.

Keywords: Hybrid chilli, micronutrients fertilization, sandy clay loam soil, quality.

INTRODUCTION

Chilli (*Capsicum annum* L.) is a remunerative vegetable, spice cum cash crop of the Indian subcontinent. It is a hot and tasting tropical berry belonging to the Solanaceae family. It was first discovered by Christopher Columbus in tropical America, and its use spread rapidly throughout the world because of its pungent flavour. Most widely used universal spice named as wonder spice. Chilli is used as both vegetable and spice crop. Chilli peppers originated in Mexico (Kraft et al., 2013). They were one of the first self-pollinating crops cultivated in Mexico, Central America and parts of South America. The genus of capsicum contains 20 species and now five domesticated species are capsicum annum, capsicum frutescens, capsicum chinense, capsicum baccatum, capsicum pubescens are only recognized (Islam et al., 2018). Chilli is famous for its nutritional value, medicinal effects and therapeutic treatments, in addition it is used as an organic colouring and flavouring agent in food industries. Chillies are the good source of Vitamin - A,B,C and E (Tocopherol), Oleoresin, Carbohydrates and minerals such as Calcium, Phosphorous, Ferrous, Sodium and Copper in trace amounts (Prathibha et al., 2013). The pungency principle is due to the presence of Capsaicin (C18H27NO3) synthesized in the epidermal cells of placenta of the fruits and possess inflammatory and anti-oxidant activities (Anupam, 2016). A chemical called chilli oleoresin-1, extracted from the dried chillies of *Capsicum annum*, is used in pain balms, plasters and prickly heat powders. Indians believe chillies aid in the circulation of blood. India is the world leading country in Chilli production followed by China and Pakistan. Andhra Pradesh, Maharashtra, Karnataka, Orissa, Tamil Nadu, Bihar, Uttar Pradesh, Rajasthan are the main Chilli growing states. India is the World's largest producer, Consumer and exporter of Chillies in the world. During 2021, Indian red chilli production is expected to be around 12,32,000 metric tonnes. In Tamil Nadu chilli is grown in Coimbatore, Ramanathapuram, Tuticorin, Tirunelveli, Virudhunagar, Kanayakumari, Madurai, Salem, Trichy, Villupuram and Cuddalore districts. In Tamil Nadu, Chilli was grown in an area of 50.7(6.54 per cent) thousand hectares with a total production of 23.1(1.55 per cent) thousand tonnes and the productivity was 0.46 tonnes ha⁻¹ followed by Punjab and Assam. Many chilli hybrids are grown in many states of India. Some of the chilli hybrids are MHP-1Tejaswini, MHCP 317- Sierra, MHCP 318- Tanaya, MHCP 310 – Teja, MHCP 321 etc, Among this let us discuss about Mahyco Sierra hybrid. The Solanaceous group of vegetables (chilli) generally takes up large amount of nutrients that have specialized functions and should be supplied to plant at the right time with suitable quantity. When chillies are adequately supplied with the essential nutrients through fertilization it improves their yield, quality and enhance maturity. Micronutrients are completely available to the plant and thus particularly effective because they are not fixed or diluted in large volumes of soil. Besides, foliar application of various macro and micronutrients has been proved beneficial, foliar feeding is a relatively new and controversial technique of feeding plants by applying liquid fertilizer directly to their leaves. Foliar fertilizers are being used in vegetables and fruit crops that contain various macro and micronutrients. Foliar fertilizers are known to immediately deliver nutrients to the tissues and organs of the crop (Baloch et al., 2008). Considering the significance of foliar fertilizers for chillies, the present study was therefore under taken to investigate the impact of nitrogen, phosphorous, potassium and boron fertilizers on quality attributes of hybrid chilli.

MATERIALS AND METHODS

Field experiment was conducted at farmers field, Vanniyarpalayam village, Kurinjippadi taluk, Cuddalore district during February 2020 – May 2020 to study the response of hybrid chilli to macro and micronutrients fertilization in sandy clay loam soils of Cuddalore Dt., Tamil Nadu with hybrid chilli mahyco sierra as test crop under irrigated condition with eight treatments replicated thrice in a randomized block design. The experimental soil was sandy clay



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loam. The treatments were T1 - (100 % RDF alone), T2 - (RDF + Borax @ 10 kg ha⁻¹), T3 - (RDF + Borax @ 0.5% Foliar spray), T4 - (RDF + Complex fertilizer 17:17:17 @ 0.5% Foliar spray), T5 - (RDF + DAP @ 0.5% Foliar spray), T6 - (RDF + Complex fertilizer 17:17:17 @ 0.5% Foliar spray + Borax @ 0.5% Foliar spray), T7 - (RDF + DAP @ 0.5% foliar spray + Borax @ 0.5% foliar spray) and T8 - (RDF + Complex fertilizer 17:17:17 @ 0.5% foliar spray + DAP @ 0.5% foliar spray + Borax @ 0.5% foliar spray). Recommended dose of fertilizers were applied uniformly in all plots. Application of inorganic fertilizers like Complex fertilizer (17:17:17), DAP and Borax were given as 0.5% foliar spray as per the treatment schedule.

RESULTS AND DISCUSSION**Quality parameters (Table 1)****Ascorbic acid content(mg 100 g⁻¹)**

Addition of recommended dose of fertilizer, complex fertilizers (17:17:17 and DAP) and borax either soil application or foliar spray caused significant effect on Ascorbic acid content. The values ranged from 279.81 to 358.13 mg 100 g⁻¹. Among the different methods of borax application with RDF treatments, soil application of borax @ 10 kg ha⁻¹ along with RDF treatment recorded highest ascorbic acid content of 298.92 mg 100 g⁻¹ and with respect to foliar application of borax @ 0.5 % as foliar spray along with RDF treatment recorded minimum value of 296.55 mg 100 g⁻¹. In RDF, foliar spray of complex fertilizers (17:17:17 and DAP) and foliar spray of borax applied treatments, RDF, complex fertilizers of 17:17:17, DAP @ 0.5 % foliar spray and borax @ 0.5 % foliar spray treatment registered significant amount of ascorbic acid content of 358.13 mg 100 g⁻¹ compare with other combination treatments. Least ascorbic acid content of 279.81 mg 100 g⁻¹ was noticed in RDF treatment. The T6 and T7 values of ascorbic acid were on par. Foliar application favoured higher photosynthetic activity, which results in higher sugar content and is duly accompanied by an increase in 137 ascorbic acid content. The results are in accordance with the findings of Sankaran *et al.* (2005) who reported that, there is a conversion of sugar into ascorbic acid. Foliar application of complex fertilizers increased the ascorbic acid content in the present investigation. Similar results were obtained by Ananthi *et al.* (2007) and Dange *et al.* (2004).

Capsaicin Content (%)

Different treatments recorded a significant effect on capsaicin content which ranged from 0.50 to 0.76 per cent with combined application of recommended dose of fertilizer, complex fertilizers of 17:17:17, DAP and borax. Maximum capsaicin content of 0.76 per cent was obtained from the application of recommended dose of fertilizer, complex fertilizer 17:17:17 @ 0.5 % foliar spray, DAP @ 0.5 % foliar spray and borax @ 0.5 % foliar spray treatment. With regards to complex fertilizers along with recommended dose of fertilizer combination treatments, complex fertilizer 17:17:17 @ 0.5 % foliar spray along with RDF recorded the maximum capsaicin (0.61 %) content noticed in DAP foliar spray treatment. Among the two methods of borax application, soil application of borax @ 10 kg ha⁻¹ recorded the highest capsaicin content of 0.56 per cent and lowest capsaicin content was noticed in borax @ 0.5 % foliar spray receiving plot. Least capsaicin content of 0.50 per cent recorded in recommended dose of fertilizer alone treatment.. The increasing capsaicin in chilli fruit might be attributed to the availability of nitrogen from inorganic and complex fertilizer increase the capsaicin content. The present investigations suggest that regulation of capsaicin, a metabolite produced only in the genus capsicum, occurs in a highly complex interaction with environment. This clearly indicates that capsaicin content might be influenced by the N fertilization regime in a cultivation system. If this regime is managed in conjunction with biochemical, physiological and nutritional factors, it might be possible to increase capsaicin content beyond this threshold Rahman and Inden (2012).

TSS (%)

From the data it is observed that the application of complex fertilizers viz., 17:17:17, DAP and borax combination with recommended dose of fertilizer was significantly increases in total soluble solids per cent in chilli. The values ranged from 11.35 to 15.23 per cent. Addition of borax @ 10 kg ha⁻¹ along with RDF treatment as soil application recorded higher total soluble solids (12.27 %) over borax applied as foliar spray along with RDF treatment (12.06 %). Complex



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fertilizers with RDF treatments improved the TSS content in chilli fruit. Regarding combination treatments RDF, complex fertilizer 17:17:17 @ 0.5 % foliar spray, DAP @ 0.5 % foliar spray and borax @ 0.5 % foliar spray of 15.23 % was found to be significantly influenced the total soluble solids. Treatment T6 was found to be on par with T7. The RDF treatment recorded lowest values of total soluble solids (11.35%). The increase TSS in this treatment might be due to the difference in mineralization, continuous availability of more nutrients in higher amount and better utilization by plants. Another possible reason for higher TSS in this treatment might be due to the nitrogen, phosphorous, potassium and boron nutrients concentration and availability of nutrients in root zone (Chetriet al., 2012).

Chlorophyll 'a' (mg g-1)

Different treatments recorded a significant effect on chlorophyll 'a' content which ranged from 0.129 to 0.164 mg g-1 of chilli fruit. Among the different methods of borax application treatments, soil application of borax recorded maximum chlorophyll 'a' content. The value was 0.138 mg g-1 and with respect to foliar application of borax @ 0.5 % as foliar spray along with RDF treatment recorded minimum value of 0.136 mg g-1. Complex fertilizers with RDF treatments improved the chlorophyll 'a' content in chilli fruit. Among the complex fertilizer treatments, RDF, complex fertilizer 17:17:17 @ 0.5 % foliar spray registered highest chlorophyll 'a' content of 0.147 mg g-1 as compared to 105 the treatment supplied with DAP @ 0.5 % foliar spray with RDF treatment (0.145 mg g-1). Combined application of RDF, complex fertilizers (17:17:17 and DAP) and borax treatment significantly improved the chlorophyll 'a' content of chilli fruit. The maximum chlorophyll 'a' content of 0.164 mg g-1 was obtained from the application of recommended dose of fertilizer, complex fertilizer along with recommended dose of fertilizer combination treatments, complex fertilizer 17:17:17 @ 0.5 % foliar spray along with RDF recorded the maximum chlorophyll content of 0.156 mg g-1 and minimum chlorophyll 'a' content (0.154 mg g-1) was noticed in DAP foliar spray treatment. The least chlorophyll 'a' content of 0.129 mg g-1 recorded in recommended dose of fertilizer treatment alone.

Chlorophyll 'b' (mg g-1)

Addition of recommended dose of fertilizer, complex fertilizers and borax application significantly influenced the chlorophyll 'b' content of chilli fruit. The values ranged from 0.144 to 0.186 mg g-1. Between two methods of application of borax, application of borax @ 10 kg ha-1 applied in soil along with RDF treatment registered highest chlorophyll 'b' content of 0.153 mg g-1 than borax applied as foliar spray along with RDF treatment. The value was 0.151 mg g-1. Regarding complex fertilizers along with recommended dose of fertilizer treatments, treatment which received complex fertilizer 17:17:17 @ 0.5 % foliar spray along with RDF registered higher influence on 106 chlorophyll 'b' content (0.166 mg g-1) as compared to application of DAP @ 0.5 % foliar spray. Data pertaining to different treatment combinations of recommended dose of fertilizer, complex fertilizers (17:17:17 and DAP) along with borax recorded significant values of chlorophyll 'b' content. The maximum value (0.186 mg g-1) was registered with the application of RDF, complex fertilizer 17:17:17 @ 0.5 % foliar spray, DAP @ 0.5 % foliar spray and borax @ 0.5 % foliar spray followed by treatment T6 (RDF + complex fertilizer 17:17:17 @ 0.5 % foliar spray + borax @ 0.5 % foliar spray) which recorded the chlorophyll 'b' content of 0.177 mg g-1. The minimal values of chlorophyll 'b' content was registered under RDF treatment of 0.144 mg g-1. Treatment T6 and T7 were comparable with each other. The minimum chlorophyll 'b' content was registered in RDF treatment of 0.144 mg g-1.

Total Chlorophyll (mg g-1)

Data showed a significant effect on total chlorophyll content from 0.273 to 0.350 mg g-1. Among the combination treatments, soil application of borax @ 10 kg ha-1 along with recommended dose of fertilizer treatment recorded maximum total chlorophyll content of 0.291 mg g-1 in chilli fruit as compared with borax applied as foliar spray along with RDF treatment of 0.287 mg g-1. The treatment which received complex fertilizer 17:17:17 @ 0.5 % foliar spray along with RDF treatment registered maximum total chlorophyll content of 0.313 mg g-1 as compared to RDF along with application of DAP @ 0.5 % as foliar spray treatment of 0.308 mg g-1. In RDF, foliar spray of complex fertilizers (17:17:17 and DAP) and foliar spray of borax applied treatments, RDF, complex fertilizers of 17:17:17, DAP @ 0.5 % foliar spray and borax @ 0.5 % foliar spray treatment registered significantly higher total chlorophyll of 0.350





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mg g⁻¹ compare with other combination treatments. Least total chlorophyll content of 0.273 mg 100 g⁻¹ was noticed in RDF treatment. The T6 and T7 values of total chlorophyll content were on par. These findings gain support from the results of Malik *et al.* (2011).

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Table 1: Effect of macro and micronutrients on ascorbic acid content (mg 100 g⁻¹), Capsaicin content (%) and TSS content (%) in fruit of hybrid chilli

Treatment particulars	Ascorbic acid content(mg 100 g ⁻¹)	Capsaicin content (%)	TSS (%)
T1 – RDF	279.81	0.50	11.35
T2 - RDF + Borax @ 10 kg ha ⁻¹	298.92	0.56	12.27
T3 - RDF + Borax @ 0.5 % Foliar spray	296.55	0.55	12.06
T4 - RDF + Complex fertilizer @ 0.5 % Foliar spray	317.29	0.62	13.20
T5 – RDF + DAP @ 0.5 % Foliar spray	314.36	0.61	12.98
T6 - RDF+ Complex fertilizer @ 0.5 % Foliar spray + Borax @ 0.5 % Foliar spray	337.89	0.69	14.37
T7 - RDF + DAP @ 0.5 % foliar spray + Borax @ 0.5 % foliar spray	334.73	0.68	13.99
T8 - RDF + Complex fertilizer @ 0.5 % foliar spray + DAP @ 0.5 % foliar spray + Borax @ 0.5 % foliar spray	358.13	0.76	15.23
SEd	6.325	0.0151	0.261
CD (p=0.05)	13.431	0.031	0.543





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Table 2: Effect of macro and micronutrients on chlorophyll content (mg g⁻¹) in fruit of hybrid chilli

Treatment particulars	Chlorophyll 'a' (mg g ⁻¹)	Chlorophyll 'b' (mg g ⁻¹)	Total Chlorophyll (mg g ⁻¹)
T1 – RDF	0.129	0.144	0.273
T2 - RDF + Borax @ 10 kg ha ⁻¹	0.138	0.153	0.291
T3 - RDF + Borax @ 0.5 % Foliar spray	0.136	0.151	0.287
T4 - RDF + Complex fertilizer @ 0.5 % Foliar spray	0.147	0.166	0.313
T5 – RDF + DAP @ 0.5 % Foliar spray	0.145	0.163	0.308
T6 - RDF+ Complex fertilizer @ 0.5 % Foliar spray + Borax @ 0.5 % Foliar spray	0.156	0.177	0.333
T7 - RDF + DAP @ 0.5 % foliar spray + Borax @ 0.5 % foliar spray	0.154	0.174	0.328
T8 - RDF + Complex fertilizer @ 0.5 % foliar spray + DAP @ 0.5 % foliar spray + Borax @ 0.5 % foliar spray	0.164	0.186	0.350
SEd	0.0023	0.0028	0.0052
CD (p=0.05)	0.005	0.006	0.011





***In silico* Screening of Lichen Compounds against SARS-COV-2 RdRp Complex**

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ABSTRACT

Sars-CoV-2 is a variant that causes COVID-19 disease. It has been spreading widely since the end of the year 2019 and now pandemic. People all over the world are in the search of cure for it. In this study the potency of over 100 of secondary metabolites from the Lichens are analysed using some computational techniques. The metabolites are ran against the RNA-dependent RNA polymerase of Corona virus and the potency of the compound are recorded. By analysing the potency of the drug on the RdRp of the Corona virus the phytochemicals of the lichen are selected. By the process of molecular docking for its binding strength by the Pymol software the compounds are further refined and only few compound is taken for its effectiveness and potency for RdRp inhibition. Thus by this process the replication of the corona virus is inhibited and by inhibiting the replication of the virus the mutation is also inhibited, which makes the diagnosis and treatment precise and efficient.

Keywords:Sars-CoV-2,Lichens, Secondary metabolites, RdRp,Pymol, Molecular docking.



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INTRODUCTION

Covid-19 is a pandemic which started in the end of year 2019 and spread worldwide. This is caused by Sars-cov-2. Researchers and scientist all over the world are working on in order to overcome the effect of diseases and to eradicate it from the world. Unlike other viruses this keeps mutating itself rapidly which is a major drawback in the diagnosis and treatment. Syndrome is a collection of disease which must be treated with care. In some patients this virus spreads asymptotically. So that each variant must be treated in accordance. Lichen are associated between fungi-photo autotrophs-algal partners- photobionts, which are commonly found on plants and surrounded area. As they live in the symbiotic relationship thus they fix the nitrogen in the environment which facilitates the growth of plants and the plant gives the suitable conditions for their growth and viability. Lichens are neither Fungi nor Plants. The internal and external parts of lichens are made up of Fungi and Algae correspondingly. Lichen compound are phenolic[1] in nature thus used as a part and alternative medicine in some countries. As they show an unusual compound with good medicinal properties which includes enzyme inhibition. But due to their slow growth and production of metabolites they are not considered much[2,3].The compounds found in lichen as a phytochemicals which are finalised from 108 compounds by testing their binding strength, Drug likeness, G- Score and by Molecular docking procedures. Then the stability of these compounds were seen by their binding. The compounds could have the antiviral activity against the target[4,5].Thus in order to suppress the Sars-CoV-2 variant replication, the lichen enzyme inhibitory compounds are used against it. By inhibiting the RdRp which is the key for replication of virus the further spread[6]and mutation can also be inhibited and this also gives us the chance to stand against the corona virus pandemic[7].

RdRp – RNA dependent RNA polymerase is an essential protein in the genomes of all RNA containing viruses but not in DNA viruses. This protein in RNA viruses helps in the replication. Especially in the *Coronaviridae* family this protein complex is used for replication, transcription and a vital role in the causing infection, which drives the researches to develop antiviral agents against this promising target for several nucleotide analog inhibitors[8]. The RdRp of SARS-CoV-2 resembles the RdRp of SARS-CoV which infected humans around 2002[9]. Though the antiviral drug are being discovered and treated effectively the evolution of the virus makes them adaptable to the drugs and treatments against them. The evolutionary process by the mutation enables them to become resistance to the medical procedures by the process of adaptation-plasticity[10]. So the quicker the action taken, faster the recovery will be. The routine in vivo and *In vitro* technique takes time for its trial and error to know the drug compatibility within the animals trails such as Mice[11], Rats, Frogs[12], Dogs, Cats, Rabbits, Hamsters, Guinea pigs[13], Monkeys, Fish[14], and Birds. Thus in order to speed up the process the Computer aided Drug Designing paves the way [15,16,17].

MATERIALS AND METHODS

The 6m71 protein structure was retrieved from the Protein Data Bank (PDB).The secondary metabolites of Lichens were retrieved from PubChem database, a database for small molecules [18]. Finally the docking study [19] was carried Lichen compounds against the RdRp spike protein out using the Glide module of the Schrödinger software by giving its score in kcal/mol[20] in G-score value. The potency of the compounds to interact with the 6m71 proteins are seen and the hydrogen bonding strength[21] were viewed and noted by using Pymol[22] software.

RESULT AND DISCUSSION

Initially the compounds were selected and scrutinized and then those compound were brought into the ADMET properties (Table 1). Thus by making it high efficient and absorption to the human body we can achieve effectiveness of the drug at its high rate of efficient. By these parameters the lipophilicity and the solubility of the drug and its absorption by the human body is noted so that if these compounds over or less reactive those will be neglected.



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These parameter include Molecular weight, donor and acceptor hydrogen bonds, surface area. Along with this parameter it has certain values within which the molecule must exist. If these molecule exceeds the parameters, it will not be taken. The compounds are mainly screened for human oral absorption percentage, this show the rate of intake of compound by the villi present in the intestine. As the percentage should not go beyond or less than 25 or 80 respectively.

By performing these various pharmacokinetic studies such as ADMET including Solvent accessible surface area (SASA), Donated and Accepted Hydrogen bonds, Water/Gas/Octane partition coefficient, metabolic reactions and molecular techniques shown that certain lichen secondary metabolites have the RdRp inhibitory properties based on the parameters and scores the lichen compounds *Citreorsein* (Figure 1) and *Diploschistesic acid* (Figure 2) shows high G-score and bond strength and these compounds shows efficient binding with the RdRp complex by analysing the binding site of residues such as VAL-66, SER-61, GLN-34, GLN-31, LYS-51, GLN-34, GLU-50, THR-46(Table 2). By the results obtained based on the above Pharmacokinetic procedure *Citreorsein* and *Diploschistesic acid* lichen secondary metabolites shows high potency in RdRp inhibition and these can be proceeded to further experimentation to obtain the antiviral compound for Sars-CoV-2.

CONCLUSION

In this study we have carried out the in silico investigation on the lichen compounds and viral protein by applying the molecular docking approach in 3D structure prediction for RdRp(6m71) protein using PDB viewer. The model structure would useful in drug designing of drugs and concluded the compounds *Citreorsein* and *Diploschistesic acid* exhibited the drug-like inhibitory activity towards the RdRp of SARS CoV-2. User friendly drugs for COVID may be developed by the in-vivo study.

CONFLICT OF INTEREST

The authors have no conflicts of interest regarding this investigation.

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Table 1: ADME Properties of Lichens Compounds

Molecule	mol_MW	SASA	Don orHB	accept HB	QPlogPoct	QPlogPw	QPlogPo/w	QPlogBB	#metab	PercentHumanOralAbsorption	RuleOfFive	RuleOfThree
Normal values	130.0 - 725.0	300.0 - 1000.0	0.0 - 6.0	2.0 - 20.0	8.0 - 35.0	4.0 - 45.0	-2.0 - 6.5	-3.0 - 1.2	1.0 - 8.0	(<25% is poor) (>80% is high)	Max.4	Max.3
4-O-Demethylbarbatic acid	346.336	616.497	5	6.75	20.724	15.566	0.729	-1.615	7	62.403	1	1
Citreorsein	286.24	457.658	3	6.25	14.71	12.853	-0.623	-1.801	5	59.094	0	0
Convirensic acid	360.32	596.703	4	6.5	19.174	14.515	1.088	-1.865	4	47.862	1	0
Diploschistesic acid	334.282	401.075	5	9	18.581	18.097	-1.649	-1.582	7	36.115	1	1
Emodin	270.241	351.92	1	4.25	8.558	7.481	0.019	-0.955	4	69.167	0	0
Evernic acid	332.309	506.485	3	8.25	16.586	14.443	-0.425	-1.293	6	69.116	0	0
Fallacinol	300.267	517.734	2	6.25	13.913	11.121	0.202	-1.482	5	72.056	0	0
Haematommonine	314.251	418.579	2	7	12.487	11.798	-0.827	-1.604	5	57.067	0	0
Leacanoric acid	318.282	393.062	4	8.25	16.48	16.045	-1.226	-1.279	5	43.277	1	0
Norlichxanthone	258.23	390.264	2	3.75	10.041	8.606	0.449	-0.917	5	76.164	0	0
Olivetolic acid	224.256	463.586	2	2.5	10.925	6.973	1.753	-1.193	4	72.109	0	0
Pannaric acid	316.267	552.007	2	5.5	13.388	10.396	1.512	-2.111	5	50.988	0	1
Protocetraric acid	374.303	575.263	4	8.5	19.911	16.543	-0.129	-2.442	4	32.375	1	1
Strepsilin	270.241	368.613	1	5.5	9.408	8.558	-0.047	-0.56	4	77.569	0	0

Table 2: Interactions of selected Lichen compounds with SARS CoV-2 target 6m71 protein

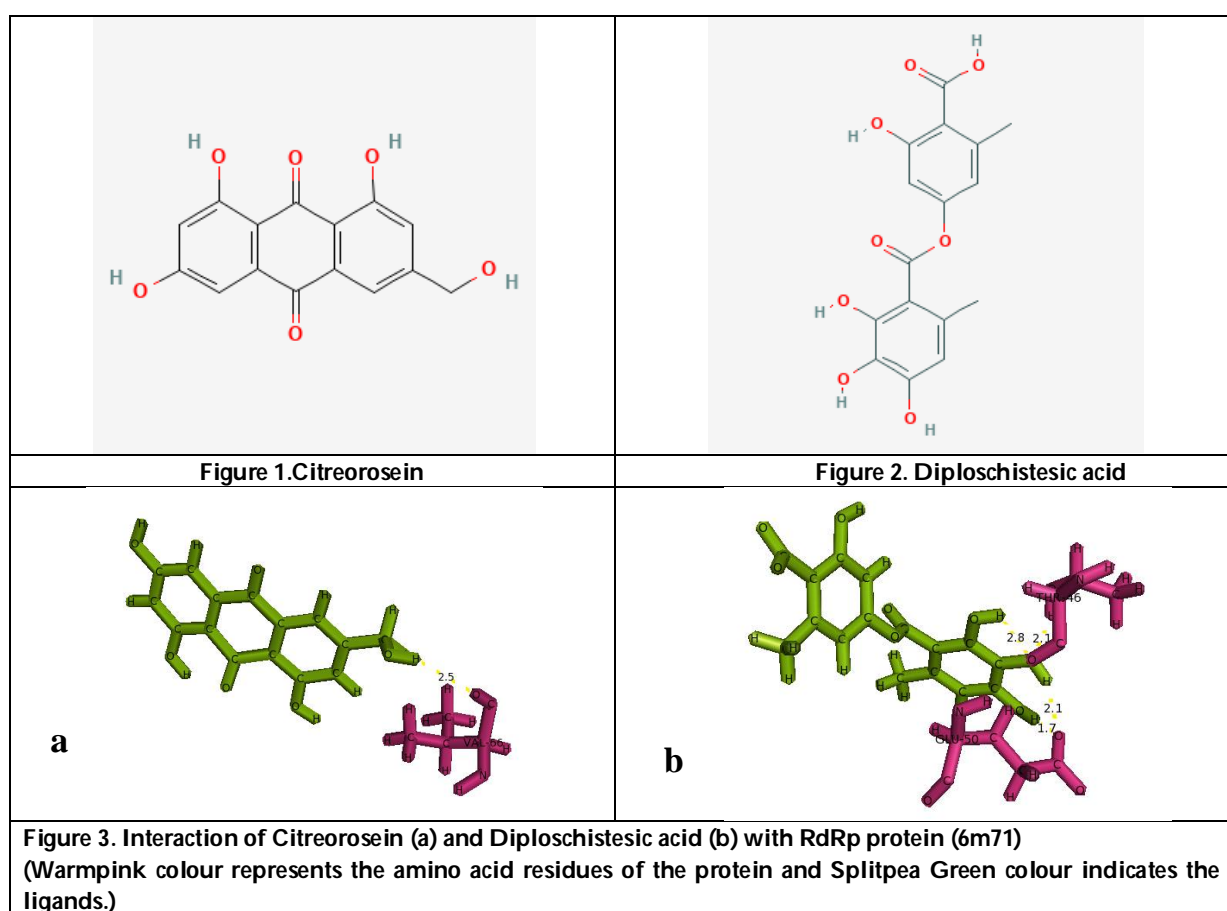
Ligand (Pubchem ID)	G-score (kcal/mol)	Bond length (Å)	No. of hydrogen bonds	Interacting residues
Citreorsein (361512)	-10.58	2.5	1	VAL-66(O-H)
Diploschistesic acid (12309260)	-10.3	1.7 2.1 2.1 2.8	5	GLU-50(H-O) THR-46(H-O) GLU-50(H-O) THR-46(O-H)
4-O-Demethylbarbatic acid (10450302)	-9.72	1.9 2.2	2	GLN-31(H-O) LYS-51(H-O)
Evermic acid (10829)	-9.5	2.3 2.5 1.9 1.7 2.8	5	SER-54(O-H) GLN-31(H-O) LYS-51(H-O) GLN-34(O-H) GLN-34 (H-O)





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Olivetolic acid (2826719)	-8.94	1.7	1	GLN-31(H-O)
Strepsilin (12443050)	-8.77	1.6 2.1	2	GLU-50(O-H) GLN-34(O-H)
Leacanoric acid (99613)	-8.59	2.8	1	GLN-31(H-O)
Fallacinol (3083633)	-8.58	1.9 2.5	2	GLN-31(H-O) SER-61(H-O)
Emodin (3220)	-8.57	1.9 2.4	2	GLN-31(H-O) SER-61(H-O)
Haematommone (11066989)	-8.33	2.3	1	SER-61(O-H)
Norlichxanthone (5281657)	-8.15	2.2	1	GLN-31(H-O)





Health Status and Immunity against COVID-19: A Study of India and G7 Countries

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ABSTRACT

This paper aims to compare the health status of India and G7 countries based on selected health indicators and find its relationship with the respective country's resilience to the current pandemic Covid-19. The initial apprehension is that a country with better health status can show better resilience or immunity. To test this assumption 9 health indicators are considered for all the 8 countries, further using Hellwig's method the countries are ranked based on the synthetic indicator attained by each country. To indicate the immunity or resilience of a country to covid-19, three parameters namely infected case (IC), recovery rate (RR) and death rate (DR) are considered. Finally, the association between health status and resilience of the countries is examined. The results show that better health status does not necessarily lead to a better resilience to Covid-19.

Keywords: Health Status, Covid-19, India and G7, Hellwig's method, Immunity

INTRODUCTION

Covid-19 has led to a massive destruction of human life throughout the globe along with the unprecedented challenges that it brings to public health, food systems and world of work each day. This pandemic has caused both economic and social devastation for the entire world. Both developed as well as developing countries have suffered a jolt to their socioeconomic status. Health is one of the major aspects that impact the socioeconomic balance of a country. When the human resource of a country is at threat it disrupts all the other spheres of life and well being. It has always been a common notion and findings in the past researches that better socioeconomic development leads to better Health status and that in turn should lead to better health facilities and effective control of pandemic situations but the current scenario of COVID-19 has seen both developed and developing countries facing the heat of



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the pandemic alike. The huge rise in number of people being infected, non availability of beds and non availability of health care workers have been of major concern in this pandemic. In this study the term Immunity refers to the resilience of a country against COVID ie to be able to bounce back and minimize the loss of human resource. This paper has two main aims, firstly to compare India and the G7 countries based on their health status by taking into consideration 9 selected Health indicators which are most relevant in the pandemic situation. Secondly to rank these countries based on its resilience against COVID which is measured in terms of Infected Case, Recovery Rate and Death Rate.

Review of Literature

Recent researches have pointed out that demographic composition, healthcare infrastructure, and behavioral nature of the population have a significant impact on the spread and fatality caused by COVID-19. A developed healthcare system helps countries withstand such pandemic emergencies and fight back with resilience (Markowitz et al.,2019). According to Abdulla et al. (2020) improved healthcare can support countries to control the death rate (DR). Whereas in the study by Biswas et al (2021) it concludes that better socioeconomic status does not necessarily lead to better resilience against COVID. According to Gardner et al (2020) Healthcare facilities, demographic composition and behavioral nature of the population has a significant impact on the fatal outcome of COVID-19. In the study conducted by Nagano et al (2020) a country's economic conditions and healthcare performance have a positive relation, an increase in the per capita GDP ensures better healthcare facilities thus leading to well being of the people. According to Abdulla et al (2020) countries with better health care can contain the Death Rate more effectively. The initial apprehension is that a country with better Health Status would report lower number of Infected Cases, better Recovery Rate and lower Death Rate. In the research conducted by Mihajlo Michael Jakovljevic(2015) Within a limited time horizon of only 19 years it appears that the share of global medical spending by the leading emerging markets has been growing steadily. Simultaneously, the world's richest countries' global share has been falling constantly, although it continues to dominate the landscape. This paper aims to investigate if better health status leads to resilience against COVID.

MATERIALS AND METHODS**Data**

Keeping in mind the current pandemic situation, the health indicators that have affected the current pandemic majorly have been selected along with the findings of past researches. Health indicators such as Crude birth rate per 1000 population, Crude Death rate per 1000 population, Infant Mortality rate, Expectation of Life at birth (average of male and female), Hospital beds per 1000 people, availability of nurses or midwives per 1000 people, availability of doctors per 1000 population, food supply (kcal/capita/day) and expenditure made on health are a few relevant indicators to compare the health status across countries. The above mentioned indicators would give a picture of both individual health and healthcare facilities available to the people. To represent the resilience of a country, indicators like Infected Case (Total cases/ IM population), Recovery Rate (Total recovery as % of infected cases) and Death Rate (Total death as % of infected cases) are selected.

Methodology

To rank the countries based on the selected 9 health indicators, the hellwig's method (1968) is used. This is a method which is widely used in social sciences to see the pattern of development. The set of variables selected initially were statistically treated. The variables which had a coefficient of variation less than the threshold value amounting to 10% were eliminated from the set of variables (Nowak 1997). Next taking into consideration the statistical criteria of high coefficient of variation and low correlation of variables, 9 variables were selected. 8 variables were found to be stimulants and 1 was found to be destimulant. This destimulant was further transformed into a stimulant based on the past studies (Zelias 2000). Further in the analysis all variables were treated as equally significant assigning unit weight to all.





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Next the data set was standardized by using the formula –

$$z_{ij} = \frac{x_{ij} - \bar{x}_j}{s_{x_j}}$$

where;

i= number of objects (countries),

j = number of variables,

\bar{x}_j = mean value of jth variable,

s_{x_j} = standard deviation of the jth variable,

z_{ij} = standardized value of the jth variable for the ith object.

We use these standardized values to establish the pattern of development, i.e., the “ideal object” with the coordinates:

$z_{01}, z_{02}, \dots, z_{0k}$, where $z_{0j} = \max\{z_{ij}\}$ represents variables that are stimulants;

$z_{0j} = \min\{z_{ij}\}$ represents variables that are de stimulants.

Then, for each object we calculate its distance from the “ideal object” by the following formula: $d_i = 1 - \frac{D_{i0}}{D_0}$

(i=1,2,3,-----n)

where;

d_i = measure of development proposed by Hellwig,

D_{i0} = Euclidean distance between the country and the “ideal object”

D_0 = critical distance between the objects and the “ideal object”

The calculation of the Euclidean distance (D_{i0}) is based on the following formula:

$$D_{i0} = \sqrt{\sum_{j=1}^m (z_{ij} - z_{0j})^2}$$

The synthetic indicator calculated for each object takes the value between 0 and 1. Based on the values of the synthetic indicator, ranks are assigned to each country.

Further, spearman's rank correlation was calculated between Health Status and Infected cases, Health Status and Recovery Rate, Health status and Death rate.

RESULTS

Table 1 shows the value of synthetic indicator and the rank that each country has obtained. According to the research results, Germany emerges as the best country in terms of health status and India's performance is poor occupying the 8th position. This research analysis gives an overview of the health status of the countries in the year 2018 that is just before the pandemic. Table 2 shows the ranking of each country based on Infected Cases, Recovery Rate and Death Rate. Here, we see a different picture of these countries than what was seen as their health status. Germany is still the best country in terms of recovery rate but we see it slipping down when it comes to the death rate. France shows a huge variation in its rank in terms of health status and its resilience against COVID-19. It is expected that a country with a good health status would be able to provide better health facilities to its population thus keeping it in better health. Hence such countries should have a better recovery rate and a low death rate but the research results point at a different picture. We see India to be doing very well in its fight against COVID-19 even though it scored poorly in terms of Health Status. Similar results can be seen in the case of other countries also. The rank correlation between Health Status and Infected cases, Health Status and Recovery rate and Health Status and Death Rate was also calculated (Table 3). It is interesting to see that there is negligible correlation between Health Status and the infected Cases and Health Status and the Death Rate. Further, there is a moderate relationship between Health Status and the Recovery Rate. The results of this study point towards a direction which is very different from the common notion of better health status leading towards better immunity against COVID-19.



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CONCLUSION

The common assumption and past studies strive on the notion that better health status of a country would enable the population to fight situations like that of the recent pandemic in the most effective way. It is interesting to note that the results of this study conclude that the Health Status of a country does not necessarily help to alleviate the impact of COVID-19. India being a developing country is ahead of developed countries like UK, US and France in terms of resilience against COVID. The results also display the fact that the spread of the disease ie Infected Cases depend on people's behaviour and other features of the population like age group, cultural practices and the amount of contact they make with each other. Similarly Death Rate also has negligible correlation with the Health Status of the respective country. It also largely depends on an individual's immune system and the age bracket that they fall into. Recovery Rate has shown moderate relationship with the Health Status and it is noteworthy that India occupies the fifth position that is ahead of many developed countries like US, UK and France. Government initiatives like nationwide complete lockdowns, compulsory wearing of masks and spreading awareness about social distancing have proved to be beneficial even though lockdowns have affected the country's economic status adversely. This study shows that better Health Status does not necessarily lead to better immunity against COVID-19. Hence to deal with such pandemic it is necessary to focus on the root causes of the spread and design a pandemic appropriate behaviour in the population.

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Table 1: Health Status Rankings

Country	Synthetic Indicator	Rank
Canada	0.30267	6
France	0.418164	2
Germany	0.428037	1
India	0.07162	8
Italy	0.396315	3
Japan	0.31842	4
United Kingdoms	0.292582	7
United States	0.302866	5

Source: Author's own calculation

Table 2: Ranking of countries on the basis of IC, RR and DR

Country	IC	RANK	RR	RANK	DR	RANK
Canada	2702	5	63.45	4	8.2	5
France	2471	4	37.91	7	15.03	8
Germany	2301	3	91.35	1	4.63	2
India	331	2	56.71	5	3.17	1
Italy	3950	6	77.29	3	14.52	7
Japan	142	1	90.03	2	5.4	4
United Kingdoms	4511	7	0.43	8	13.98	6
United States	7326	8	42.08	6	5.17	3

Source: Kaggle database (As on June 2020)

Table 3: Correlation between Health status, IC, RR and DR

		Rank_IC		Rank_RR		Rank_DR
Spearman's rho	Rank_HS	0.142857		0.47619		-0.28571

Source: Author's own calculation





On Compactness in Pythagorean Fuzzy Rough Topological Spaces

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ABSTRACT

Present paper is an concept of Pythagorean fuzzy topology deals with compactness and obtain of their theorems and properties respectively.

2010 AMS Classification: 54A40

Keywords: Pythagorean fuzzy rough topology, compact, open cover, sub covering.

INTRODUCTION

Fuzzy set was introduced by Zadeh. Intuitionistic fuzzy set (IFS) was introduced by Atanassov it deals with condition $0 \leq (\mu_{IF}) + (\lambda_{IF}) \leq 1$. Pythagorean fuzzy set (PFS) was introduced by yager [5] it deals with the condition $0 \leq (\mu_{PyF})^2 + (\lambda_{PyF})^2 \leq 1$. Fuzzy rough topological spaces was introduced by Anita Shanthy *et al.* [1,2]. Pythagorean fuzzy rough connected spaces was introduced by Revathi *et al.* [3]. In this article, the concept of Pythagorean fuzzy rough (PyFR) topology deals with compactness and obtain their theorems respectively.

Pythagorean Fuzzy Rough Compact Spaces

Definition: Let Z be the universe and $G \subseteq Z$ Let PyFR be a Pythagorean fuzzy equivalence relation on Z and $\tau_{PyFR} = (Z, \phi, \underline{PyFR}(G), \overline{PyFR}(G))$ satisfies the following axioms:

- 1) $Z, \phi \in \tau_{PyFR}$
- 2) For any $G_1, G_2 \in \tau_{PyFR}$, we have $G_1 \cap G_2 \in \tau_{PyFR}$
- 3) For any $(G_i)_{i \in H} \subset \tau_{PyFR}$, we have $\bigcup_{i \in H} G_i \in \tau_{PyFR}$





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τ_{PyFR} forms a Pythagorean fuzzy rough topology (PyFRT) on Z with respect to G and $(Z, PyFR, \tau_{PyFR})$ is said to be the Pythagorean fuzzy rough topological space (PyFRTS).

Definition: Let $(Z, PyFR(G), \tau)$ be a PyFRTS. A collection ζ of open PyFR sets $\{PyFR(G_j) : j \in J\}$, J be the index set is said to be PyFR open cover of $PyFR(G)$ if $PyFR(G) \subseteq \bigcup_{j \in J} PyFR(G_j)$.

Definition: Every PyFR open cover of $PyFR(G)$ has a PyFR finite sub cover. Then PyFRTS $(Z, PyFR(G), \tau)$ is called PyFR compact.

Example:

Consider, $Z = \{B_1, B_2, B_3\}$,

$$G = \left\{ \frac{B_1}{(0.5, 0.7)}, \frac{B_2}{(0.7, 0.5)}, \frac{B_3}{(0.6, 0.7)} \right\} \text{ and}$$

$$PyFR = \begin{pmatrix} (1, 0) & (0.7, 0.5) & (0.5, 0.7) \\ (0.7, 0.5) & (1, 0) & (0.7, 0.5) \\ (0.5, 0.7) & (0.7, 0.5) & (1, 0) \end{pmatrix}$$

The lower approximations membership are

$$\mu_{\underline{PyFR}(G)}(B_1) = 0.5, \mu_{\underline{PyFR}(G)}(B_2) = 0.5, \mu_{\underline{PyFR}(G)}(B_3) = 0.5$$

$$\underline{PyFR}(G) = \left\{ \frac{B_1}{0.5}, \frac{B_2}{0.5}, \frac{B_3}{0.5} \right\}.$$

The lower approximations non- membership are

$$\lambda_{\underline{PyFR}(G)}(B_1) = 0.7, \lambda_{\underline{PyFR}(G)}(B_2) = 0.5, \lambda_{\underline{PyFR}(G)}(B_3) = 0.7$$

$$\underline{PyFR}(G) = \left\{ \frac{B_1}{0.7}, \frac{B_2}{0.5}, \frac{B_3}{0.7} \right\}.$$

Therefore, $\underline{PyFR}(G) = \left\{ \frac{B_1}{(0.5, 0.7)}, \frac{B_2}{(0.5, 0.5)}, \frac{B_3}{(0.5, 0.7)} \right\}$

The upper approximations membership are

$$\mu_{\overline{PyFR}(G)}(B_1) = 0.7, \mu_{\overline{PyFR}(G)}(B_2) = 0.7, \mu_{\overline{PyFR}(G)}(B_3) = 0.7$$

$$\overline{PyFR}(G) = \left\{ \frac{B_1}{0.7}, \frac{B_2}{0.7}, \frac{B_3}{0.7} \right\}.$$

The upper approximations non- membership are

$$\lambda_{\overline{PyFR}(G)}(B_1) = 0.5, \lambda_{\overline{PyFR}(G)}(B_2) = 0.5, \lambda_{\overline{PyFR}(G)}(B_3) = 0.5$$

$$\overline{PyFR}(G) = \left\{ \frac{B_1}{0.5}, \frac{B_2}{0.5}, \frac{B_3}{0.5} \right\}.$$

Therefore, $\overline{PyFR}(G) = \left\{ \frac{B_1}{(0.7, 0.5)}, \frac{B_2}{(0.7, 0.5)}, \frac{B_3}{(0.7, 0.5)} \right\}$

$$PyFR(G) = \left\{ \frac{B_1}{(0.5, 0.7)}, \frac{B_2}{(0.5, 0.5)}, \frac{B_3}{(0.5, 0.7)} \right\}, \left\{ \frac{B_1}{(0.7, 0.5)}, \frac{B_2}{(0.7, 0.5)}, \frac{B_3}{(0.7, 0.5)} \right\}.$$





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Consider, $Z = \{B_1, B_2, B_3\}$,

$$G_1 = \left\{ \frac{B_1}{(0.5, 0.3)}, \frac{B_2}{(0.5, 0.2)}, \frac{B_3}{(0.5, 0.3)} \right\} \text{ and}$$

$$PyFR = \begin{pmatrix} (1,0) & (0.5,0.8) & (0.3,0.2) \\ (0.5,0.8) & (1,0) & (0.5,0.8) \\ (0.3,0.2) & (0.5,0.8) & (1,0) \end{pmatrix}$$

$$PyFR(G_1) = \left\{ \frac{B_1}{(0.5, 0.2)}, \frac{B_2}{(0.5, 0.3)}, \frac{B_3}{(0.5, 0.2)} \right\}, \left\{ \frac{B_1}{(0.5, 0.2)}, \frac{B_2}{(0.5, 0.3)}, \frac{B_3}{(0.5, 0.2)} \right\}.$$

Consider, $Z = \{B_1, B_2, B_3\}$,

$$G_2 = \left\{ \frac{B_1}{(0.1, 0.4)}, \frac{B_2}{(0.2, 0.4)}, \frac{B_3}{(0.3, 0.4)} \right\} \text{ and}$$

$$PyFR = \begin{pmatrix} (1,0) & (0.2,0.1) & (0.3,0.4) \\ (0.2,0.1) & (1,0) & (0.2,0.1) \\ (0.3,0.4) & (0.2,0.1) & (1,0) \end{pmatrix}$$

$$PyFR(G_2) = \left\{ \frac{B_1}{(0.1, 0.4)}, \frac{B_2}{(0.2, 0.1)}, \frac{B_3}{(0.3, 0.4)} \right\}, \left\{ \frac{B_1}{(0.3, 0.4)}, \frac{B_2}{(0.3, 0.9)}, \frac{B_3}{(0.3, 0.6)} \right\}.$$

$$\cup PyFR(G_i) = \left\{ \frac{B_1}{(0.5, 0.2)}, \frac{B_2}{(0.5, 0.1)}, \frac{B_3}{(0.3, 0.2)} \right\}, \left\{ \frac{B_1}{(0.5, 0.2)}, \frac{B_2}{(0.5, 0.3)}, \frac{B_3}{(0.5, 0.2)} \right\}$$

$$\text{Thus } PyFR \subseteq \bigcup_{j \in J} \{PyFR(G_j)\}$$

Hence $PyFR(G)$ is $PyFR$ compact.

Theorem: Let $(Z, PyFR, \tau)$ and $(Z^*, PyFR(H), \tau^*)$ be $PyFR$ TS and $k: PyFR(G) \rightarrow PyFR(H)$ Pythagorean fuzzy rough continuous. If $PyFR(G)$ compact in $(Z, PyFR(G), \tau)$, then $k(PyFR(G))$ is $PyFR$ compact in $(Z^*, PyFR(H), \tau^*)$

Proof: Let $\gamma = \{PyFR(H_j) : j \in J\}$ be a open cover Pythagorean fuzzy rough of $k(PyFR(G))$ and

$\zeta = \{k^{-1}(PyFR(H) : PyFR(H) \in \gamma)\}$. we now show that ζ is a open cover Pythagorean fuzzy rough of $PyFR(G)$. Let $x \in PyFR(G)$ be any $PyFR$ rough point.

$$\Rightarrow k(x \in PyFR(G)) \in k(PyFR(G)). \text{ There exists a } PyFR \subseteq PyFR(H_j) \text{ of } \gamma \text{ such that } k(x \in PyFR(G)) \in \gamma$$

$$\text{Therefore, } x \in k^{-1} \left(\bigcup_{j \in J} (PyFR(H_j)) \right) = \bigcup_{j \in J} k^{-1}(PyFR(H_j))$$

$$\Rightarrow PyFR(G) \subseteq \bigcup_{j \in J} k^{-1}(PyFR(H_j))$$

$$\Rightarrow k(PyFR(G)) \subseteq \bigcup_{j \in J} (PyFR(H_j)).$$





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Again, since K is PyFR continuous, each member of ζ is open PyFR. So, ζ is an open cover PyFR of $\text{PyFR}(G)$ is PyFR compact, there exist finitely many members of ζ , say $k^{-1}(\text{PyFR}(H_1)), k^{-1}(\text{PyFR}(H_2)), \dots, k^{-1}(\text{PyFR}(H_n))$

Where $(\text{PyFR}(H_1)), (\text{PyFR}(H_2)), \dots, (\text{PyFR}(H_n)) \in \mathcal{Y}$ such that

$$\text{PyFR}(G) \subseteq k^{-1}(\text{PyFR}(H_1)) \cup k^{-1}(\text{PyFR}(H_2)) \cup \dots \cup k^{-1}(\text{PyFR}(H_n))$$

$$= k^{-1}(\text{PyFR}(H_1) \cup \text{PyFR}(H_2) \cup \dots \cup \text{PyFR}(H_n))$$

$$\Rightarrow k(\text{PyFR}(G)) \subseteq (\text{PyFR}(H_1) \cup \text{PyFR}(H_2) \cup \dots \cup \text{PyFR}(H_n))$$

$\Rightarrow \{\text{PyFR}(H_1), \text{PyFR}(H_2), \dots, \text{PyFR}(H_n)\}$ is a PyFR finite sub cover of $K(\text{PyFR}(G))$

$\Rightarrow k(\text{PyFR}(G))$ is PyFR compact.

Theorem: Let $[\text{PyFR}(E)]^c$ be a closed PyFR subset of $\text{PyFR}(A)$ which is PyFR compact in $(Z, \text{PyFR}(G), \mathcal{T})$. Then $[\text{PyFR}]^c$ is PyFR compact.

Proof: Let $\{\text{PyFR}(G_j); j \in J\}$ be an open cover Pythagorean fuzzy rough of $[\text{PyFR}(E)]^c$. Then $[\text{PyFR}(E)]^c \subseteq (\bigcup_{i \in I} \text{PyFR}(G_j)) \cup (\text{PyFR}(E))$. i.e. $\text{PyFR}(G_j)$ together with open Pythagorean fuzzy rough set $\text{PyFR}(E)$ is an open cover Pythagorean fuzzy rough cover of $[\text{PyFR}]^c$. Since $\text{PyFR}(G)$ is PyFR compact \exists a finite sub covering $\text{PyFR}(G_1), \text{PyFR}(G_2), \dots, \text{PyFR}(G_n) \text{PyFR}(E)$ such that

$$[\text{PyFR}]^c \subseteq \text{PyFR}(G_1) \cup \text{PyFR}(G_2) \cup \dots \cup \text{PyFR}(G_n) \cup \text{PyFR}(E)$$

$$\Rightarrow [\text{PyFR}(E)]^c \subseteq \text{PyFR}(G_1) \cup \text{PyFR}(G_2) \cup \dots \cup \text{PyFR}(G_n).$$

Hence $[\text{PyFR}(E)]^c$ has a PyFR finite sub covering

Therefore $[\text{PyFR}(E)]^c$ is PyFR compact.

Theorem: If $[\text{PyFR}(E)]^c$ is PyFR compact in PyFR Hausdorff space $(Z, \text{PyFR}(G), \text{PyFR}(H), \mathcal{T})$. Then $[\text{PyFR}]^c$ is PyFR closed.

Proof: Let $x \in \text{PyFR}(Q), y \in \text{PyFR}(P)$ be distinct PyFR points in a PyFR Hausdorff space $(Z, \text{PyFR}(G), \text{PyFR}(H), \mathcal{T})$

$\Rightarrow \exists$ distinct open sets $\text{PyFR}(G)$ and $\text{PyFR}(H)$

Such that

$x \in \text{PyFR}(P) \in \text{PyFR}(G), y \in \text{PyFR}(Q) \in \text{PyFR}(H)$. Now, let $\{(\text{PyFR}(H_i); i \in J)\}$ be an open cover PyFR of $[\text{PyFR}]^c$. Since $[\text{PyFR}(E)]^c$ is PyFR compact it has a finite PyFR sub cover $\{(\text{PyFR}(H_1), \text{PyFR}(H_2), \dots, \text{PyFR}(H_n))\}$.

i.e. $[\text{PyFR}(E)]^c \subseteq \bigcup_{j=1}^n \text{PyFR}(H_j)$. Then $\text{PyFR}(G)$ is an open set containing $x \in \text{PyFR}(Q)$ and contained in $[\text{PyFR}(E)]^c$ is PyFR closed.

Theorem: Let $(Z, \text{PyFR}(G), \mathcal{T})$ and $(Z^*, \text{PyFR}(H), \tau)$ be two PyFR TS and $K: \text{PyFR}(G) \rightarrow \text{PyFR}(H)$ be PyFR continuous. If $\text{PyFR}(G)$ is PyFR compact, then $\text{PyFR}(H)$ is compact PyFR.

Proof: Let $\{\text{PyFR}(G_j); j \in J\}$ be an open covering PyFR of $\text{PyFR}(H)$

$$\text{i.e. } \text{PyFR}(H) \subseteq \bigcup_{j \in J} (\text{PyFR}(G_j))$$

$$\Rightarrow k^{-1}(\text{PyFR}(H)) \subseteq k^{-1}(\bigcup_{j \in J} (\text{PyFR}(G_j))) \text{ and since } K \text{ is PyFR continuous } \text{PyFR}(G) \subseteq$$

$$(\bigcup_{j \in J} k^{-1}(\text{PyFR}(G_j)))$$





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$\Rightarrow k^{-1}(PyFR(G_j))$ is open covering PyFR of $PyFR(G)$. Since $PyFR(G)$ is compact $PyFR \exists$ a $PyFR$ finite sub-covering such that $PyFR(G) \subseteq k^{-1}(PyFR(G_1)) \cup k^{-1}(PyFR(G_2)) \cup \dots \cup k^{-1}PyFR(G_n)$.
 $PyFR(H) = K(PyFR(G))$
 $\subseteq k(k^{-1}(PyFR(G_1)) \cup \dots \cup k^{-1}(PyFR(G_n)))$
 $= PyFR(G_1) \cup PyFR(G_2) \cup \dots \cup PyFR(G_n)$.
 $\Rightarrow PyFR(H)$ is compact PyFR.

Definition: Let $(Z, PyFR(G), \tau)$ and $(Z^*, PyFR(H), \tau')$ be two PyFRS. A PyFR mapping $h = ((f^\mu, f^\lambda), (g^\mu, g^\lambda)): PyFR(G) \rightarrow PyFR(H)$ is said to be closed PyFR if $h(PyFR(G))$ is closed PyFR in $(Z^*, PyFR(H), \tau')$ for all closed Pythagorean fuzzy rough set $PyFR(G)$ in $(Z, PyFR(G), \tau)$.

Theorem: Let $(Z, PyFR(G), \tau)$ be a PyFR compact space and $(Z^*, PyFR(H), PyFR(I), \tau')$ be a PyFR Hausdorff space. Then the function g is closed PyFR if PyFR function $g: PyFR(G) \rightarrow PyFR(H)$ is PyFR continuous.

Proof: Let $[PyFR(E)]^c$ be a closed PyFR subset of $PyFR(G)$ which is compact PyFR in $(Z, PyFR(G), \tau)$. It follows from theorem 3.5 that, $[PyFR(E)]^c$ is compact PyFR compact. Since g is a PyFR continuous function it follows from theorem 3.4 that $h[PyFR(E)]^c$ is PyFR compact in $(Z^*, PyFR(H), \tau')$. As $(Z^*, PyFR(H), PyFR(I), \tau')$ is a PyFR Hausdorff space, it follows from theorem 3.6 that $g[PyFR(E)]^c$ is PyFR closed. Therefore g is PyFR closed.

Theorem: Let $(PyFR(H_s), \tau_{PyFR(H_s)})$ be a PyFR subspace of a PyFRS $(Z, PyFR(G), \tau)$. Then $PyFR(G)$ is PyFR compact in $(Z, PyFR(G), \tau)$ if and only if $PyFR(G)$ is PyFR compact in $(PyFR(H_s), \tau_{PyFR(H_s)})$.

Proof: Let $PyFR(G)$ be PyFR compact in $(Z, PyFR(G), \tau)$ and $\{PyFR(H_j) | j \in J\}$ be a collection of open PyFR sets in $(PyFR(H_s), \tau_{PyFR(H_s)})$ which covers $PyFR(G)$ so that $PyFR(G) \subseteq \bigcup_{j \in J} PyFR(H_j)$. Then there exists $\{PyFR(G_j) | j \in J\}$ which is open PyFR in $(Z, PyFR(G), \tau)$ such that

$PyFR(H_j) = PyFR(H_s) \cap PyFR(G_j)$ for any $j \in J$. Then $PyFR(G) \subseteq \bigcup_{j \in J} PyFR(G_j)$, so that $\{PyFR(G_j) | j \in J\}$ is

PyFR open cover of $PyFR(G)$. Since $PyFR(G)$ is PyFR compact in $(Z, PyFR(G), \tau)$ there exists a PyFR finite sub cover $\{PyFR(G_1), PyFR(G_2), \dots, PyFR(G_n)\}$ such that $PyFR(G) \subseteq \bigcup_{j=1}^n PyFR(G_j)$. Since $(PyFR(H_s), \tau_{PyFR(H_s)})$ is a PyFR

subspace of $(Z, PyFR(G), \tau)$ $PyFR(G) \subseteq PyFR(H_s) \cap (PyFR(G_{\lambda_1}) \cup \dots \cup PyFR(G_{\lambda_n}))$
 $= (PyFR(H_s) \cap PyFR(G_{\lambda_1})) \cup (PyFR(H_s) \cap PyFR(G_{\lambda_2})) \cup \dots \cup (PyFR(H_s) \cap PyFR(G_{\lambda_n}))$.

$\Rightarrow PyFR(G)$ is PyFR compact in $(PyFR(H_s), \tau_{PyFR(H_s)})$.

Conversely, let $PyFR(G)$ be PyFR compact in $(PyFR(H_s), \tau_{PyFR(H_s)})$ and $\{PyFR(G_j) | j \in J\}$ be a open cover of $(Z, PyFR(G), \tau)$ so that $PyFR(G) \subseteq \bigcup_{j \in J} PyFR(G_j)$.

Hence, $PyFR(G) \subseteq PyFR(H_s) \cap (\bigcup_{j \in J} PyFR(G_j))$

$= \bigcup_{j \in J} (PyFR(H_s) \cap PyFR(G_j))$. since $PyFR(G)$ is compact PyFR in $PyFR(H_s)$,





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we must have ,

$$PyFR(G) \subseteq ((PyFR(H_s) \cap PyFR(G_1)) \cup ((PyFR(H_s) \cap PyFR(G_2)) \cup \dots \cup ((PyFR(H_s) \cap PyFR(G_n))))$$

for finitely many indices $\lambda_1, \lambda_2, \dots, \lambda_n$.

This implies that $PyFR(G) \subseteq \bigcup_{j=1}^n (PyFR(G_{\lambda_j}))$

$\Rightarrow PyFR(G)$ is compact PyFR in $(Z, PyFR(G), \mathcal{T})$.

Theorem: Let $(Z, PyFR(G), \mathcal{T})$ and $(Z^*, PyFR(H), \tau')$ be two PyFRTS. Let $K =$

$((f^\mu, f^\lambda), (g^\mu, g^\lambda)): PyFR(G) \rightarrow PyFR(H)$ be a PyFR continuous bijective function. If $PyFR(G)$ is compact PyFR in $(Z, PyFR(G), \mathcal{T})$ and $(Z^*, PyFR(H), PyFR(R), \tau')$ is a PyFR Hausdorff space, then K is a PyFR homeomorphism.

Proof: It is necessary to prove that k^{-1} is PyFR continuous.

ie., $(K^{-1})^{-1}(PyFR(O))$ is open PyFR in $(Z^*, PyFR(H), PyFR(R), \tau')$ \forall $PyFR(o)$ open PyFR in $(Z, PyFR(G), \mathcal{T})$.

To Prove that $K[PyFR(K)]^c$ is closed PyFR in $(Z^*, PyFR(H), PyFR(K), \tau')$, $\forall [PyFR(K)]^c$ is closed PyFR in $(Z, PyFR(G), \mathcal{T})$.

Since $K[PyFR(K)]^c$ is closed PyFR in $(Z^*, PyFR(H), PyFR(R), \tau')$ and $PyFR(G)$ compact PyFR and K is PyFR rough continuous

$\Rightarrow K [PyFR(K)]^c$ is compact PyFR, by Theorem 3.4.

$(Z^*, PyFR(H), PyFR(R), \tau')$ is PyFR Hausdorff and $K[PyFR(K)]^c$ is compact PyFR in $(Z^*, PyFR(H), PyFR(R), \tau')$

Hence it follows by theorem 3.6 that $k[PyFR(K)]^c$ is closed PyFR.

$\Rightarrow k^{-1}$ is PyFR continuous.

CONCLUSION

In this paper, we have introduced compactness on Pythagorean fuzzy rough topology with some theorems and properties with suitable examples. In further study, we will analysis the concepts of separation axioms for Pythagorean fuzzy rough topology.

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Mathematical Modeling of Virus and T – Cell Population

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ABSTRACT

The spread of virus in various forms has been crucial for spread of several diseases not only to humans but also in other species. In this paper, we will provide methods to model the spread of virus mathematically and study the associated T – cell populations when a particular infection gets spread throughout the community by considering a simple model and a general model.

Keywords: Virus Population, T – cell population, Steady State, Drug Efficiency, Equilibrium

INTRODUCTION

During recent years, the whole world has been affected by Corona Virus spread and huge impact has been felt due to it. Several mathematical models have been proposed to understand and control the spread of virus and several researches has been conducted to produce suitable vaccines which can save human lives. In this paper, we had provided simple and general mathematical models to study spread of virus and T – cells when a infection gets spread in a particular community.

Formulation and Solution of Simple Model

During the occurrence of a infection, there would be very rapid changes in viral and immune cell populations during the first few months. In this model, we will focus on the long, seemingly steady state asymptomatic period that follows the sustained levels normally referred to as the *set point*. A big hint as to what is going on in steady state stems from the clinical observation that treatment with a powerful antiretroviral drug, thereby removing the source of new virus, results in rapid exponential decrease of virus. This strongly suggests that the virus population $V(t)$ is





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being controlled by a combination of constant source P (every T-cell gets zapped by virus, producing an infected T-cell T^* , which spews forth virus), an effective clearance rate for virus expressed through the differential equation

$$\frac{dV}{dt} = P - cV \tag{1}$$

A completely efficient drug (Figure 1) would make $P = 0$ so that from (1), we obtain $V(t) = V(0)e^{-ct}$ (2). Clinical data suggests that $1/c = 1$ hour. Given this, then in steady state without the drug, (when V is independent of time), from (1), we must have $P - cV = 0$ (3). Now using the estimates of $V(0)$ we arrive to the conclusion that P is approximately 10^{10} virions/day. Since drug efficiency is less than 100%, we have an overestimate for $1/c$ (c really has to be higher than observed, to take care of the remnant of P).

Formulation and Solution of General Model

The argument in simple model leaves unexplained both the contributions to the viral growth rate and the size of the T-cell population that unwittingly serves as the source of virus. For these, we need a more general model in this section. Let us refer all populations to some unit volume (generally taken as $1 \mu l = 1 \text{ mm}^3$).

To begin with, we distinguish between the susceptible but uninfected T-cell population $T(t)$ and the population $T^*(t)$ that has been successfully infected. The uninfected T 's will be modeled via a source s , a natural death rate d , and a rate at which they become infected, taken (as in the chemical kinetics law of mass action) as proportional both to the viral concentration and T-cell concentration. With these, we have the differential equation

$$\frac{dT}{dt} = s - dT - kVT \tag{4}$$

The infected T 's are of course produced at the same rate kVT , and have their own natural death rate δ after infection giving rise to the equation $\frac{dT^*}{dt} = kVT - \delta T^*$ (5).

The infected cells are indeed the source of new virions, but each T^* can churn out a large number, say N approximately between 10^2 and 10^4 number of virions before dying, so now we have another equation

$$\frac{dV}{dt} = N\delta T^* - cV \tag{6}$$

This general model consisting of three coupled ordinary differential equations (4), (5) and (6) is fairly straightforward but not analytically trivial, and it is worth looking at some extreme cases to get a feeling for its properties. To do so, we must decide what "extreme" means; after all, there are six parameters to deal with. Since there are three concentration variables and one time variable, we can choose units so that two of the rate contributions in each equation have the same coefficient, and one of the time derivatives as well. Scaling as $T = \alpha\tau, T^* = \alpha^*\tau^*, V = \beta v$ and $t = \gamma t'$, we can express equations (4), (5) and (6) respectively as

$$\frac{\alpha}{\gamma} \frac{d\tau}{dt'} = s - d\alpha\tau - k\beta\alpha v\tau \tag{7}$$

$$\frac{\alpha^*}{\gamma} \frac{d\tau^*}{dt'} = k\beta\alpha v\tau - \delta\alpha^*\tau^* \tag{8}$$

$$\frac{\beta}{\gamma} \frac{dv}{dt'} = N\delta\alpha^*\tau^* - c\beta v \tag{9}$$





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Now choosing $\beta = \frac{d}{k}, \gamma = \frac{1}{c}, \alpha^* = \frac{cd}{N\delta k}, \alpha = \frac{c}{Nk}, a = \frac{Nk}{cd}$ equations (7), (8) and (9) can be expressed in canonical form as

$$\frac{c}{d} \frac{d\tau}{dt'} = a - \tau - v\tau \quad (10)$$

$$\frac{c}{\delta} \frac{d\tau^*}{dt'} = v\tau - \tau^* \quad (11)$$

$$\frac{dv}{dt'} = \tau^* - v \quad (12)$$

We can now solve differential equations (10) and (11) and use that to solve equation (12).

The solution to (12) gives the rate change of virus and also provides the conclusion (Figure 2) that equilibrium is achieved when $v(0) = a - 1$ for $a > 1$.

CONCLUSION

In this paper, we have proposed two mathematical models the first simple and second general model for studying the behavior of virus and T – cells population observed in a particular infection. For this, we have considered ordinary differential equations and made our conclusions upon solving such equations. In particular, through simple model in section 2, we have mathematically proved that upon consuming useful and efficient drugs, the rate of virus spread decreases rapidly leading to full recovery of the affected. For tackling situations like viral growth rate and size of T – cell population, a general model is proposed in section 3. In doing so, we obtained three ordinary differential equations expressing the rate changes of T – cell, infected T – cells and Virus spread level through equations (4), (5) and (5) respectively. By scaling and considering suitable substitutions, we have converted the three differential equations governing the model in to three canonical equations (10), (11) and (12) which in turn can be solved easily.

Specifically, using the solution of (10), we can solve (11) and using this solution, we could determine the viral growth in a population through (12). As can be noticed from Figure 2, the equilibrium condition is achieved when $v(0) = a - 1$, for $a > 1$. Thus the ideas discussed in this paper helps us to understand the growth rate of virus in a population associated with T – cells.

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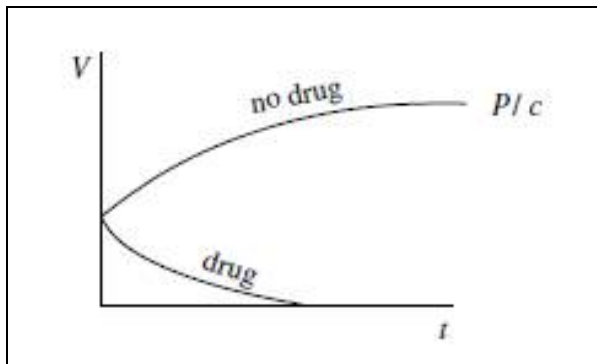


Figure 1: Trend observed under ideal drug treatment

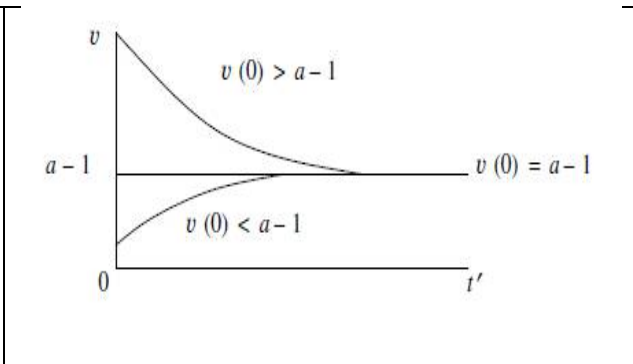


Figure 2: Rate Change of Virus





Polymer Nanocomposites from Waste Thermoplastics

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ABSTRACT

With the rise in population comes an increase in the use of plastic, which poses a threat to the environment. It is critical that waste plastics be turned into valuable resources through up cycling methods. Preparation of polymer nanocomposites from discarded plastics is one of these processes. As a result of their unique combination of advantageous chemical and physical properties, such as excellent heat conductivity, chemical stability, advanced optical properties, and high mechanical strength, polymer nanocomposites have piqued the scientific community's interest. The remarkable changes in physical and mechanical properties of polymers due to the addition of nanoparticles is explained by the large surface area, which increases the interaction between the particles. The purpose of this review is to provide an overview of various waste thermoplastic polymers and the synthesis of polymer based nano composites from them by melt mixing & solution mixing method.

Keywords: Polymer Nanocomposites, Thermoplastic, Solution mixing, Melt mixing

INTRODUCTION

Because of the increase in population across the world the usage of plastics has grown exponentially which are widely utilised all over the world due to their include durability, light weight, low cost, and so on. Plastics are used in a variety of applications, including packaging, construction, electronic, and automotive industries. However, the fundamental issue with these plastics is that they are not biodegradable, causing them to remain on land and in the sea for many years, resulting in a large amount of solid waste and serious environmental pollution that is hazardous to human, animal, and aquatic life and the most common plastic waste among these are the single use plastic products that are prepared from the thermoplastic polymers that are mentioned in table 1. To reduce the harmful impact of plastics on the environment, it is necessary to design methods to recycle used waste plastics into useful valuable products. Converting used waste plastics to polymer nano composites is one such recycling approach,

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which involves melting the plastic into polymer and then mixing in nano components to increase mechanical, electrical, optical, and magnetic properties, among other things.

In general, the composite materials can be classified based on the type of the matrix used as a) Metal matrix composite, b) Ceramic matrix composite and c) Polymer matrix composite. Polymers have an advantage over metal and ceramic matrices due to their ease of availability, processing, and inexpensive cost. However, the main disadvantage of polymer matrices is their low modulus strength and thermal degradation temperatures, which limit their use in diverse applications. Nanoparticles are introduced as filler materials to the polymer matrix to address these limitations, resulting in the development of a polymer nano-composite with enhanced properties. The word "nano-composite" refers to a system in which at least one component is on the nanometre scale (1-100 nm). And the nano structured phase of the nano-composite structure can be classified as a) zero-dimensional (embedded cluster, quantum dots, etc.) b) one dimensional (1D-example carbon nano tubes) c) two-dimensional (2D-nanoscale coatings and thin-films) d) Three dimensional (3D- Nano-powders and embedded network structures). And these nanoparticles have unique properties which are shown in figure 1.

And addition of these nanoparticles [1,2] to the polymer matrix result in a remarkable enhancement in the physical, chemical [3,4] as well as some mechanical properties owing to their small size and high surface area which leads to a better interfacial interaction between the polymer matrix and the dispersed nanofiller. The fundamental advantage of these polymer nano-composites is that they can be made using traditional polymer processing processes, making them relatively unique in terms of manufacturing as a result of which preparation of polymer nano composites from waste plastics can be viewed as a helpful and simple way for recycling plastic waste while also leading to the development of novel materials with unique features and various applications. In this review we have highlighted on the synthesis of polymer nano composites from waste thermoplastics

Recycling Methods For Thermoplastics

In general, there are three methods of recycling these plastics and they are 1) Chemical 2) Thermal & 3) mechanical recycling. Chemical recycling involves converting a polymer back into a monomer or other basic chemical by chemical reactions, and then using those monomers to make new plastics through polymerisation reactions. Thermal recycling breaks down the chemical structure of polymers at a higher temperature in the absence of oxygen. This thermal degradation can be applied to all types of polymers, and two types of products can be formed during the thermal degradation of the polymers: pure compounds that can be used as raw materials, and complex products that are difficult to separate but can be used as fuel. Waste plastics are transformed into flakes, granules, or small particles of proper quality and size through mechanical recycling, and then melted by extrusion to create new goods and the type and quantity of stress applied, morphological properties of the polymer, molecular weight of the polymer, crystallinity, and Glass transition Temperature (T_g) of the polymer are all elements that influence the final product following mechanical recycling. Mechanical recycling is a great procedure for plastic recycling because it uses no toxic chemicals, unlike chemical recycling, and the temperature is not as high. However, the only disadvantage of mechanical recycling is that the heat and mechanical stress involved in the process alter the structure and morphology, resulting in a reduction or change in physical properties and this problem is avoided by the inclusion of the nanoparticle into the polymer matrix can solve this issue.

Polymer Nanocomposites

Polymer nanocomposite(PNC) is a composite material which consists of a polymeric material (thermoplastics, thermosetting, or an elastomer) as the matrix phase and the dispersed phase or the filler consists of nanoscale material (nanoparticle) and at least one of the dimensions of the nano particle is in the size range of 1nm-100nm. The final properties of the polymer nanocomposites depend upon a) Types of nanoparticles and their surface treatments b) Nature of the polymer matrix b) Matrix morphology and dispersed phase morphology d) Polymer nano composites synthesis methods, e) Polymer matrix crystallinity and glass transition temperature, and f) Nature of the interaction between the polymer matrix and the nanoparticles dispersed. The fundamental benefit of using



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thermoplastic polymers like Poly vinyl chloride (PVC), Poly methyl methacrylate (PMMA), Polystyrene (PS), High density Poly ethylene (HDPE), Polypropylene (PP) etc. as a matrix is that they retain their original properties even after reheating and reforming because these thermoplastics contains linear chain molecules that gets softened in heating and stiffened upon cooling in a range of temperature owing to the nature of the bonding like dipole dipole interaction, hydrogen bonding, and weak Vander Waals forces in them. The final properties and applications of the polymer nanocomposite also depend upon the nature and type of the dispersed nanoparticle. Because of their small size and high surface area, the contact between the polymer melts and the nanoparticle is increased, resulting in a considerable improvement in the properties of the polymer nanocomposites. Many different types of nanoparticles can be incorporated into the polymer matrix to create polymer nanocomposites. The most commonly utilised nanoparticles include nano clay, carbon nanotubes, nano silica, nano aluminium oxide (Alumina, Al_2O_3), nano titanium dioxide (TiO_2), nano zinc oxide (ZnO), metal nanoparticles, and other nanoparticles. Table2. Gives a brief summary of the different nanoparticles used as fillers or dispersed phase and the improvement in the properties of the PNC reported by different researchers.

Preparation Of Polymer Nanocomposites

The different ways of synthesis of Polymer nanocomposites include melt mixing method, solution mixing method, template synthesis and in-situ method of synthesis. The first two methods that are melt mixing method, solution mixing method, for preparing the polymer nanocomposites from waste plastics are summarised as follows.

Melt Mixing Method

In melt mixing method¹⁵ the polymer is melted first, and the nanofiller is then combined with the polymer melt using a shear extruder. In most cases, it's done in the presence of an inert gas like argon, nitrogen, or neon. It is a safe approach due to the lack of organic solvents, and it has gained popularity due to its compatibility with industrial processes such as extrusion and injection moulding. M. Avella *et al.*[16] prepared a novel biodegradable starch/clay nanocomposite film by homogeneously dispersing montmorillonite nanoparticles in different starch-based materials via polymer melt processing techniques. Structural and mechanical characterizations on the nanocomposite films were performed. The results show, in the case of starch/clay material, a good intercalation of the polymeric phase into clay interlayer galleries, together with an increase of mechanical parameters, such as modulus and tensile strength. Andrić *et al* [17] mixed the virgin PVC and $CaCO_3$ nanoparticles to a waste laminate containing PVC, $CaCO_3$ and PP in the contents of 40, 25, and 10 wt. %, respectively. In conclusion, PVC and also the waste blends and composites can be recycled by nano clay and $CaCO_3$ at different concentrations. Yoo *et al.* [18] used a melt mixing method to make a polymer matrix composite from recycled PVC and found that when 10wt% nano clay was added, the characteristic peak of clay vanished completely. For varying clay loadings of 1, 3, 5, and 10% wt. percent, the nanocomposite's mechanical characteristics improved synchronously. Hemmasi *et al.*¹⁹ studied the influence of nanoclay loading on the water absorption and thickness swelling of rHDPE/wood composite. Shadpour malakpour *et al.* [20] have prepared and characterized nanocomposite materials from incorporation of d-glucose functionalized MWCNTs into the recycled poly(ethylene terephthalate). Junior *et al.*²¹ used melt intercalation to create recycled high-impact polystyrene (PS)/organoclay nanocomposites. In the processing zones, temperatures were from 150 to 190 degrees Celsius. Before mixing, the high-impact PS was milled to improve surface area and facilitate dispersion. And according to reports, the higher mixing speed of 600 rpm yielded nanocomposites with better dispersion. Martin *et al.*²² investigated the nanocomposite of rPMMA with both natural and organically modified silicate layers. The tensile modulus increased with nanoclay content for both nanoclays which introduced nanocomposites with attractive properties by the maintenance of transparency and thermal properties of waste matrix.

Solution Mixing Method

Solution casting is based on a solvent system which relies on evaporating the solvent from the solution [23]. This method involves dissolving of a polymer in a suitable solvent and suspending the nanofiller in the same or another compatible solvent after which high-speed shear mixing, ultrasonication, or stirring is usually employed to mix the filler suspension with the polymer solution followed by the composite film casting



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due to the solvent evaporation. The use of the solvent depends upon the polymer solubility in the solvent. Solvents used in this method include toluene, xylene, tetrahydrofuran (THF) chloroform, dimethyl formamide (DMF), acetone, and cyclohexane etc. Processing of polymer nanocomposites using solution casting technique is one of the most promising and popular method of producing polymer nanocomposites at the laboratory scale. Solution casting technique is based on the Stokes's law [24]. Preparation of polymer nano composites by solution casting method involves the dispersion of nanofiller (particles, fibres or platelets) in a polymer solution by energetic agitation that can be achieved using magnetic stirring, shear mixing, reflux, or the most commonly used method of sonication. The agitation step is then followed by the composite film casting due to the evaporation of the volatile solvent²⁵. Solution casting is a simple, economic method as it doesn't require large experimental setup, excess quantity of chemicals and more energy inputs. This method yields a substantial amount of polymer nanocomposites within a short span of time. This process has an advantage over other methods for preparing polymer nanocomposites because of the low viscosity of the solution, that improves the dispersion of nanoparticles in the matrix phase. The processing parameters like the weight percent of the nanofiller used, volume of the solvent, sonication type, sonication time, solvent type have a significant effect on the dispersion of the nanofiller in the polymer matrix. The correct solvent selection is critical to the process efficiency since it must not only offer complete dissolving of the polymer matrix material but also maintain suitable viscosity to evenly disperse nanoparticles via sonication. The physical properties such as glass transition temperature (T_g) of the composite are also affected if there is an accumulation of residual solvent at the nanofiller-polymer interface.

The water uptake of the Wood polymer composite was reduced by the addition of SiO₂ and nanoclay. Diao She *et al.* [26] made biochar/gutta percha composite films by solution mixing varying amounts of biochar (0, 2, 4, 6, and 8%, w/w) with the gutta percha matrix. The biochar increased the hydrophobicity and mechanical qualities, as well as having a high stretchability, according to the findings. Ari and Aydin²⁷ created poly(vinyl chloride)/CaCO₃ nanocomposite using a solution mixing method and discovered that the mechanical characteristics of the composite improved. Dana and *et al.* [28] made a polypropylene-clay composite with xylene as the solvent and reported improved mechanical characteristics. R. Singh, A. Indolia, and M. S. Gaur [29] used a solution mixing approach to make a polyurethane/polysulfone/multi-walled carbon nanotube polymer nanocomposite.

CONCLUSION

Recycling of waste plastics into polymer nanocomposites with improved characteristics employing a suitable nano material is unquestionably a viable approach of managing plastic waste and producing value-added composite products for specific applications. Depending on the nature of the nanoparticles and thermoplastic polymers, a variety of techniques can be utilised to manufacture polymer nanocomposites from thermoplastic waste. The interfacial contact between the polymer matrix and the nano filler is another key issue to consider when producing polymer nanocomposites. This chapter explains two methods for the manufacture of polymer nanocomposites that are widely employed by researchers.

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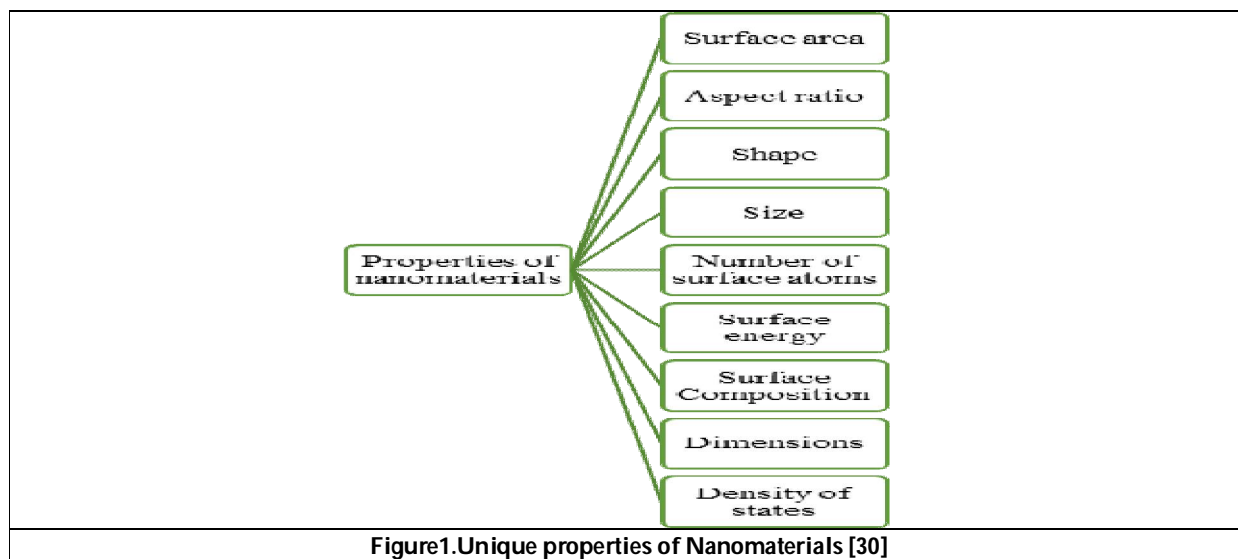
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Table 1. Polymers used in manufacturing of single usage plastic products

Polymer	Product
Polyethylene terephthalate (PET)	Water bottles, dispensing containers, biscuit trays
High—density polyethylene (HDPE)	Shampoo bottles, milk bottles, freezer bags, ice cream containers
Low—density polyethylene (LDPE)	Bags, trays, containers, food packaging film
Polypropylene (PP)	Potato chip bags, microwave dishes, ice cream tubs, bottle caps, single-use face masks
Polystyrene (PS)	Cutlery, plates, cups
Polymethyl methacrylate (PMMA),	glass roofing, façade design, advertising, automotive headlamps, window panels

Table 2. Nano fillers and their contribution in the polymer nanocomposite.

Nanoparticle	Property enhanced	Reference
Nano clay	Mechanical, thermal,	[5 ,6]
Zinc oxide (ZnO)	Photocatalytic and rheological	[7,8]
Silica (SiO ₂)	Thermal and electrical conductivity	[9,10]
Alumina (Al ₂ O ₃)	Mechanical & Thermal	[11]
Carbon nanotubes	Thermal stability and tensile strength	[12]
Calcium carbonate (CaCO ₃)	Hardness and impact strength	[13]
Graphene	Mechanical and electrical	[14]





Economic Evaluation of Drip Irrigation and Mulching on Tuberose Cultivation in Lower Indo-Gangetic Plains Region

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ABSTRACT

Optimal irrigation and proper mulching for water conservation is vital for sustainability of ornamental plant. A field experiment was carried out during 2017-18 to 2019-20 to assess four irrigation regimes (gravity drip at 1.0, 0.8 and 0.6 of pan evaporation and surface irrigation) and three mulch management practice (no, paddy straw and black polythene) on tuberose cv. Calcutta Double grown in sandy loam soil. The results showed that under assured water supply, maximum yield (252080 stick ha⁻¹), gross return (₹ 504160 ha⁻¹), net return (₹ 368877 ha⁻¹) and BCR (2.73) was obtained with drip irrigation at 1.0 E₀ with BPM. In limited water supply, higher yield (249140 stick ha⁻¹), gross return (₹ 498280 ha⁻¹), net return (₹ 363208 ha⁻¹) and BCR (2.69) was observed with moderate deficit drip irrigation at 0.8 E₀ with BPM. Under water scarcity, modest yield (208890 stick ha⁻¹), gross return (₹ 417780 ha⁻¹), net return (₹ 282917 ha⁻¹) and BCR (2.10) was found with higher deficit drip irrigation at 0.6 E₀ with BPM. This study highlights the techno-economic impact of the precise planning and efficient management of available water resources and mulching for the tuberose farmers in choosing the best alternative option.

Keywords: *Polianthes tuberosa*, Irrigation schedule, Stick yield, Water use, Economics

INTRODUCTION

Tuberose (*Polianthes tuberosa* L.) commonly known as Rajnigandha is an important herbaceous ornamental bulbous plant grown mainly in sub-humid tropical and sub-tropical climate. The popularity of this flower plant in the present world is widespread not only for its aesthetic social values, but also for its economic contribution. This night-



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blooming plant is valued much for their beauty and fragrance of the cut flowers as well as loose flowers (Padaganur *et al.*, 2005; Alan *et al.*, 2007)[4, 2]. The flowers possess excellent keeping quality and can withstand long distance transportation. It occupies a prominent place in Indian culture. People usually prefer the scented blooms for making garlands, bouquets and floral ornaments for all their ceremonies like wedding, birthday, religious offerings and various traditional rituals. It has great commercial demand in the domestic and international flower markets due to its potential for cut flower trade and aromatic oil for perfume industry and its production is highly profitable (Vaid *et al.*, 2019)[22]. The major tuberose cultivating states in India are Karnataka, Maharashtra, Assam, Rajasthan, Gujarat, Tamil Nadu, Andhra Pradesh and West Bengal. Total area under tuberose cultivation in the lower Gangetic plains region of West Bengal is 5297 ha with production of 1250.8 million cut flowers and productivity of 2.36 lakh sticks per ha (Anonymous, 2013-14)[3].

The soil moisture availability is an important environmental factor which influences the growth, yield and quality of flowers. The excessive or inadequate water supply during any physiological stages has detrimental effects on growth and flower productivity (Halepyati *et al.*, 1996)[10], whereas frequent irrigation in synchrony with plant demand has increased the growth, flower and bulb yield (Rathore and Singh, 2009)[20]. The judicious management of water is the key to meet the daily water requirement of plant for sustainable production. Under scarce or limited water supply condition, irrigation scheduling is considered a vital component to produce higher water use efficiency under any irrigation system (Panigrahi *et al.*, 2011)[16]. The meteorological based irrigation scheduling approach such as pan evaporation replenishment, cumulative pan evaporation, ratio between irrigation water and cumulative pan evaporation (IW/CPE) and soil moisture depletion have been widely used at the farmer's level. Deficit irrigation is the modern approach of irrigation scheduling which is regarded as one of the solutions to save precarious water resource with minimal compromise of yield (Pereira *et al.*, 2002)[19]. Optimum irrigation schedule and appropriate quantity of water applied at the right time are the deciding factors on increased yield and quality of flowers (EL-Naggar and Byari, 2009; Deshmukh, 2012)[9,7]. Drip irrigation is an advanced water saving technology because it maintains optimum soil water balance to meet the daily requirements of water for plant and renders higher water use efficiency due to the direct application of precise amounts of water in the vicinity of root zone (Brahma *et al.*, 2010; Abd El-Wahed and Ali, 2013)[5, 1]. It is superior to other methods of irrigation because it maintains a uniform distribution of water and nutrients around the rhizosphere and reduces runoff, soil evaporation and deep percolation loss with increased yield (Vijayakumar *et al.*, 2010; Deshmukh and Hardaha, 2014)[23, 6].

Mulching is an important agronomic tool in conserving soil moisture, modifying the physical, chemical and biological environment of soil, improving the nutrient recycling and organic matter build-up, promoting hydrothermal regimes, increasing the yield and water use efficiency of crop (Khurshid *et al.*, 2006; Patel *et al.*, 2014)[13,17]. Different types of materials like wheat straw, rice straw, leaves, husk, crop residue, grass, hyacinth, wood, gravel, sand and synthetic plastic film are used as mulches. Plastic mulches substantially reduce evaporation of water from the soil surface when it is exclusively used in drip irrigation keeping soil moisture at optimum and curtailing the irrigation requirements (Mahajan *et al.*, 2007; Douglas, 2007)[14, 8]. The role of plastic mulch in promoting the vegetative growth, flower and bulb development through their beneficial influence on soil moisture conservation, soil temperature moderation, weed control and reduced disease and pest infestation is proven (Jaikumaran and Nandini, 2001; Pattanaik *et al.*, 2003; Barman *et al.*, 2015)[12, 18, 4].

In the lower Gangetic plains region of West Bengal, tuberose is a promising remunerative ornamental plant and has a high market demand all the year round. It has great potential for gainful man-days creation, more employment opportunity to family labour and provides a regular source of income to the farm family. Although the cost of cultivation of tuberose is more expensive than the major competing crops, however the monetary return is considerably higher than the competing crops. Ironically, the local farmers raise the crop following the conventional furrow method of irrigation, which is quite inefficient and causes substantial loss of water and nutrients in deep percolation resulting in sub-optimal water and nutrient use efficiencies, low yield and inferior flower quality. The problem becomes more acute in sandy loam soils, where deep percolation of water and nutrients is very high. The plant during some parts of their growth cycle also suffers from water scarcity due to erratic and uneven distribution



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of rainfall. Since tuberose cultivation in this region is gaining popularity, but the technical-economical information on the irrigation schedule by drip irrigation system and water conservation aspect of the plant is scanty. Keeping these views in mind, the present study was undertaken to optimize water requirement by gravity drip irrigation system under mulching condition to ensure higher flower production and maximum monetary benefit.

MATERIALS AND METHODS

A field investigation was conducted during the three consecutive growing seasons of 2017-18 to 2019-20 at the Regional Research Station, Gayeshpur, Nadia, Bidhan Chandra Krishi Viswavidyalaya representing the Indo-Gangetic plains region of West Bengal, India. The experimental site is located at a latitude of 22°58'31" N and longitude of 88°26'20" E with an average altitude of 9.75 m above MSL. The climate is sub-humid tropics. The mean monthly temperature was 37.6 to 25.4 °C in summer and 23.7 to 10.5 °C in winter. The mean annual rainfall is 1500 mm and pan evaporation loss varies from 1.1 to 4.9 mm day⁻¹. The soil is sandy loam in texture (Typic Fluvaquept) having bulk density 1.49 Mg m⁻³, organic C 5.6 g kg⁻¹, pH 6.9, EC 0.23 dS m⁻¹ with low in available N (168.7.1 kg ha⁻¹) and medium in available P (35.6 kg ha⁻¹) and available K (151.5 kg ha⁻¹).

The field trial was consisted of twelve treatment combinations with four irrigation regimes (gravity drip irrigation schedule at 0.6, 0.8 and 1.0 of pan evaporation replenishment (E_0) including surface irrigation at 40 mm depth) allotted in the main plots and three mulch level (no-mulch, paddy straw mulch and black polythene mulch) in sub-plots was laid out in a split plot design with three replications. The unsprouted, healthy and disease free medium sized bulb (1.9-2.5 cm diameter and 15.2-16.5 g weight) cv. Calcutta Double were planted on 25 March 2017 at 5 cm depth with spacing of 30 cm row to row and 30 cm plant to plant distance. The unit plot size was 3.0 m × 3.0 m leaving aside 0.5 m bund width and 1.0 m irrigation channel. The number of bulb planted per plot was 100. The bulbs prior to planting were treated with 0.2% Carbendazim for 30 minutes. Well decomposed farmyard manure @15 t ha⁻¹ was uniformly applied and thoroughly mixed up with the soil during final land preparation. All treatments received a common fertilizer dose of 200 kg N, 200 kg P₂O₅ and 150 kg K₂O per hectare in the form of urea, single superphosphate and muriate of potash, respectively. Half dose of N and full doses of P₂O₅ and K₂O were applied as basal at the time of planting. The remaining half dose of N was applied in three equal splits at 30, 60 and 90 days after planting as top dressing. Irrigation was applied as per proposed schedules. For mulching, black polythene film (BPM) of 25 μ thickness having small holes of 60 mm diameter at a distance of 30 cm was spread over the prepared field and bulbs were planted in the holes. Paddy straw mulch (PSM) @ 5 t ha⁻¹ on air-dry weight basis was spread uniformly at 4-5 cm thickness. After harvesting the main crop, the flower stalks were cut off leaving behind 2.0-2.5 cm aerial parts. The field was kept for first and second ratoon crop. The same dose of manure and fertilizers, irrigation and mulch treatments as given in main crop was also provided for ratoon crops. Standard cultural practices and plant protection measures were equally performed in all the treatments for better growth and development of the plants. Five representative plants from the inner rows of each replicated plot were randomly selected and used for recording of stick yield. Final harvesting of main as well as ratoon crop was completed in the third week of February in the succeeding experimental year. Irrigations were applied based on conventional farmers' practice of surface irrigation at 40 mm depth at 25-30 days interval in the dry period whereas gravity drip irrigation was scheduled at 0.6, 0.8 and 1.0 of pan evaporation replenishment (E_0), respectively at 3 days interval. Nine number of irrigation was applied in surface irrigation, while 47 number of irrigation was employed for gravity drip irrigation. The depth of irrigation water applied in surface irrigation and drip irrigation at 1.0, 0.8 and 0.6 of E_0 was 360.0, 256.5, 206.5 and 157.0 mm, respectively.

Benefit-cost ratio (BCR) analysis was carried out to examine the economic feasibility of different irrigation and mulch management treatments. The seasonal cost of gravity drip irrigation system with 4 HP water pump included 4% depreciation, 10% interest rate and 2% for repair and maintenance calculated from the fixed cost. The life span of the gravity drip system was considered to be 10 years. The cost of cultivation accommodated the expenses incurred on field preparation, sowing, intercultural operation, harvesting and processing and cost of seed, mineral fertilizers,



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FYM including application, crop protection measures and irrigation charges. The gross return was worked out by accounting the prevailing average market price of the produce during the experimental period. The net return was estimated by deducting the total cost of cultivation from the gross return. The benefit-cost ratio (BCR) of each treatment was calculated by dividing the net return with the cost of cultivation. The stick yield data of three year obtained were subjected to analysis of variance and the least significant difference (LSD) values were used to compare treatment means at $p < 0.05$.

RESULTS AND DISCUSSION**Stick Yield**

The overall stick yield of tuberose was significantly differed by the interactions between irrigation schedule and mulch material (Table 2). Highest average yield (252080 stick ha⁻¹) was obtained with optimum drip irrigation schedule at 1.0 E₀ complemented with BPM (I₃M₂). This treatment combination was on parity with moderate deficit drip irrigation schedule at 0.8 E₀ with BPM (I₂M₂) and optimum drip irrigation schedule at 1.0 E₀ with PSM (I₃M₁) with corresponding value of 249140 stick ha⁻¹ and 234510 stick ha⁻¹, respectively. Significantly the lowest average yield of 186540 stick ha⁻¹ was found with higher deficit drip irrigation schedule at 0.6 E₀ without mulch (I₁M₀). Conventional surface irrigation in conjunction with and without PSM and BPM displayed moderate yields ranging from 194280 to 223360 stick ha⁻¹. Maximum stick yield with optimum or marginal deficit irrigation regime coupling with BPM was probably due to favourable soil moisture and temperature regimes within the rhizosphere zone and the minor weed infestation which likely help more interception of incoming solar radiation and more absorption of water and nutrients through proliferated roots resulting into increased plant growth and yield (Islam *et al.*, 1990; Tiwari *et al.*, 2003; Rathore and Singh, 2009)^[11, 21, 20]. Water saving is an important criteria where the amount of water saved by adopting controlled drip irrigation system can be utilized for irrigating the uncultivated land for crop production. In this study, the water savings at various levels of drip irrigation with different mulching conditions ranged from 18.96 to 32.24% as compared with surface irrigation and mulch conditions. The effect on water savings was more pronounced at deficit irrigation regimes than at optimum irrigation regime and that too with BPM than with PSM.

Economic Analysis

The detailed total cost of cultivation including cost for irrigation and mulching, gross monetary returns, net monetary returns and BCR under different drip and surface irrigated conditions and mulch management on tuberose is summarized in Tables 1 and 2. The analysis of data showed that cost of cultivation for different treatments consistently increased with increase in irrigation water supply and addition of mulches. The cost of cultivation irrespective of mulching materials was found maximum in surface irrigation at 40 mm depth followed by drip irrigation schedule at 1.0 E₀ and 0.8 E₀, respectively and the least value was observed in drip irrigation schedule at 0.6 E₀. In each irrigation level, the incorporation of BPM followed by PSM substantially increased the cost of production (Table 1). The gross return, net return and BCR increased progressively with the proportionate increase in stick yield due to increase in drip irrigation level supplemented with types of mulching, whereas the corresponding values were moderate in surface irrigation complemented with different mulch conditions. Maximum gross return (₹ 504160 ha⁻¹), net return (₹ 368877 ha⁻¹) and BCR (2.73) were obtained with optimum drip irrigation schedule at 1.0 E₀ coupling with BPM (I₃M₂) which were followed immediately by moderate deficit drip irrigation schedule at 0.8 E₀ with BPM (I₂M₂) with the corresponding value of ₹ 498280 ha⁻¹, ₹ 363208 ha⁻¹ and 2.69, respectively. Relatively moderate gross return (₹ 417780 ha⁻¹), net return (₹ 282917 ha⁻¹) and BCR (2.10) was found with higher deficit drip irrigation schedule at 0.6 E₀ with BPM (I₁M₂). The latter two treatments are likely to be beneficial under limited water supply condition. On the other hand, the surface irrigation in association with BPM (I₄M₂) recorded intermediate values of gross return (₹ 446720 ha⁻¹), net return (₹ 302958 ha⁻¹) and BCR (2.11). The higher monetary returns and BCR in optimal or nearly optimal irrigation level by drip irrigation system provided with BPM was perhaps due to the sustenance of favourable hydrothermal regime in root zone resulting in higher root elongation and proliferation, more absorption of water and nutrients which eventually reflected in higher yield.





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CONCLUSION

Based on the above findings, it can be inferred that under assured water supply condition, maximum yield, highest gross return, net return and BCR was obtained with optimal drip irrigation schedule at 1.0 E_0 coupling with BPM. However, under limited water supply condition moderate deficit drip irrigation schedule at 0.8 E_0 with BPM was the alternative option in deriving higher stick yield, gross return, net return and BCR. Under water scarce situation, moderate yield, gross return, net return and BCR was accomplished with imposition of higher deficit drip irrigation schedule at 0.6 E_0 with BPM. This study attempted to portray the techno-economic impact of the precise planning and efficient management of available water resources and mulching which likely to be helpful for tuberose farmers of the lower Indo-Gangetic plains region in choosing the best alternative option according to their socio-economic strata.

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Table 1: Details of cost calculation for irrigation and mulching for tuberose

Treatment	Depth of water applied (cm)	Total volume of water (L)	Pump operation (h)	Diesel consumption (L)	Cost of irrigation (₹ ha ⁻¹)	Cost of mulching (₹ ha ⁻¹)	System Cost incurred (₹ ha ⁻¹)	Cost for general cultivation (₹ ha ⁻¹)	Total cost of cultivation (₹ ha ⁻¹)
I ₁ M ₀	15.7	1570000	27.62	13.81	663	0	6400	120000	127063
I ₁ M ₁	15.7	1570000	27.62	13.81	663	3500	6400	120000	130563
I ₁ M ₂	15.7	1570000	27.62	13.81	663	7800	6400	120000	134863
I ₂ M ₀	20.65	2065000	36.33	18.16	872	0	6400	120000	127272
I ₂ M ₁	20.65	2065000	36.33	18.16	872	3500	6400	120000	130772
I ₂ M ₂	20.65	2065000	36.33	18.16	872	7800	6400	120000	135072
I ₃ M ₀	25.65	2565000	45.13	22.56	1083	0	6400	120000	127483
I ₃ M ₁	25.65	2565000	45.13	22.56	1083	3500	6400	120000	130983
I ₃ M ₂	25.65	2565000	45.13	22.56	1083	7800	6400	120000	135283
I ₄ M ₀	36	3600000	102.56	51.28	2462	0	3500	130000	135962
I ₄ M ₁	36	3600000	102.56	51.28	2462	3500	3500	130000	139462
I ₄ M ₂	36	3600000	102.56	51.28	2462	7800	3500	130000	143762

I₁ = drip irrigation at 0.6 E₀, I₂ = drip irrigation at 0.8 E₀, I₃ = drip irrigation at 1.0 E₀, I₄ = surface irrigation at 40 mm depth; M₀ = no-mulch, M₁ = paddy straw mulch, M₂ = black polythene mulch; **Rate of diesel consumption 0.5 lph with discharge rate 15 lps; ***Cost of diesel ₹ 48 L⁻¹; Assumed efficiency of surface irrigation 65% and drip irrigation 85%

Table 2: Economics of tuberose cultivation under different drip and surface irrigation regimes and mulching (average data of 3 years)

Treatment	Cost of cultivation (₹ ha ⁻¹)	Yield (Stick ha ⁻¹)	Gross return (₹ ha ⁻¹)	Net return (₹ ha ⁻¹)	Benefit-cost ratio
I ₁ M ₀	127063	186540	373080	246017	1.94
I ₁ M ₁	130563	200600	401200	270637	2.07
I ₁ M ₂	134863	208890	417780	282917	2.10
I ₂ M ₀	127272	216180	432360	305088	2.40
I ₂ M ₁	130772	231590	463180	332408	2.54
I ₂ M ₂	135072	249140	498280	363208	2.69



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I ₃ M ₀	127483	222830	445660	318177	2.50
I ₃ M ₁	130983	234510	469020	338037	2.58
I ₃ M ₂	135283	252080	504160	368877	2.73
I ₄ M ₀	135962	194280	388560	252598	1.86
I ₄ M ₁	139462	207190	414380	274918	1.97
I ₄ M ₂	143762	223360	446720	302958	2.11
CD (0.05)	-	18440	-	-	-

I₁ = drip irrigation at 0.6 E₀, I₂ = drip irrigation at 0.8 E₀, I₃ = drip irrigation at 1.0 E₀, I₄ = surface irrigation at 40 mm depth; M₀ = no-mulch, M₁ = paddy straw mulch, M₂ = black polythene mulch; Cost @ ₹ 2.00 per stick





Bridgeless SEPIC PFC Converter using Soft Switching PWM Technique

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ABSTRACT

The single phase high efficient ac to dc PWM bridgeless SEPIC converter using soft switching PWM technique is being presented here. The proposed converter offers low conduction loss and less input current harmonics because of the absence bridge input diode and also uses two semiconductor switches are available in the current flowing in the path during each of the switching cycle unlike other types of conventional SEPIC converters. The efficiency can be improved of the proposed converter which uses soft switching PWM technique by using the help of auxiliary circuit. The output current can be controlled by using feed forward controller with the converter which improves the efficiency. As the input current harmonics is less so the power factor is almost equal to one. The circuit arrangement, performance, design principle and simulated output results are presented here.

Keywords: SEPIC Converter, Bridgeless, PFC, Soft Switching Technique

INTRODUCTION

Switch mode power converters are extensively used in the power electronics, communication and industrial applications. The converters agonize from switching loss, less efficiency and low EMI with hard switching technique. The converter efficiency can improve by using two methods; first method is by minimizing the energy loss of all component used in the circuit and the second method is by using the soft switching PWM technique [5]. The SEPIC converter is explained here with the help of soft switching technique in [7-9]. In all the papers [7-9] soft switching techniques are explained in number of ways but the conduction loss is more. The input diode bridge rectifier uses in the SEPIC converter is shown in the Figure 1. The components used in the switching cycle are increased which makes conduction loss more and due to which efficiency is less although the construction is very simple and economic in cost. This paper objective is to improve the efficiency so here a bridgeless converter is designed using soft switching technique. The bridgeless converters are popular in design of SMPS.





For the semiconductor elements the soft switching can be achieved without using any additional current stress which can be reduced by increasing the efficiency of the converter and soft switching technique is put in to the proposed converter with the help of auxiliary circuit which can provide resonance. The resonant converter which depends upon the resonant inductor and resonant capacitor can be used for turning on the ZVS and turning off the ZCS. The output voltage is used as control signal to drive the gate of the switch. So that the output voltage can be regulated and efficiency can be improved [1-2]. The efficiency of the different types of switching devices and its analysis made with respect to output power [4]. The improvement of the efficiency is more in IGBT which is used as the switching device. All semiconductor switches are controlled by pulse width modulation and operated by the help of soft switching mode. The converter provides improved efficiency and the switches are operated using soft switching technique and controlled by pulse width modulation (PWM) [2-3].

Circuit Diagram of SEPIC Converter

The SEPIC converter with diode bridge rectifier is shown in the figure 1. The boost converter with bridgeless rectifier and soft switching technique is shown in the figure 2. The proposed circuit diagram of converter is shown in the figure 3. The circuit diagram of consists of two low recovery diodes D_1 to D_4 , one fast recovery diode D_5 , two power semiconductor switches S_1 , S_2 and auxiliary switch S_a , input inductors L_1 and L_2 and output inductor L_3 , capacitors C_1 and C_2 , the output capacitor C_3 .

Principle of Operation

The duty cycle D for the SEPIC Converter is given by the equation

$$D = \frac{V_{out}}{V_{in} + V_{out} + V_D} \quad (3.1)$$

Where D =Duty cycle

V_D = Diode Forward voltage

Considering all the devices are ideal, $V_D=0$, Using equ.2.1 D is calculate as **$D=0.6$**

Inductor Selection

A good rule for determining the inductance is to allow the peak-to-peak ripple current to be approximately 40% of maximum input current at the minimum input voltage [5]

The ripple current flowing in equal value inductor L_1 and L_o is given by

$$\Delta i_L = I_{in} \times 40\% \quad (3.2)$$

$$\Rightarrow \Delta i_L = I_{out} \times \frac{V_{out}}{V_{in_{min}}} \times 40\% = 0.66 A \quad (3.3)$$

$$\text{Now } \Rightarrow L_1 = L_o = \frac{V_{in_{min}}}{\Delta i_L \times f_{sw}} \times D_{max} \quad (3.4)$$

$$\Rightarrow L_1 = L_o = 490 \mu H$$

As L_2 is working in the negative half line period, for the symmetry of the model its value is chosen as **$L_2=L_1=L_o=490\mu H$** .

Power MOSFET Selection

The MOSFET peak current is

$$\Rightarrow I_{Q1(peak)} = I_{L1(peak)} + I_{L_o(peak)} = 5.62 A \quad (3.5)$$

And the rms current is





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$$\Rightarrow I_{Q1_{rms}} = I_{out} \sqrt{\frac{(V_{out} + V_{in_{min}})V_{out}}{V_{in_{min}}^2}} = 2.788 \text{ A} \quad (3.6)$$

The rated drain voltage for the MOSFET must be higher than $V_{in}+V_{out}$. Choosing $R_{DSon}=8m\Omega$ and $Q_{GD}=10nC$, The estimated power loss is

$$P_{Q1} = I_{Q1_{rms}} \times R_{DSon} \times D_{max} \times (V_{in_{min}} + V_{out}) \times I_{Q1_{peak}} \times \frac{Q_{GD} \times f_{sw}}{I_g} \quad (3.7)$$

Where I_g is the gate drive current. Choosing $I_g=0.3A$, $P_{Q1}=0.05922W$

Thus the estimated power loss is **0.05922W**

Coupling capacitor selection (energy transfer capacitor)

The rms current of the C_1 is

$$I_{C1(rms)} = I_{out} \times \sqrt{\frac{V_{out} + V_D}{V_{in_{min}}}} = 2.247 \text{ A}$$

The ripple voltage for the coupling capacitor is given by

$$\Delta V_{C1} = \frac{I_{out} \times D_{max}}{C_1 \times f_{sw}} \quad (3.8)$$

$$C_1 = \frac{I_{out} \times D_{max}}{\Delta V_{C1} \times f_{sw}} = 42 \mu F \quad (3.9)$$

For the symmetry of the model the capacitor C_2 is chosen same as C_1 i.e. **$C_2=C_1=42\mu F$**

Output Capacitor selection

In a SEPIC converter, when the power switch Q_1 is turned on, the inductor is charging and the output current is supplied by the output capacitor. As a result, the output capacitor sees large ripple currents. Thus the selected output capacitor must be capable of handling the maximum RMS current. The RMS current in the output capacitor is:

$$I_{C_{out_{rms}}} = I_{out} \times \sqrt{\frac{V_{out} + V_D}{V_{in_{min}}}} \text{ and } C_{out} \geq \frac{I_{out} \times D_{max}}{V_{ripple} \times 0.5 \times f_{sw}} = 5mF$$

Closed Loop PWM Control Technique

In order to improve the response of the SEPIC converter there are two types of control schemes are available. The current control technique with feed forward is used for the converter operated in continuous conduction mode as per the fig.6

Design Considerations and Design Parameters

The resonant frequency and the value of the R_2 resistance mathematically expresses in equation 5 and equation 6 respectively.

$$f_r = \frac{1}{2\pi\sqrt{LC}} \quad (5.1)$$

$$R_2 = \frac{R_1}{V_0 - V_{ref}} \quad (5.2)$$



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The proposed converter is simulated by using the PSIM software. The converter design specifications shown in the table 1.

SIMULATION RESULT

In order to observe the transient of the switching time in the waveform then select the resonant frequency must be 5 times more than the switching frequency. Fig.7 shows the input voltage and current result. From the result waveform it is clearly seen that both voltage and current are in phase with each other and hence offers unity power factor. The output voltage waveform of the bridgeless SEPIC converter is shown in the Figure 8. To improve the efficiency, the proposed SEPIC converter utilizes the soft switching technique. The comparison of efficiency between hard switching and soft switching is shown in the Figure 9. The voltage waveform of the switch S1 of the proposed SEPIC converter is shown in the Figure 10. The efficiency of the suggested converter is enhanced to 92% by using the auxiliary circuit, resonant elements and control circuits. From the waveform it is clear that common area is not there which makes switching loss less. The switching pulse signal and voltage signal of switch S1 is shown in the Figure 11.

CONCLUSIONS

In this paper by using soft switching technique a high efficient PWM bridgeless SEPIC converter is introduced. The objective of the suggested converter is to provide the efficiency enhancement and the loss minimization which is clearly shown in the simulation results. It is found that the efficiency is nearly 92%. The power factor which is obtained satisfied as per the standard of IEC6100-3-2. The regulated output voltage provides the required response.

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Table 1. Circuit Design Parameter Specifications

Sl. No.	Circuit Design Parameter	Circuit Design Parameter Values
1	Input ac voltage, $V_{ac}(RMS)$	110V _{rms} to 200 V _{rms} @ 60 Hz
2	Output DC Voltage, $V_o(RMS)$	60V
3	Switching Frequency, f_{sw}	100 KHz
4	Output Power, P_o	180W
5	$C_1=C_2$	3.7 μF
6	$L_1=L_2$	490 μH
7	L_3	490 μH
8	C_0	42 μF

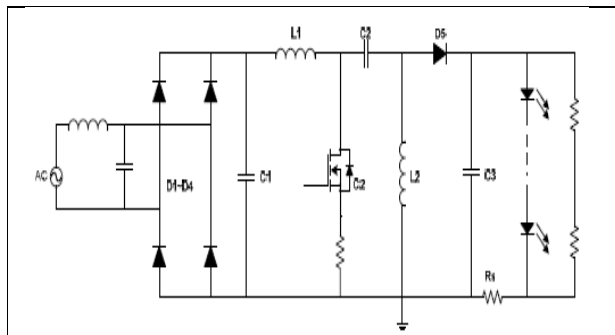


Figure 1. SEPIC Converter with Bridge Rectifier

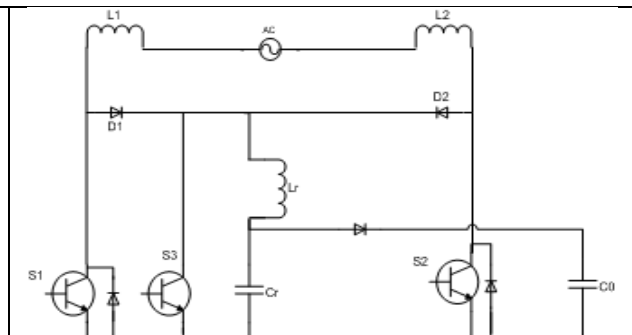


Figure 2. Boost Converter with Bridgeless Rectifier and Soft Switching Technique

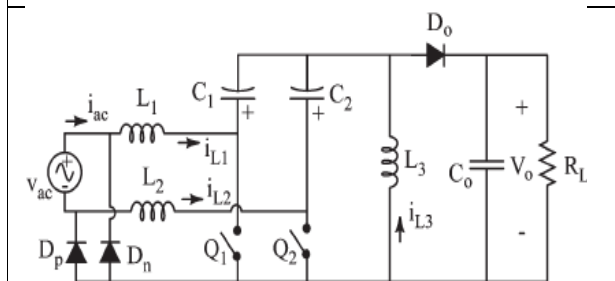


Figure 3. Bridgeless PWM SEPIC Proposed Converter with ZVS

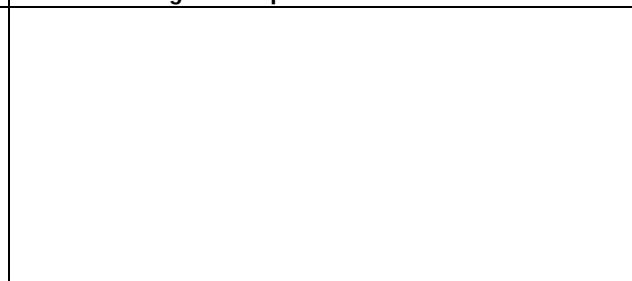


Figure 6. Current loop system with feed forward compensation

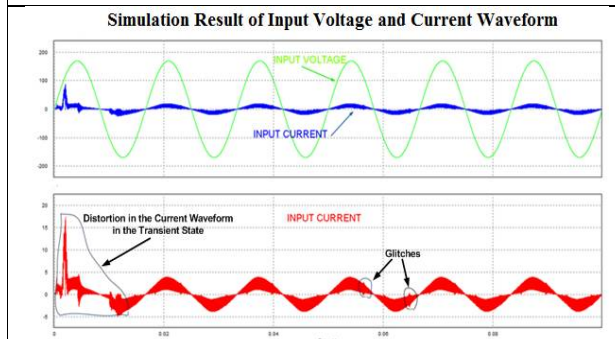


Figure 7. Waveform of Input Voltage and Input Current of Proposed SEPIC Converter

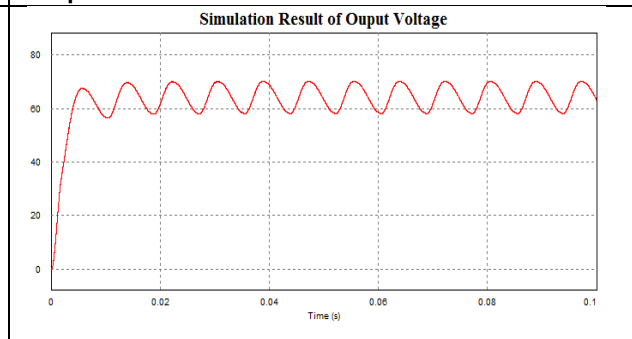


Figure 8. Waveform of Output Voltage of SEPIC Converter





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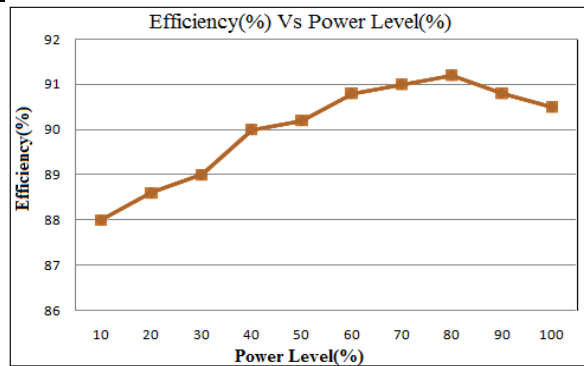


Figure 9. Efficiency Vs Power level

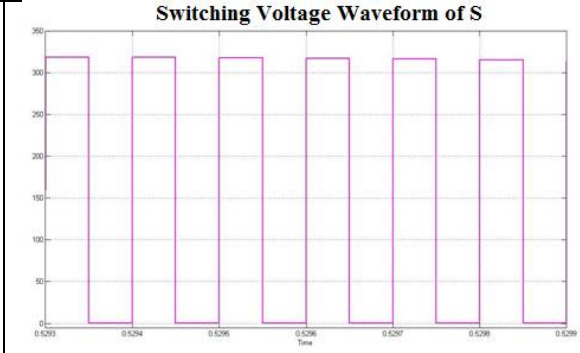


Figure 10. Voltage Signal and Current Signal of Switch S₁ of the Suggested SEPIC Converter

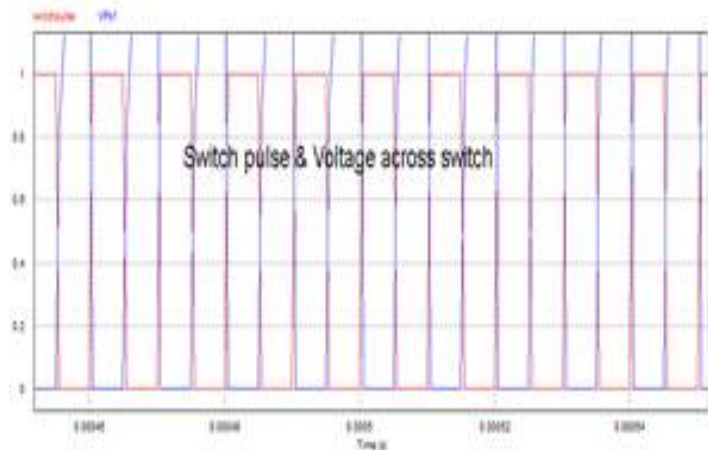


Figure 11. Switch Pulse Signal and Voltage Signal of Switch S₁





Phytochemical Analysis of *Sida cordata* Burm. F.

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ABSTRACT

For thousands of years, plants and herbs have been used as a source of food and medicine. Medicinal plants include a high concentration of phytochemicals, which have great therapeutic qualities. They are often low-cost, effective, and safe to use over time. Therapeutic plants and herbs are extremely important in countries such as India, where Ayurveda originated and is practised in every state. *Sida L.* is an important medicinal herb. *Sida L.* is one of the most diverse genera in the Malvaceae family, and its species are used to treat a wide range of illnesses in many countries throughout the world, with ethnomedicinal use supported by pharmacological assays. *Sida L.* has been used in traditional medicine for millennia in numerous nations to prevent and treat ailments such as diarrhoea, dysentery, gastrointestinal and urinary infections, malarial and other fevers, cardiac and neurological issues, asthma, bronchitis and other respiratory difficulties, and so on. The goal of this research was to investigate the phytonutritional and phytochemical profiles of *S. cordata*.

Keywords: Phytochemical analysis, *Sida cordata*, ethnomedicine, Malvaceae

INTRODUCTION

The importance of many types of plants cannot be emphasised. Plants have been used in a variety of approaches since time immemorial. Numerous pharmaceutical companies that create a wide range of allopathic medicines appreciate a number of established nutritional/medicinal quality plants due to their phytochemical qualities. As a result, individuals and the majority of corporations producing the majority of synthetic pharmaceuticals are increasingly considering natural drugs. Increased study on medicinal plants will undoubtedly pave the way for the identification of innovative therapeutic agents against a wide range of diseases that threaten human





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survival.(Perumalsamy *et al.*, 2019). Surprisingly, the WHO has acknowledged the importance of traditional medicine in the health-care sector, stating that nearly 80% of the population in underdeveloped nations rely on herbal remedies for their main health-care requirements. (Negash *et al.*, 2017). Many tropical plants have yet to be harnessed; understanding their Phyto-profile will aid in attracting many more individuals to their usefulness as a result of their bioactive compounds. Phytochemicals, also known as bioactive compounds are the most prevalent molecules discovered in medicinal plants and are responsible for a wide range of physiological functions.(Ekpo and Etim, 2009).These phytochemicals can be found in a variety of forms, such as alkaloids, steroids, tannins, glycosides, volatile oils, phenols and flavonoids, bioflavonoid, benzophenones, xanthenes, saponins, cyanates, oxalate, and anthrax-quinones, and are found in non-specifically confined parts of plants such as leaves, flowers, bark, seeds, fruits, or roots (Perumalsamy *et al.*, 2019). All of these active chemicals are used in phototherapy to treat or prevent a range of disorders. Because of biological active chemicals found in various parts of the plant, medicinal plants are thought to have therapeutic capabilities.

The genus *Sida L.* is one of the most diverse in the Malvaceae family, with over 200 species found worldwide (Brandao *et al.*, 2017). The presence of two different physical traits distinguishes *Sida* from other Malvaceae genera: I) a calyx with 10 veins and II) schizocarp fruits with 5-10 one-seed mericarps(Fryxell, 1997; Brandao *et al.*, 2017). This genus' plants are ubiquitous weeds in tropical and subtropical grasslands and wastelands all over the world.

S. cordata is a shade-loving trailing roadside plant. It thrives in woods clearings and as weeds in overgrown grass in gardens and public parks in Pakistan, India, and other tropical countries (Lutterodt, 1988). Farid buti, Rajbala, Bhumibala, and Shaktibala are some of the Indian names for it (Dash,1991). In the codified Indian medicinal systems of Siddha and Ayurveda, it is commonly used for therapeutic purposes. It is recommended for cystitis, colic gonorrhoea, tenseness, and piles because its roots are diuretic, astringent, stomachic, febrifuge, and demulcent, while its seeds are laxative, aphrodisiac, and demulcent. It has the ability to energise and enliven the body (Shinwari& Khan, 2000).The plant can reach a height of 30-80 cm. *Sida cordata* has relatively little literature study as compared to other *Sida*genus species such as *Sida cordifolia*, but have a lot of therapeutic potential (Pawa RS *et al.*, 2011).



Kingdom:	Plantae
Order:	Malvales
Family:	Malvaceae
Genus:	<i>Sida</i>
Species:	<i>S. cordata</i>

MATERIAL AND METHODS

Collection Of Plant Material

S. cordata was collected from local areas of Bhubaneswar city, Odisha in the month of April 2022.

Selection of plants

S. cordata was selected to examine the presence of antimicrobial activity in the plant.

Preparation of the plant material

Distilled water was used to wash the fresh plant pieces. The leaves, stems, and roots of *S. acuta* were then cut into pieces with a knife and oven-dried for 12 hours at 70°C to remove all moisture. The samples were pounded in a



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mortar using a pestle and then powdered in a blender. The powder was then placed in an airtight container and stored in a cool, dark, and dry location before unit analysis began.

Aqueous extract

A total of 5g of dried *Sida cordata* leaf was ground. A mixture of leaf powder and water was placed in a 250ml sterile tube and incubated in a shaking incubator for 24 hours. The extract was filtered using Whatman no. 1 filter paper. For future testing, the plant extract was maintained in a refrigerator at 4 degrees Celsius.

Ethanol extract

To prepare the plant's ethanol extract, powdered sample of the leaf was steeped in 100ml of ethanol. Before use, the entire setup was left at room temperature for 72 hours. The solution was filtered using Whatman filter paper. The extract was then concentrated. The solvent was allowed to evaporate using a rotary evaporator. The concentrated extract was refrigerated in an airtight container. Refrigerate at 20°C until required for analysis.

Petroleum ether

To prepare the plant's petroleum ether extract, powdered sample of leaf was soaked in 100ml of petroleum ether. Whatman filter paper was used to filter the extract. The extract was then transferred to a sterile sealed bottle.

Methanol extract

To prepare the plant's petroleum ether extract, powdered sample of leaf was soaked in 100ml of petroleum ether. Whatman filter paper was used to filter the extract. The extract was then transferred to a sterile sealed bottle.

RESULTS AND DISCUSSION**Test for carbohydrate****Benedict's test:**

To 0.5ml of plant extract, 5ml of Benedict's solution was added and then boiled in water bath.

Result- The Yellow or Red or Green color of precipitate confirmed the presence of carbohydrate.

Test for Tannins

2gm of Ferric chloride was added with 5ml of aqueous plant extract.

Result- Brown water shows the presence of tannins.

Test for saponin

0.5ml of distilled water was mixed with aqueous crude extract in a test tube and it was mixed with vigorously.

Result- The presence of saponin was confirmed by the appearance of foam.

Test for flavonoids**Shinoda test**

In aqueous crude plant extract, pieces of Mg ribbon and concentrated HCl were added and then mixed

Result- Pink colour of the solution confirms the presence of flavonoid.

Alkaline reagent test

In aqueous plant crude extract, 2ml of 20% NaOH mixture was mixed and then added with dilute acid to the mixture.

Result- conc. Yellow colour was produced which become colourless which shows the presence of flavonoid.

Test for alkaloid

2ml of dil. HCl was mixed with aqueous plant extract, then added 1ml of Mayer reagent and mixed vigorously.

Result – Foam shows the presence of alkaloid.



**Payal Priyadarshini et al****Test for presence of Terpenoids**

To 5ml of aqueous extract, 2ml of chloroform was added and then evaporated with the help of water bath and then boiled with 3ml of concentrated. H₂SO₄.

Result- the presence of terpenoids was affirmative to formation of Grey color.

Test for Glycosides**Libermann's test**

2ml of chloroform along with 2.0 ml of acetic acid was mixed with whole aqueous plant crude extract. The mixture was then left to cool down. Then conc. H₂SO₄ was added to it.

Result- Green colour appeared which shows the presence of glycoside.

Salkowski's test

2ml of conc. H₂SO₄ added to whole aqueous plant crude extract.

Result- Reddish brown colour shows the presence of glycosides.

Test for presence of Steroids

Concentrated H₂SO₄ along with 2ml of Chloroform were added to the 5ml aqueous plant crude extract.

Result- Red colour shows the presence of steroid.

CONCLUSION

The components of *Sida cordata* are high in bioactive compounds, which provide numerous health benefits. Alkaloids were found in the highest concentrations in the leaf, which is thought to be the principal active component, with others detected in lower concentrations. The therapeutic characteristics of plants are governed by their chemical components, which cause distinct pharmacological activities in human and animal bodies. As a result, the leaf of this plant could be regarded a high alkaloid source. Finally, given the alkaloid content of this plant's leaf, it has the potential to be employed as an analgesic. The presence of numerous bioactive compounds validates traditional Indian medicine practitioners' use of the entire plant to treat a variety of ailments. Some of the found bioactive secondary metabolites have the potential to become commercially important phytopharmaceuticals. More research is needed, however, to determine their biological and pharmacological activity. The above research contributes to Sustainable developmental goals (SDG 3) ensuring health benefits to all.

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Table1 summarises the outcome of phytochemical analysis of *Sida cordata*:

Name of the test	Petroleum ether	Ethanol	Methanol	Aq. solution
Test for presence of carbohydrate	Negative (-)	Positive (+)	Positive (+)	Positive (+)
Test for presence of Tannin	Negative (-)	Positive (+)	Positive (+)	Positive (+)
Test for presence of Saponin	Negative (-)	Negative (-)	Negative (-)	Positive (+)
Test for presence of Flavonoid	Positive (+)	Negative (-)	Negative (-)	Positive (+)
Test for presence of Flavonoid	Positive (+)	Negative (-)	Negative (-)	Positive (+)
Test for presence of Alkaloid	Positive (+)	Positive (+)	Positive (+)	Positive (+)
Test for presence of Terpenoids	Negative (-)	Positive (+)	Positive (+)	Positive (+)
Test for presence of Glycosides	Negative (-)	Positive (+)	Negative (-)	Positive (+)
Test for presence of Glycosides	Negative (-)	Positive (+)	Negative (-)	Positive (+)
Test for presence of steroids	Negative (-)	Positive (+)	Positive (+)	Negative (-)





Effect of Mass Flow Rate on Heat Transfer in a Double Pipe Heat Exchanger

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ABSTRACT

Double pipe heat exchangers are widely used in heat transfer applications in many industries including power sector, automobile, food processing and other process industries due to their simplicity in construction and heat transfer performance. Many researchers have investigated to improve the performance of double pipe heat exchanger by simulation using computational fluid dynamics. However, the operating parameters like mass flow rate need to be investigated in detail for optimizing efficiency of heat exchanger. In the current work, the simulation of double pipe heat exchanger is carried out and the effect of mass flow rate on inlet and outlet temperatures of fluids is studied to maximise heat transfer.

Keywords: Double pipe, Heat exchanger, Temperature, Heat transfer

INTRODUCTION

Energy loss is a major concern in twenty first century due to increased industrialisation and rapid globalisation. Therefore, several energy recovery devices are used in industries for various heat recovery applications in order to meet the present energy demand. Heat exchanger is one of the major energy recovery devices that are used in the industry where energy transfer is essential between two or more fluids at different temperatures [1]. They are used in large number of industrial applications such as power generation, refrigeration, chemical industries, food industries and process industries in both heating and cooling processes [2-4]. There are different types of heat exchangers used depending upon the specific applications for which they are meant for. They are broadly divided into two types, direct contact type where the two fluids are directly contact with each other and indirectly contact type where fluids are separated from each other by wall. Direct contact type heat exchangers are used where the mixing of fluids is desirable [5]. But most of the practical purposes in industry, indirect contact type heat exchangers are extensively used where the heat is exchanged through the separating wall. Double pipe or concentric tube heat exchanger is one of the important indirect contact heat exchanger. It falls in the category of recuperative type heat exchanger. The wide applications of double pipe heat exchanger are due to their compactness, better performance and ease of maintenance [6-7]. In double pipe heat exchanger, the two pipes are placed concentrically to pass the fluids that are

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at two different temperatures. Heat is transmitted through the wall separating the hot and cold fluids. As the fluid passes through the pipes of heat exchanger, there is a continuous change in temperature of fluid and pipe wall of heat exchangers. Therefore temperature distribution in double pipe heat exchangers is crucial that can predict the performance of heat exchanger. Most of the research work on double pipe heat exchanger is based on improving the performance of heat exchanger [8]. Onyiriuka et al. [9] carried out heat transfer investigation in double pipe heat exchanger using nano fluid. Targui and Kahalerras [10] investigated heat transfer and fluid flow in a double pipe heat exchanger with porous material. In the present work, the simulation of double pipe heat exchanger is carried out using Simulia software in computational fluid dynamics (CFD) environment and the effect of mass flow rate on heat transfer is studied. The study shows that heat transfer is enhanced at higher mass flow rate of fluids.

Mathematical Modelling

The mathematical modelling is based on conservation equations of mass, momentum and energy which are as follows:

$$\frac{\partial \rho}{\partial t} + \nabla \cdot (\rho u) = 0, \dots \dots \dots \text{Conservation of Mass (1)}$$

$$\frac{du}{dt} + (u \cdot \nabla)u = -\frac{1}{\rho} \nabla p + F + \frac{\mu}{\rho} \nabla^2 u, \dots \dots \dots \text{Conservation of Momentum (2)}$$

$$\rho \left(\frac{d\varepsilon}{dt} + u \cdot \nabla \varepsilon \right) - \nabla \cdot (K_H \nabla T) + p \nabla \cdot u = 0, \dots \dots \dots \text{Conservation of Energy (3)}$$

The above conservation equations are discretised using Simulia software in CFD and results are obtained in the form of temperatures at the outlet of double pipe heat exchanger.

RESULTS AND DISCUSSION

The temperature distribution of cold and hot fluid at the inlet and outlet of double pipe heat exchanger is shown in Fig.1. The cold fluid is allowed to flow in the inner pipe whereas the hot fluid is made to flow at the outer. As the fluid is allowed to flow inside the double pipe heat exchanger in counter flow direction, the heat transfer occurs along the length of heat exchanger through the pipe wall separating the two fluids. As a result of heat exchange, the hot fluid losses heat and cold fluid gains heat. From the simulation result of fluids at the outlet of double pipe heat exchanger, it is apparent that the hot fluid temperature is reducing and cold fluid temperature is increasing as a result of heat exchange. The effect of mass flow rate of hot and cold fluid is shown in Fig.2-3. The outlet temperature of hot fluid reduces with increase in mass flow rate. Similarly the outlet temperature of cold fluid enhances with increase in mass flow rate of cold fluid. The increase in cold fluid temperature or the decrease in hot fluid temperature with rise in mass flow rate indicates there is better heat transfer at higher mass flow rate of fluids. The effect of mass flow rate on temperature difference between outlet and inlet temperature of fluid is displayed in Fig.4. The temperature difference increases with increase in mass flow rate which also justifies the higher heat transfer at higher mass flow rate of fluids. When the mass flow rate of fluid increases, it results an increase in velocity of fluid. Therefore, the heat exchange between hot and cold fluid is enhanced which causes an increase in temperature difference.

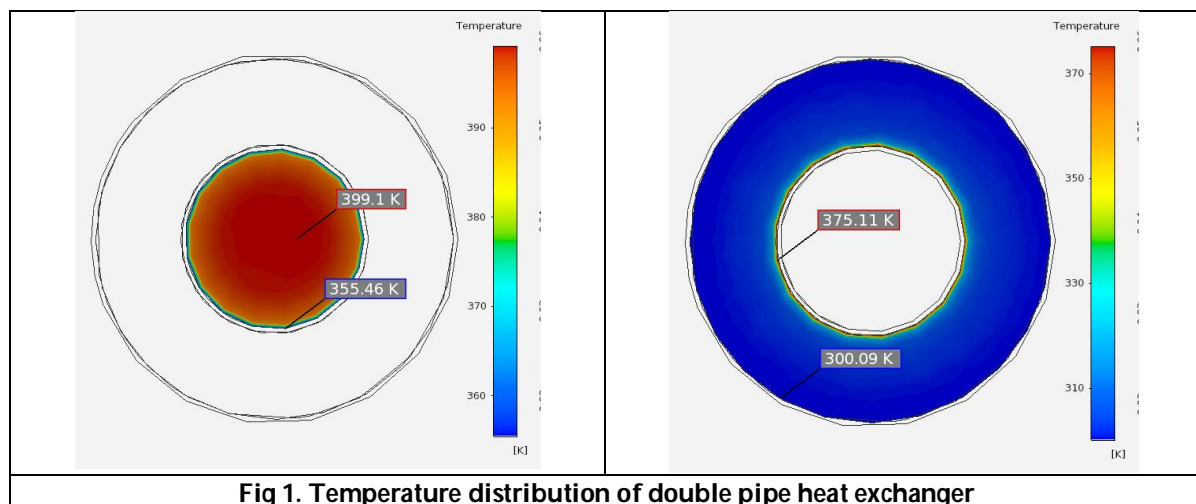
CONCLUSION

Double pipe heat exchangers are used in large number of process industries for heat transfer applications. In the present work, the simulation of double pipe heat exchanger is carried out using Simulia software in CFD. The flow is made in counter flow direction with same mass flow rate of both fluids. It is noticed that the increase in mass flow rate results an increase in outlet temperature of cold fluid and decrease in outlet temperature of hot fluid which indicates higher heat exchange. However, the effect of mass flow rate on pressure is not studied and can be carried out as an extension to the present research.



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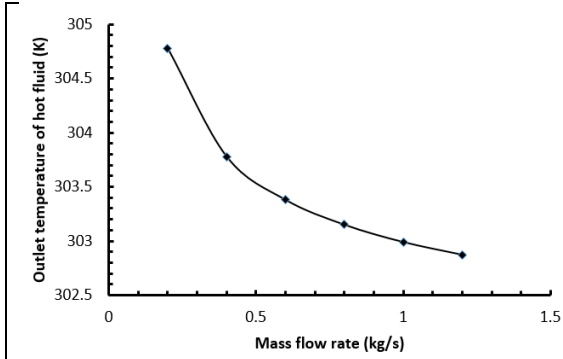


Fig 2. Effect of mass flow rate on hot fluid outlet temperature

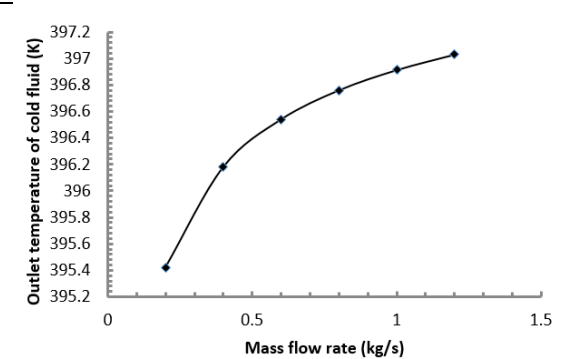


Fig 3. Effect of mass flow rate on cold fluid outlet temperature

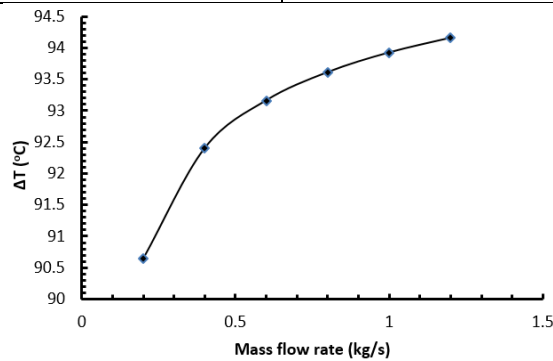


Fig 4. Effect of mass flow rate on temperature difference





Phytochemical Analysis of *Sida acuta* Burm. F

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ABSTRACT

Plants and herbs have been used as a source of food and medicine for thousands of years. Medicinal plants are high in phytochemicals, which have powerful therapeutic properties. They are generally inexpensive, effective, and safe for long-term usage. The importance of therapeutic plants and herbs is quite great in nations such as India, where Ayurveda originated and is practised in every state. *Sida L.* is a vital medicinal herb. *Sida L.* is one of the most varied genera in the Malvaceae family, and its members are used to cure a variety of ailments in numerous nations across the world, with ethnomedicinal use validated by pharmacological assays. For centuries, *Sida L.* has been used in traditional medicines in various countries for the prevention and treatment of various diseases such as diarrhoea, dysentery, gastrointestinal and urinary infections, malarial and other fevers, cardiac and neural problems, asthma, bronchitis and other respiratory problems and so on. The purpose of this study was to look into phytonutritional, and phytochemical profiles of *Sida acuta*.

Keywords: Phytochemical analysis, *Sida acuta*, Malvaceae

INTRODUCTION

The significance of diverse sorts of plants cannot be overstated. Plants have played an essential role in many techniques since time immemorial. As a result of their phytochemical properties, numerous pharmaceutical businesses that manufacture a wide range of allopathic medicines value a variety of plants of established nutritional/medicinal quality. This has resulted in an increase in the consideration of natural drugs by individuals and the majority of firms generating most synthetic drugs. Increased research on medicinal plants will almost certainly pave the way for the discovery of novel therapeutic agents for a wide range of diseases that threaten human





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survival(Perumalsamy *et al.*, 2019). Unsurprisingly, the WHO has acknowledged the importance of traditional medicine in the health-care sector, estimating that almost 80% of the population in underdeveloped nations uses herbal medicines for their basic health-care requirements (Negash *et al.*, 2017). Many tropical plants have not been harnessed; knowing their phyto-profile will help to draw many individuals to their usefulness due to their phyto-properties. Phytochemicals, also known as active principles or phytochemical substances, are the most abundant compounds in many therapeutic plants and are responsible for a wide range of physiological effects.(Ekpo and Etim, 2009). These phytochemicals can be found in a variety of forms, including alkaloids, steroids, tannins, glycosides, volatile oils, phenols, and flavonoids, bioflavonoid, benzophenones, xanthenes, saponins, cyanates, oxalate, and anthrax-quinones, which are found in non-specifically confined parts of plants such as leaves, flowers, bark, seeds, fruits, or roots(Perumalsamy *et al.*, 2019). All of these active substances are utilised in phototherapy and aid in the control or prevention of a variety of ailments. Medicinal plants are believed to have medicinal properties due to biological active compounds found in various areas of the plant. With over 200 species scattered worldwide, the genus *Sida L.* is one of the most varied in the Malvaceae family (Brandao *et al.*, 2017). *Sida* is distinguishable from other Malvaceae genera by the presence of two distinct morphological features: I) a calyx with 10 veins and II) schizocarp fruits with 5-10 one-seed mericarps (Fryxell, 1997; Brandao *et al.*, 2017). Plants of this genus are common weeds in tropical and subtropical pastures and wastelands around the world.

Broom weed (*Sida acuta*) is a medicinal plant that grows in abundance in the tropics. Drought-tolerant tropical weeds can be found almost anywhere. *Sida acuta* is a perennial shrub with a woody tap base, hairy branched up to 1m high, and seeds that grows upright and branches. When young, the stem is fibrous and hairy, and it is woody, rounded, and slender. The leaves are simple and alternate, and the inflorescence is axillary and solitary, with stalks up to 1.3 cm long that are linked halfway down. The flowers are yellow with five petals, and the fruit is capsuled with five to six carpels. (Ekpo and Etim, 2009). *Sida acuta* has been used for a variety of purposes, including neurological diseases, headaches, leucorrhoea, TB, diabetes, malarial and other fevers, uterine disorders, rheumatic problems, renal inflammation, asthma, ulcers, childbirth, and worms, among others (Wake, 2011; Coee and Anderson, 1996a).



Kingdom:	Plantae
Order:	Malvales
Family:	Malvaceae
Genus:	<i>Sida</i>
Species:	<i>S. acuta</i>

MATERIAL AND METHODS

Collection Of Plant Material

Matured *S. acuta* was collected from Centurion University, Bhubaneswar in the month of March 2022.

Selection Of Plants

The plant *S. acuta* was selected to examine the presence of antimicrobial activity in the plant.





Subhasmita Mallik et al.

Preparation Of The Plant Material

Distilled water was used to wash the fresh plant pieces. The leaves, stems, and roots of *S. acuta* were then cut into pieces with a knife and oven-dried for 12 hours at 70°C to remove all moisture. The samples were pounded in a mortar using a pestle and then powdered in a blender. The powder was then placed in an airtight container and stored in a cool, dark, and dry location before unit analysis began.

Aqueous Extract

A total of 5g of dried *Sida acuta* leaf was ground. A mixture of leaf powder and water was placed in a 250ml sterile tube and incubated in a shaking incubator for 24 hours. The extract was filtered using Whatman no. 1 filter paper. For future testing, the plant extract was maintained in a refrigerator at 4 degrees Celsius.

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Petroleum Ether

To prepare the plant's petroleum ether extract, powdered sample of leaf was soaked in 100ml of petroleum ether. Whatman filter paper was used to filter the extract. The extract was then transferred to a sterile sealed bottle.

Methanol Extract

To prepare the plant's petroleum ether extract, powdered sample of leaf was soaked in 100ml of petroleum ether. Whatman filter paper was used to filter the extract. The extract was then transferred to a sterile sealed bottle.

RESULTS AND DISCUSSION

Test For Carbohydrate

Benedict's test:

A water bath was used to boil 5ml of Benedict's solution and 0.5ml of plant extract.

Result- Carbohydrate is detected by the presence of a yellow, red, or green precipitate.

Test for Saponin

In a test tube, 0.5ml of distilled water was combined with aqueous crude extract and vigorously stirred.

Result- Saponin was detected by the development of foam.

Test for flavonoids

Shinoda test:

Aqueous crude plant extract was combined with Magnesium ribbon and conc. HCl.

Result- Flavonoid presence is shown by the pink colour.

Alkaline reagent test

2 mL of a 20% NaOH solution was mixed with aqueous plant crude extract, then dilute acid was added to the mixture.

Result- conc. Yellow colour was produced which become colourless which shows the presence of flavonoid.

Test for Glycosides



**Subhasmita Mallik et al.****Libermann's test:-**

With aqueous plant crude extract, 2.0 mL acetic acid and 2 mL chloroform was added and after cooling the mixture, conc. H₂SO₄ was added.

Result-The presence of Glycosides was confirmed by green color.

Salkowski's test

2 mL concentrated H₂SO₄ was added to the total aqueous plant crude extract.

Result- The presence of glycosides was confirmed by appearance of Reddish brown colour

Test for Terpenoids

To 5ml of aqueous plant extract, 2.0ml of chloroform was added and then evaporated on the water bath followed by boiling with 3ml of conc. H₂SO₄.

Result- Gray colour formed which shows the presence of terpenoids.

Test for Steroids

2ml of Chloroform and conc. H₂SO₄ were added with the 5ml aqueous plant crude extract.

Result- Red colour shows the presence of steroid.

CONCLUSION

The components of *Sida acuta* are rich in bioactive chemicals that offer great health advantages. Alkaloids were found in the highest concentrations in the leaf, which is assumed to be the main active component, with others detected to a lesser amount. Plants' medicinal properties are determined by their chemical components, which produce unique pharmacological activities in the human and animal bodies. As a result, the leaf of this plant could be considered a rich source of alkaloid. In conclusion, given the level of alkaloid in this plant's leaf, it has the potential to be used as an analgesic. The presence of many bioactive chemicals justifies the use of the entire plant for treating various diseases by practitioners of traditional Indian medicine. Some of the bioactive secondary metabolites discovered could become commercially important phytopharmaceuticals. However, more research is required to determine their biological and pharmacological action. These phytopharmaceuticals will play an important role in ensuring human health. The above research contributes to sustainable developmental goals (SDG 3) which aims at ensuring healthy life. However, more research is required to determine their biological and pharmacological action.

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**Subhasmita Mallik et al.****Table 1. Summarizes the results of phytochemical analysis of *Sida acuta*:**

Name of phytochemical analysis	Petroleum ether	Ethanol	Methanol	Aqueous solution
Test for presence of carbohydrate	Negative (-)	Positive (+)	Positive (+)	Positive (+)
Test for presence of Saponin	Negative (-)	Negative (-)	Negative (-)	Positive (+)
Test for presence of Flavonoids	Negative (-)	Negative (-)	Negative (-)	Positive (+)
Test for presence of Flavonoids	Negative (-)	Negative (-)	Negative (-)	Positive (+)
Test for presence of Glycosides	Positive (+)	Positive (+)	Positive (+)	Negative (-)
Test for presence of Glycosides	Negative (-)	Negative (-)	Positive (+)	Negative (-)
Test for presence of Terpenoids	Negative (-)	Positive (+)	Positive (+)	Negative (-)
Test for presence of Steroids	Negative (-)	Positive (+)	Positive (+)	Negative (-)





Digital Tools, Pedagogies and Competencies in Higher Education

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ABSTRACT

Digital learning is not about the use of digital technologies, but about approaching these tools from a pedagogical perspective. So, it's not just about using digital tools in a meaningful way, it's about the selection of right tools and impact in the teaching and learning process. This shift from the traditional to digital requires a shift in the culture of the teaching-learning environment. The uncertainty of the situation has led to a new normal. It has become quite evident that the hybrid model of education in the ELT field is slowly emerging and gaining significance. With the selection of the appropriate online tools, English language classes can become very engaging and meaningful. The way technology is being used to teach and learn is giving rise to a new pedagogy. There is a need for digital flexibility and also a demand for the various digital tools. The endeavour is to help the faculty achieve SDG 4 to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

Keywords: Digital, ELT, Learning, Education, Pedagogy.

INTRODUCTION

In March 2020, at the height of the Covid pandemic, around 50 lakhs of students all over the world were engaged in remote learning (UNESCO, 2020). There were many who had a device in the form of a smartphone, tablet, laptop, desktop and were fortunate to access learning. New approaches of teaching, alternative methods to face-to-face teaching were undertaken by the challenged teachers to keep the learning on the move for the students. Faculty and students started realising that this mode of teaching and learning is going to be there for some time and even post-Covid, hybrid classrooms are to stay. The faculty is learning to explore the new pedagogy of online teaching and trying to find out how the learning can become more engaging so that an outstanding learning experience is produced. The attempts of the teachers to replicate face-to-face classes online failed because synchronous classes are not possible for all with challenges of device availability, bandwidth access and understanding capability of the students. The teachers realised the inefficiency of this replication. Adaptation of a technology that can be functional

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and meaningful to the communities is the need of the time while at the same time not missing out what's on the real (Prajna, & Anubha, 2020).

This situation was also brought to the forefront and the glare of all that knowledge is endless as there is no dearth of information on the internet. There has been a need to understand how to find, analyse, evaluate and apply the knowledge so that it becomes easy to manage. This application of knowledge should meet the demands of the 21st-Century society, where active learning cultivates skills like critical thinking, creative thinking, decision making, collaboration and communication. These are today's survival skills - not only for career success, but for personal and civic quality of life as well (Partnership for 21st-Century Skills, 2010). An environment needs to be created so that students get ample opportunities to develop, exercise, apply and assess these skills. Thus, students learn to manage their learning and become life-long learners. The world is developing rapidly with the given unprecedented situation and hence it becomes imperative for the teachers and the students to be learning skills by learning by doing which will help them in sustaining themselves in the future.

The figure 1 demonstrates how the demands for skills have changed over the years (World Economic Forum Report, 2020). Experiential learning or learning by doing is an active learning method that gives the scope of reflection on doing, focusing on the learning process rather than the transitive process of learning and teaching. The learning pyramid in Figure 2 has shown how important it is to give experiential learning to the students. The 21st century skills become relevant and are integrated easily in the process of learning by doing. What better way to consolidate one's learning?

Researchers have found out that active learning or experiential learning or learning by doing is recalled better and the students enjoy and understand it better. During learning by doing neural connections are made physically in the brain which is known as learning. This method gives the learner as well as the teacher opportunities to give feedback to know the gaps through reflecting on one's teaching/learning, develops thinking skills such as analysis, problem-solving and evaluation. It helps the learners to use their learning in realistic ways and find its use and relevance (Zhang & Hua, 2012).

Today's students grow up realising the significance and the role played by informational and technological literacy skills giving rise to the importance of blended learning which is and will become the new normal. The increased emphasis is on applying knowledge to meet the demands of 21st-century society, using skills such as critical thinking, independent learning, the use of relevant information technology, software, and data within a discipline, and entrepreneurialism. The development of such skills requires active learning in rich and complex environments, with plenty of opportunities to develop, apply, assess and practice such skills. This means educating students with the skills to manage their learning throughout life, so they can continue to learn after graduation. Life-long learning, especially given expectations about rapid developments impacting the future of work, is now an imperative of governments around the world committing to developing a skilled workforce. With the pandemic likely to induce a global recession, demonstrable and certifiable skills will become key to securing and retaining work.

Frequent socio-economic changes and new global trends indicate that a new and broader perception is needed to bridge gaps in education and learning that result from this dynamic upheaval. Students must be educated within the education system to become the citizens of tomorrow to cope with the challenges of the information era. At the same time the training process for student-teachers must prepare them to be the teachers of tomorrow since they also suffer from these gaps. In general, technology advances at a much faster pace than pedagogy adopts the new technologies and it seems that the reality of the field of education still lags behind (Mishra & Koehler, 2006). The 21st century presents a multi-faceted reality and embodies many trends; it is characterized by globalisation, rapid technological development, dynamism and significant, widespread socio-economic processes. Current reviews, conducted by the Center for Educational Technology (2010) indicate that the younger generation is now exposed to intense changes, far more than in the past. Routine knowledge will not prepare young people for life in the 21st





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century. Thus, innovation and creativity, teamwork and collaboration must be central components in learning programs". In other words, a "new pedagogy" is needed.

OBJECTIVES

The main objective of the capacity-building programme was to help the English faculty understand the value of digital tools, and acquire the digital and pedagogical competencies needed in higher education. The study also aims to reflect on the impact of the capacity-building programme 'Google Workspace for Higher Education' organised in a state private university in Odisha, India. The endeavour is to help the faculty achieve SDG 4 to ensure quality education

METHODOLOGY

A capacity-building workshop was conducted for the teachers of higher education. The sample of the study consists of eighty teachers of English from the various universities in Odisha. Data was collected from the feedforward forms, discussions, chats and performance sheets. Qualitative and quantitative analysis was done to study the impact of the capacity-building programme.

DIGITAL TOOLS FOR HIGHER EDUCATION

Google Classroom

Google classroom is an easy-to-use free web service that makes teaching-learning creative and simplifies the sharing of information and evaluating assignments. It has a deck of G-Suites attached to it which allows the users to use Google Docs, Sheets, Slides, Sites, Earth, Calendar, and Gmail, and can be supplemented by Google Hangouts or Meet for face-to-face live teaching or questions. It allows the students to submit papers to be graded and the teacher to maintain a complete record of the various assignments given to the students.

Google Sites

One of the G-Suite tools which allows collaboration and creation of beautiful websites easily through drag and drop, without the involvement of the IT department. It also has easy access to all the content on Google Workspace. The creation of courses, making portfolios, preparing reports are some of the things that may be done through a Google Site. The site may be shared with people across through the sharing settings to bring in more visibility.

Google Extensions

These are programs that can be added to Google Chrome so that an existing programme may be modified by the installation of the extensions. It adds new features to Chrome improving the functionality of an existing in use program, making it more user-friendly and adding value to it. Examples of a few extensions are – Grammarly, Mote(a voice thread).

Jamboard

This is a digital, interactive whiteboard that brings the ideas and thoughts of the team alive through online collaboration. The G-Suite support added to the Jamboard makes its usage interesting and productive. Shapes, Sticky notes, Stylus, Slides, Erasers give the user ways to express, saving everything automatically onto the cloud. Collaborative activities were conducted during the capacity-building programme. Figure 3 shows the discussion board used by the participants.

Mentimeter

Mentimeter is an easy-to-use online presentation software to keep a track of the performance of the students in the class by asking questions anytime, anywhere. The responses may be a word cloud, multiple-choice questions, live polls which make the classes stimulating. This tool makes the lectures and presentations innovative and memorable



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for the students. Mentimeter was used during the capacity-building programme to generate instant feedback. Education technology was made easy for the participants.

IMPACT OF THE CAPACITY BUILDING PROGRAMME

The paper reports the impact of the five-day capacity-building programme. It was overwhelming to see the online presence and visibility of the participants while using the digital tools. Examined in more detail are the findings of the sessions on Google Class, Google Sites, Google Extensions, Jamboard and Mentimeter.

The participants found the sessions relevant and engaging. Figure 5 shows that the participants found the Google Classroom appealing and relevant to use for sharing the resources and materials with the students. The system of conducting assignments and assessing them was also appealing. One of the participants said that due to digitalisation of the whole education world because of the pandemic, Google Classroom would be very appropriate to track the students' performance and work. "We can connect better with our students through Google classroom", is what one of the participants had to say which was resonated by many more. According to Figure 5, the participants found Google Sites very interesting. They felt that it was a good way to create one's website with minimal technical skills. They felt that it could be used effectively for creating portfolios. Collaboratively it can be used to produce Annual Reports.

The Google Form, Jamboard and Mentimeter were found to be equally exciting tools for engaging and collaborating with the students. One of the participants put forward his/her views about the Jamboard in the following way: "...we can combinedly do a better job as at a time.... we can get so many ideas on one platform". The participants found the tools to be student- centered and student-friendly, which will encourage the students to participate in the classroom activities especially in online classes. It is important to exchange feedback, reflect and then redesign the teaching-learning process. This is an ongoing practice that improves the quality of the deliverables by the educators. Through this capacity-building programme it was understood that these tools play a very involved role in augmenting and improving the classroom engagement for the better.

Around 84% of the participants expressed their interest in using Google Classroom for giving assignments and doing assessments. This shows that faculty/teachers are interested in using tools that put the classrooms in a more systematic way so that the assignments and assessments are more methodical. The pandemic has forced teachers to think about how learning can happen both synchronously and asynchronously. Keeping the challenges of the availability of the devices as well as the internet connectivity of the students and the faculty in mind, these tools play a crucial role in elevating teaching-learning experiences.

The capacity-building programme has boosted the confidence of the participants to design their website using Google Sites. Around 54% of the faculty showcased their websites on soft skills, English Language Teaching, e-portfolios, and designed assignments on collaborative platforms. 41% of the faculty showed enthusiasm to design their web pages for communication and collaboration. This shows the need to use such collaborative digital tools.

A google form was shared with the participants before the hands-on capacity building programme to understand their expectations:

- To be familiar with Google workspace for Education
- To keep language classroom activities organised
- To understand how to integrate Google Workspace for Education in ELT classrooms for collaboration and interaction
- To know about Mote, and other tools to use in class
- To learn how Google workspace can help teach more effectively
- To learn details to design a Google classroom
- To learn to design a website and e-portfolios
- To enhance the knowledge of Google applications in an effective way.



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- To learn new online teaching tools for best delivery in classes
- To improve classroom interaction
- To learn and explore
- To use google classrooms to engage the students in English language learning

It was overwhelming to see the capacity building programme was successful in matching the expectations of the participants.

“Am technically not strong. This capacity-building programme provided me a great way of learning” – this is what one participant had to say after the programme. The participants believed that if Google tools are utilized properly, it would be a way forward to have engaging classes with the students instead of having just lectures. Creating Google classrooms helps to map the assessments and the learning of the students. It would facilitate the classroom connection even in an asynchronous mode. The participants felt that “Using new tools like Mentimeter and Jamboard is a great way to engage the students”. Google websites accommodate students learning by collaborating and learning to explore more on their own leading to self-learning. They learned how to use the various tools of Google Workspace for Education for e.g. docs, forms in a confident manner and found their usage in their lesson plans. They were excited about the fact that the Jamboard was a great way to brainstorm a topic at one time online, not being in physical classrooms. The flipped class could be easily incorporated through the Google classroom. They believed that Mentimeter could be used as an effective tool to get feedback from the students and also to discuss a topic collaboratively. In a nutshell, the participants found the tools an amazing way to make classes more interactive and effective. Figure 8 shows how far the faculty development programme was successful in matching the expectations of the participants. There was a sense of satisfaction amongst all the participants at the end of the programme in some way or the other and each and every one understood the significance of using digital tools to enhance their classroom transactions.

CONCLUSION

The pandemic has necessitated a massive requirement for online teaching and learning. It has become a dominant mode of education in all spheres, whether K12 school or higher education. It is essential and becomes the responsibility of the teacher and the faculty to retain the number of students learning online. Virtual learning demands more innovative pedagogies to take lessons to the classrooms. The capacity-building programme reiterated the importance of classes being engaging and interactive to hold on to the student strength. The insufficiency of the capacities of the faculty was felt and satisfied to consolidate the understanding that if faculty do not use technology effectively, they may be outdated. Though English teachers across the world were challenged to use technology overnight because of the unprecedented pandemic, it has also proved that teachers are willing to become learners so that their students are not deprived of education. The technology used helps them and does not replace them in any way and that is what made the learning and integrating the digital tools in the classes so worthy and exciting.

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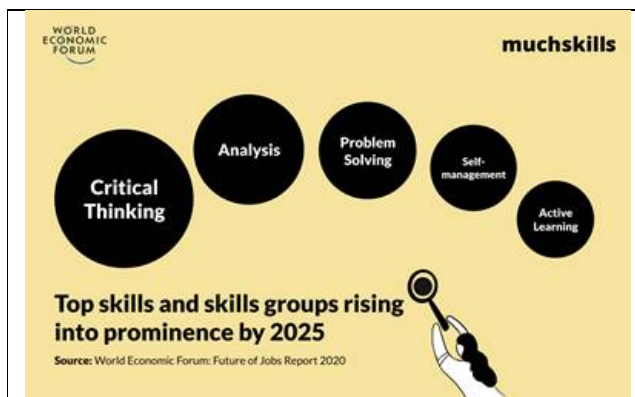


Fig.1: The top skills getting prominent by 2025 (Source: World Economic Forum, 2020)

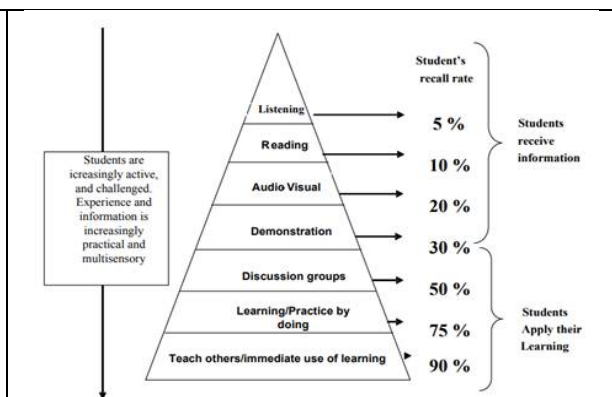


Fig.2: The Learning Pyramid: The recall rate of different teaching strategies (Source: <https://www.sciencedirect.com/science/article/pii/S1875389212003719>)



Fig 3: Screenshot of sticky notes on Jamboard

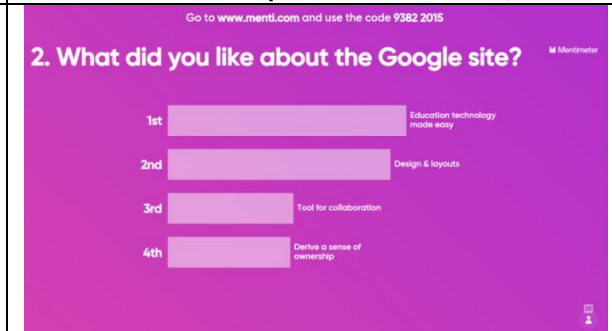


Fig 4. Instant feedback on Mentimeter





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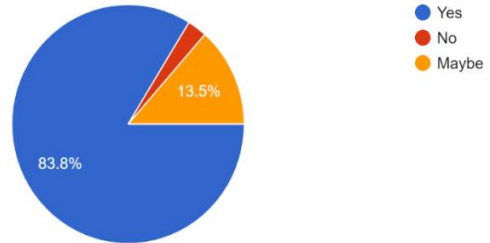
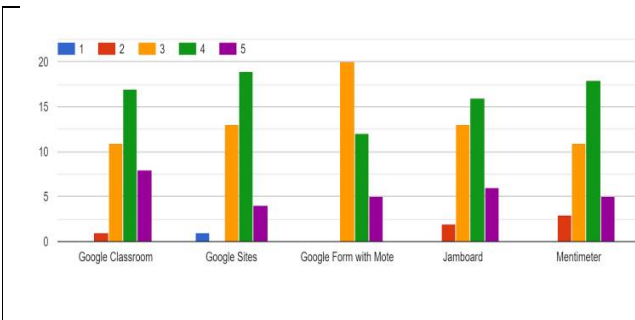


Fig 5: Relevance and participant engagement on Google Workspace for Education

Fig 6: Use Google classroom for assignments and assessments

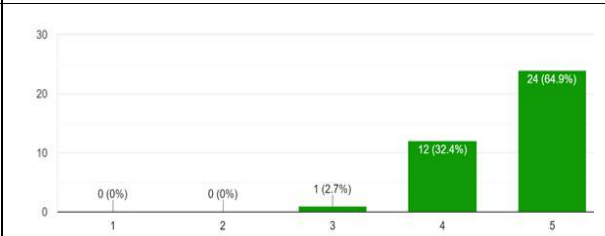
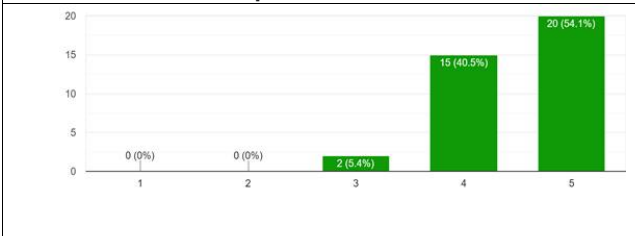


Fig 7: Participants interested and confident to design their websites

Fig 8: Expected outcome





Identification of Real-time Maglev System using GA based Low Complexity based ANN

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ABSTRACT

In the recent past identification of nonlinear plant is a significant work has done by many researcher and it is found to be an emerging area for further research due to its wide application. In this article, the characteristics and behavior of a real time maglev plant has been identified using an efficient low complexity based Artificial Neural Network (ANN) based on functional expansion technique i.e. functional link artificial neural network (FLANN). The weights of FLANN has been iteratively updated by a heuristic optimization algorithm i.e. a natural genetics. So that the error needs to minimized, which is considered as a cost function. To demonstrate the robust identification performance of the Maglev plant Mean square error (MSE) and CPU time is considered for analysis. The simulation results justify the proposed model robustly identifies the characteristics and parameters of non-linear dynamic maglev plant.

Keywords: Non-linear System; System Identification; FLANN; Maglev plant; Chebyshev Expansion; GA.

INTRODUCTION

The principle of identification is to formulate a mathematical modeling of plant by taking its input-output data. A mathematical modeling of a system can be determined by using laws of nature or through the experimentation. Out of many techniques to find out the mathematical modelling (using parameter estimation) of the system, direct modeling and inverse modeling, have most attractive features [1], [2]. As maximum plants are non-linear and dynamic in nature, their identification is a thought provoking. Accurate and fast identification of above system is still a nightmare. Identification of non-linear plants finds application in the area of control system, power system, communication, instrumentation and many other fields. This technique helps to design an identification technology for wide range of nonlinear system for sustainable development.



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To perform the above task in highly non-linear environment, an ANN is the best solution for it. As ANN can take the non-linear decision based on the objective. Pao *et al.* have proposed FLANN to overcome the above issue [3], [4], [5]. The FLANN is one of its kind and it holds the advantages of both single layer and multi-layer network. Mainly the FLANN is popular for its simple structure and less computation complexity due to absence of the hidden layer. The input of the FLANN gets functional expanded and combined to a linear combiner. The functional expansion of inputs gets by different expansion method like power series expansion, trigonometric expansion and Chebyshev expansion [6]. In this article, the Chebyshev expansion has been used to functionally expand the input.

The FLANN model has been trained by using the GA technique. This is a random search algorithm, which is based on the three steps, which includes selection, crossover, and mutation. Using these steps, the cost function is minimized. Here, the error is considered as the cost function. The performance of the proposed identification technique has been studied in terms of error, MSE and the CPU time. This paper layout having, Section 2 presents the model of maglev plant. In Section 3 deals with the principle of system identification. Section 4 explain the basics of Genetic Algorithm (GA). The proposed GA based FLANN structure is discussed in section 5. The simulation result is discussed in section 6. Finally, the concluding remarks of the paper is outlined in section 7.

The Magnetic Levitation System

Magnetic levitation (Maglev) has been extensively accepted due to its contactless, low noise and low friction behavior and has application in many engineering field [7], [8]. Basically, Maglev plant is a highly non-linear plant and their control and identification is still a problem. The Maglev setup consist of two parts i.e. a physical Maglev plant and a computer interface. The Maglev plant is consist of electromagnet, IR sensor, amplifier and control objects. The electromagnet helps to control the steel ball in moving up and down from the equilibrium position. When current flows in the electromagnet, then their induces an emf, which controls the position of the steel ball. The steel ball is balanced by electromagnet force and gravitational force to keep it in the desired position. The IR sensor helps to measure the position of the ball and send a signal to input. The amplifier used to improve the level of the input voltage. The Maglev laboratory setup used for experimentation is manufactured by Feedback Instrument Ltd. and it works with MATLAB environment. where, m is the mass of the ball, $y(t)$ is the distance between ball and electromagnet, g is the acceleration constant, F indicates electromagnetic force, $i(t)$ is the current through the coil. The physical parameters of Maglev plant is given in Table 1.

System Identification Overview

System identification is a technique that helps to estimate a mathematical modeling for any system from its input-output data. The proposed ANN based FLANN model is a single layer network with absence of hidden layer and the weights are updated by a nature-inspired algorithm GA [9], [10], [11]. Here, $u(k)$ represents the input, $y(k)$ is output, $\hat{y}(k)$ indicates the estimated output and $e(k)$ is the error. The cost function is taken as error for the identification of Maglev plant. The cost function need to minimize to get an efficient identified model whose response efficiently track the real-time Maglev plant response. This technique helps to design an identification technology for wide range of nonlinear system for sustainable development.

The Genetic Algorithm (GA)

Genetic Algorithms (GA) is a nature inspired and natural genetics random search algorithms. John Holland has developed a random search GA with a concept of survival of fittest [12], [13], [14]. The GA is basically a random search in complex spaces and its concept based on the Darwinian natural biological selection rule and genetic mechanism. It provides a space for searching of global minima or maxima within a limited search space. By using GA does not guarantee for an optimal solution, but it provides on average a good solution. GA can be modified depends on the type of application. The GA algorithm has broadly three steps, which includes selection, crossover, and mutation. The selection process takes place from the initial population by evaluating the fitness. The crossover represents mating between individuals and the mutation introduces random modifications in the population. These steps are being repeated until it gets an optimal solution. Over successive generations, GA converges towards the





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global optimum. The selection process and the crossover process are converges the cost function. For the simulation, we have considered 0.8 as the crossover probability and 0.125 as the mutation probability.

Proposed GA based FLANN Network

Pao *et al.* has proposed a single layer ANN i.e. functional link artificial neural network (FLANN), in which the inputs are expanded functionally. It generates the decision boundaries, which is capable of taking complex decision. Mainly the FLANN improves the learning rate with less computational complexity for identification problem. The proposed FLANN model with input signal $x(k)$ is functionally expanded to a number of non-linear components which is given as input to a linear combiner with weights are associated with it as shown in Figure 3. The functional expansion of inputs gets by different expansion method like power series expansion, trigonometric expansion and Chebyshev expansion. In this article, the Chebyshev expansion has been used to functionally expand the input. Mathematically, Chebyshev expansion can be written as,

$$T_0(x_k) = 1 \quad \text{for } k = 0$$

$$T_1(x_k) = x_k \quad \text{for } k = 1$$

$$T_2(x_k) = 2x_k^2 - 1 \quad \text{for } k = 2$$

$$T_{k+1}(x_k) = 2x_k T_k(x_k) - T_{k-1}(x_k) \quad \text{for } k > 2 \quad (1)$$

where, $x(k)$ is the input and $w(k)$ is the weights of the model. The output of the proposed model is given as

$$\hat{y}(k) = \sum_{m=1}^{Q-1} s_m(k) w_m(k) \quad (2)$$

The weights of the proposed FLANN model are updated by GA algorithm for identification of Maglev plant.

RESULT AND DISCUSSION

The proposed method is simulated and test by using *acer Aspire V*, 8 GB RAM, intel CORE i5 processor, 1.80GHZ with Windows 10. For identification of real time Maglev plant 5000 no. of samples have been taken, out of that in 8:2 propotion is taken for training and testing with 10 no. of iteration. The performance of the proposed FLANN network updated by GA algorithm is analysed in terms of error, MSE and CPU time. Here, the error is 0.0014, MSE is 0.00001 and CPU time is 31.866 sec. From Figure 6, it shows that the high convergence rate of MSE curve.

CONCLUSION

In this paper, the proposed model successfully identified the real time Maglev system based on the input-output data. Here, GA technique has play the important role to updated the weights of the FLANN model. A simulation study is carried to check the effectiveness of proposed GA based FLANN network. The efficacy of proposed model found from the closed fitting of identified model response and actual model response, which exhibit that the proposed model using GA is more suitable for identification of highly nonlinear Maglev plant. The research work in this area includes efficient neural network structure optimized by efficient nature inspired algorithm for further development to enhance its robustness and efficiency. This technique helps to design an identification technology for wide range of nonlinear system for sustainable development.

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Table 1. The physical parameter of MAGLEV plant

Sl. no.	Parameters	Value
1	m—Steel ball mass	0.02kg
2	g—Acceleration Constant	9.81m/s ²
3	i ₀ — Current value at equilibrium	0.8 A
4	x ₀ —Equilibrium position	0.009m
5	Control input (u)	±5v
6	output voltage (x _v)	+1.25v to -3.75 v





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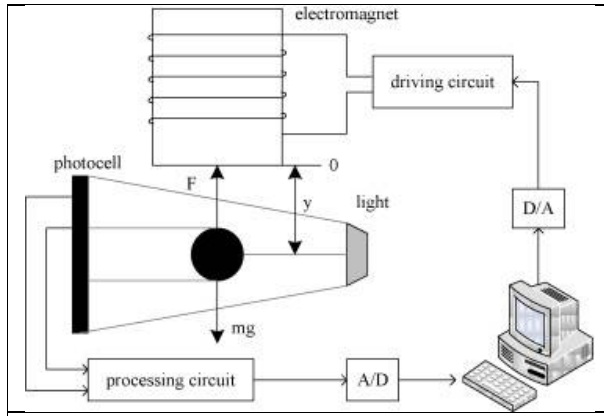


Figure 1. Block diagram of the MAGLEV system

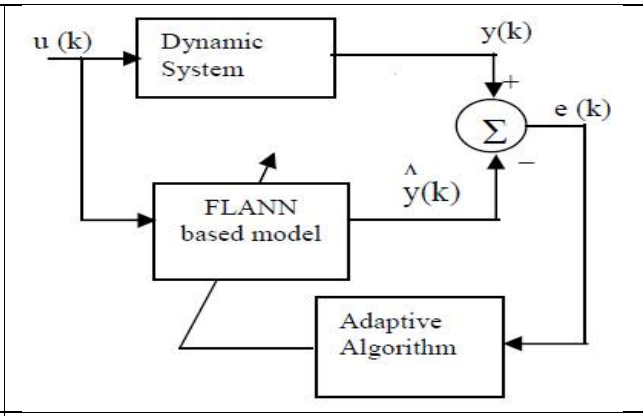


Figure 2. Schematic diagram of Maglev plant identification

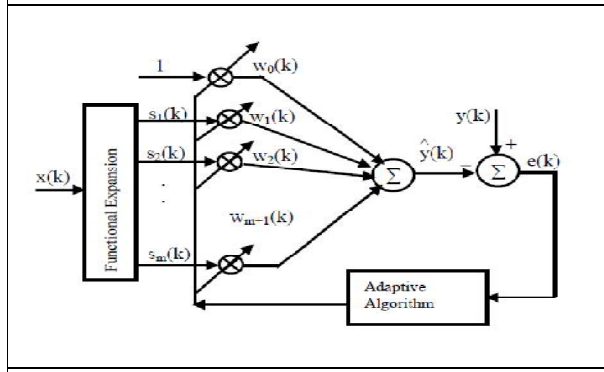


Figure 3. Structure of FLANN Model

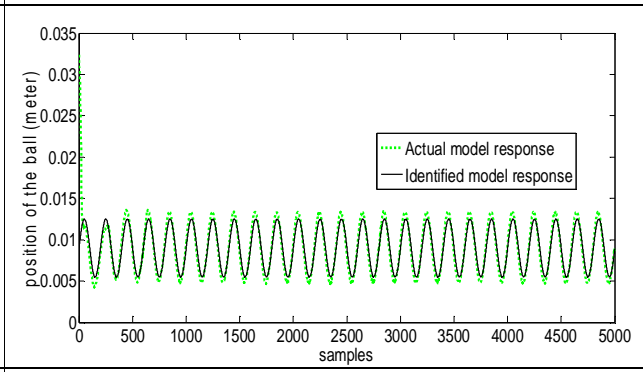


Figure 4. Actual and Identified model response (position of the ball)

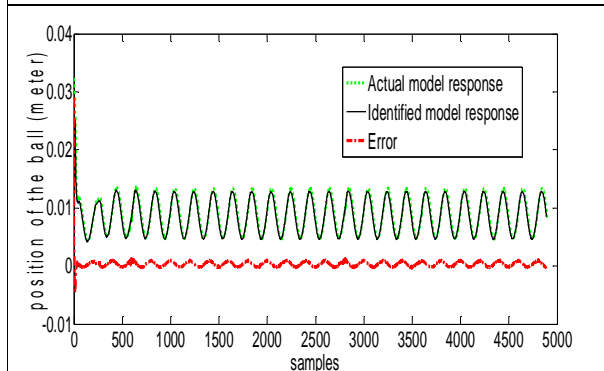


Figure 5. Identified model response generated by FLANN-GA

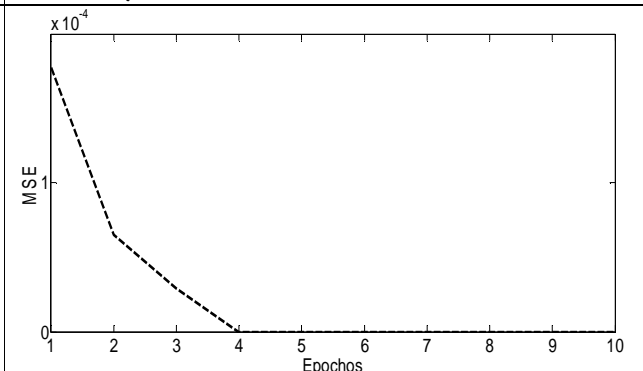


Figure 6. MSE plot of FLANN-GA





Gomti River Dying day by day: A Review

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ABSTRACT

Every other day we read of new water pollution scandals frequently after people sick, but sometimes due to large-scale fish die off or other hazardous environmental impacts. Human sources of water pollution include various types of household and industrial waste, agricultural chemicals, and livestock waste, which all end up in water bodies and cause pollution. Water pollution is one the main environmental issues that we are facing, as more than 70% of the Earth's surface is water-covered. India is very lucky in the matter of water resources, the 6th most river containing country in world. But due to rapid civilization and increasing population, rivers are dying. Here I have discussed about pollution story of a famous river named Gomti River. This river is also connected with Hindu religion sentiments.

Keywords: River, Pollution, Gomti, Sewage, Industrial waste

INTRODUCTION

Water is the major resource required to sustain the life on this earth. Gomti River is the most important River system in Uttar Pradesh. One of the major tributes of the Ganga River is the Gomti River. As per mythology it is believe that the Gomti River is daughter of muni Vshistha, which originates from Madhotandagomad Lake, pilibhit. The Gomti River also called as Aadi Ganga. The river passes the great alluvial plain which is of Pleistocene-Holocene origin and after that redistributes the weathered sediments of plain derived from Himalaya known as Gangetic alluvial plain. This river approximately travel 821 km, by passes through the districts of Pilibhit, LakhmpurKheri, Hardoli, Sitapur,



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Lucknow, Barabanki, Sultanpur & Jaunpur. Then again ultimately join the River Ganga near village Kaithi of district Gazipur.[1,2]

Due to increasing pollution because of rapid industrialization now days, river pollution is a serious and emerging problem in the majority of developing countries. Due to rapid industrialization, there has been an increase in the amount of effluent being disposed to River. Industrial wastes and sewages entering in to the river is one of the prime sources of environmental toxicity, which endangers aquatic biota and deteriorates water quality. This increasing human population results acceleration in emission of organic and inorganic pollutants such as pesticides, salts, petroleum products, acids, heavy metals etc. Most of them cannot be easily degradable & hence they accumulate in environment & heavy metals are one of them. Among all the pollutants, heavy metals are of more dangerous because they accumulate in ecology through the food chain and create various types of environmental issues. Higher concentrations of heavy metals can form complex compounds, which critically effect different biological function in living organism's body. Heavy metal pollution can be a much more serious issue because they cannot be eliminated by natural processes and persist in sediment of River bed and in surface of River bodies.[3,6,13]

Also for the reason of pollution Gomti River looks like a natural drain form Madhotanda to MohmmadiKheri. Most polluted stretch lies between Sitapur district to district Jaunpur, approximately length 628 km. Uttar Pradesh Jal Nigam mentioned in their report that every year approximately 865 MLD sewages is disposed in River Gomti during its long journey. Between Pilibhit to Barabanki district it carries rain water during monsoon through connected different natural or manmade drainage system, from approximately 7500 sq.km. catchment area of both banks. As per the data of Irrigation department, maximum flow observed is around 55000 MLD in rainy season and minimum flow observed 500 MLD in summer. The following review article represents the research work carried out by the various researchers in the past on the heavy metal pollution of River Gomti.[2]

Sources Of Heavy Metal.

Generally heavy metals are defined as any metallic chemical elements that has a relative high densities (ranging from 3.7-7 g/cm³), atomic weight or atomic numbers and also they having density 5 times greater than the water. It is very toxic / poisonous at very low concentration. E.g. Cd, Hg, Fe, Cr, Pb, As.[6]. These are one of the widely spread pollutant. Due to their physical and chemical properties they create very serious ecological ramification for aquatic living organisms with human civilization. Heavy metals are very unique pollutant toxicant among all pollutant in that they all are naturally occurring and, in many cases, are ubiquitous within the human environment. Thus how safely metals are used in industrial processes or consumer products, some level of human exposure is inevitable. All life has evolved in presence of metals and organisms have been forced to deal with these potentially toxic elements. In fact, for various biological processes some metals are essential which are known as essential metals e.g. Fe, K, Cu etc.[9]. If exposure of essential metal increases then it became toxic. Heavy metals differ from other toxic substances because, as elements, they are neither created nor destroyed by human activity. Sometimes nonessential toxic metals behave like essential metals and thereby gain access to, potentially disrupted, key cellular functions. This can also considered for bioaccumulation of toxic metals.[6]

Heavy metals are redistributed naturally by both geologic and biologic cycles in environment. Rain water or river stream, water fall dissolves rocks, ores and transport pollutant including heavy metal, to underground water (e.g. arsenic), depositing and stripping materials from adjacent soil and eventually transporting these substances to the ocean to be precipitated as sediment. Biological cycles moving metal include biomagnification by plants and animals resulting in incorporation into food cycles.[9] The main anthropogenic sources of heavy metals pollutants are mining, milling, plating and surface finishing industries.[6] In last few decades it is found that, the concentration of heavy metals in river and it's sediments has increased rapidly. Consequently concentration of toxic metals in grain and vegetables which grown in contaminated soils have increased at alarming rates, which affects entire food chain. Due to it's toxicity, non-biodegradability and bioaccumulation, it threatened us.[6]





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How heavy metal affecting ecosystem?

Heavy metals are essential as trace elements to maintain the metabolism of the human body or animal body or plant body although at higher concentration, they may show toxic effects.[6, 9] Heavy metals are always present in environment every time in different form with owing their chemical characteristics. But sometimes they changing from one chemical state to another one and eventually accumulating in the food chain. Because of heavy metals are highly water soluble, it can be easily absorbed by living organisms.[6] 23 metals have been defined as heavy metals out of 35 metals which are consider dangerous for living being which are given below.[6] Antimony, arsenic, cerium, cadmium, bismuth, zinc, copper, cobalt, manganese, mercury, gallium, gold, iron, lead, silver, platinum, tellurium, tin, thallium, uranium, vanadium. But the major lethal effects to human health caused by lead, cadmium, mercury, cadmium, arsenic exposure which are generally metalloids but usually defined as heavy metals.

Large amount of these metals may causes chronic or acute toxicity which result damaged or reduced mental & central nervous system functions, modify blood composition, damage the lung, kidney, liver & other vital organ functions. Long term exposure to heavy metals may results in slowly progressing muscular, physical & neurological degenerative processes that mimic Alzheimer disease parkinson's diseases, muscular dystrophy, multiple sclerosis & cancer.[6, 9] Due to hazard effects of heavy metals the control of heavy metal dumping and the removal of toxic heavy metals from water body has become a challenge for the twenty first century. [6] Important problems related to selected toxic metals like occurrences in nature, sources of water pollution, toxic effects etc. are described below.

Here,

WHO stands for World Health Organization

USEPA stands for United States Environmental Protection Agency,

ISI stands for Indian Standard Institution,

ICMR stands for Indian Council of Medical Research,

CPCB stands for Central Pollution Control Board.

Source of heavy metal for Gomti River pollution. [54]

The immersion of hundreds of Deva-Devi idols after hundreds of festival in the Hindu religion also results in metallic contamination. Hundreds of idols of Goddesses containing biodegradable and non-biodegradable materials were immersed in the river every year during the festive season. However, for the last few years, idols are usually buried in a huge pit along the banks of the Gomti River which indirectly causes River water pollution. The 13 km stretch in Lucknow city is dangerously polluted by 36 drains of city swage which flow into the river. It gets worse when effluents from different sugar mills around the city are also discharged their waste product into it, said by Dr. Venkatesh Dutta, one of environmental scientist of B R Ambedkar University, Lucknow. There are 30 highly pollution causing industries present in the catchment area of River Gomti. This industries' waste discharge swage are connected to it, which is also a reason of heavy metal contamination.

Status of heavy metal in River Gomti water and sediments.

There are so many studies have been carried out by several researchers on heavy metal pollution of River Gomti. They studied the concentrations of cadmium, cobalt, chromium, copper, iron, manganese, nickel, lead and zinc in the water and sediments of the river Gomti in different location but, mostly in Lucknow and reported that there was considerable variation in the elements from one sampling station to the other. They also analyzed the temporal and spatial variations in the heavy metals distributions in the river Gomti sediment. [2] As per Vinod K. Singh *et al.* research (2004), they detect heavy metals in river water by using ICP-AES. They found concentration heavy metals in the River water surface were in the range: [1] And the heavy metals concentration in the River sediments were in the range:[1]

As per a research of Uttar Pradesh Jal Nigam in 2019, the stretch of River from Sitapur to Jaunpur is very much polluted by different type of heavy metals, acids, pesticides etc. which are discharged to river indirectly or directly. Water of River Gomti is neither fit for Drinking water nor for Outdoor bathing and Fish Culture etc. between kudiaghat to Jagdishpur. It can only be used for irrigation, industrial cooling or controlled waste disposal.[5] As per



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Nizami G *et al.* research (2018), they found concentration of heavy metals in the River water were in the range: As ($0.07\text{--}0.7 \mu\text{g g}^{-1}$); Cu ($10.98\text{--}36.73 \mu\text{g g}^{-1}$); Fe ($7462.00\text{--}7977.00 \mu\text{g g}^{-1}$). And in post-monsoon, As ($0.05\text{--}0.07 \mu\text{g g}^{-1}$); Cu ($32.00\text{--}9.23 \mu\text{g g}^{-1}$); Fe ($543.00\text{--}7797.00 \mu\text{g g}^{-1}$) detected for heavy metal concentration. Then they conclude that the concentration of iron and Arsenic was observed insignificant to small level whereas Cu found from little to modest level.[4]

Strategies applied to control the heavy metal pollution of River Gomti.**Short-term action plan. [5]**

Estimation of total sewage produced from Cities where sewage treatment facility does not available and prepare a detailed project report for treatment of sewage. Re-excess of Water Pollution causing Industries in the catchment area of the drains and their status with respect to policy effluent treatment plant, adequacy of effluent treatment plant and final discharge point of sewage. The industries which are present closure to the catchment area of river, operating without consent or non-compliant monitoring & ensuring their water pollution. Measurement of flow & load of all the drains contributing pollution load to the River Gomti. Installation of Bar-meshes in every drain, regular cleaning them & disposal of Solid Waste from them. Untapped drains to be provided with In-Situ bio-remediation. Take legal action against industries which are illegally drains their pollution causing waste water to the river. Force sugar industries for reducing the water consumption, improving the quality of treated effluent & then force them reuse of water in irrigation.

Long-term action plan. [5]

Like Electroplating, Dyeing, Pulp & Paper industries etc. are required to adapt cleaner technologies by water polluting industrial sectors having major impact on water quality of the river. Set sewage Treatment Plants of adequate capacity. Ensuring use of treated water & Infrastructure Development in Irrigation/Horticulture/Sprinkling/Industries. Imposing strict rules in Distillery, Pulp & Paper, Slaughter House.

CONCLUSION

River water pollution is a global problem and not peculiar to India. However, rising pollution of rivers in India is a significant concern for the Indian government and population. India is home to about 20 major river basins. Unfortunately, most rivers and river basins in India are victims of pollution. Rivers in India are facing multiple problems of severe pollution, over extraction, encroachment, dams and barrages which cut off the connectivity of the river with its associated ecosystems, climate change, deforestation in catchment areas, etc. Particularly, the links between dams, hydrological changes and fisheries require urgent attention and more work. In North India, There are many places having a single water body (River). Water pollution is a major environmental issue due to many reasons which include not only rapid growth in population but also the more dependence of technology and lack of awareness amongst peoples about the preservation of water and the effect of water pollution on their future. However, most of these impacts of pollution are confined to specific stretches and the rivers have overall shown a good potential energy resource, with no declines, except in the point discharge areas. In spite of these favorable conditions, Peoples have been showing a decreasing trend and key factors for this are erratic flood patterns, regulation in flow, and reduction in water volume. Dams, Hydropower projects, barrages, embankments and subsequent abstraction and regulation are the main reason for degradation of riverine environment and subsequently, The need of the hour is to explore and implement ways through which our existing water infrastructure becomes friendlier to fish and other aquatic species. Fortunately, many such options exist today which can be implemented if there is a strong political will, regulatory mechanism and community participation.





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TABLE-1

SL.NO.	HEAVY METAL POLLUTANTS	MAJOR SOURCES	REFERENCES
1.	Arsenic	Arsenic containing fungicides, pesticides and herbicides, byproducts of mining activities, metal smelters, chemical waste.	[12]
2.	Cadmium	Cadmium producing industries, welding, byproducts from refining of Pb, Zn & Cu, fertilizer & pesticides industries, electroplating, Cd-Ni batteries, nuclear fission plants.	[13]
3.	Chromium	Metallurgical and chemical industries, processes using chromate compounds, cement & asbestos units.	[13]
4.	Copper	Iron & steel industries, fertilizer industries, burning of wood, discharge of mine tailings, disposal of fly ash, disposal of municipal & industrial wastes.	[13]
5.	Iron	Cast iron, wrought iron, steel alloys, construction, transportation, machine manufacturing.	[6]
6.	Lead	Automobile emissions, lead smelters, burning of coal and oil, lead arsenate, pesticides, smoking, mining, plumbing.	[13]
7.	Mercury	Mining & refining of mercury, organic mercurial used in pesticides, laboratories using mercury.	[14]
8.	Nickel	Metallurgical industries using nickel, combination of fuels containing nickel, additives, electroplating units using nickel salts, burning of coal & oil, incineration of nickel containing substances.	[13]
9.	Zinc	Zinc refineries, brass manufacture, metal plating, galvanizing process, plumbing.	[6]





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TABLE-2

SL.NO	METAL	EFFECTS ON HUMAN	EFFECTS ON PLANT	EFFECTS ON MICROORGANISM	REFERENCE
1	Antimony	Cancer, conjunctivitis, dermatitis, cardiovascular disease, liver damage, nasal ulceration, respiratory disease.	Decrease synthesis of some metabolites, growth inhibition, inhibit chlorophyll synthesis	Inhibit enzyme activities, reduce growth rate	[22, 23]
2	Arsenic	Brain damage, dermatitis, skin cancer, conjunctivitis Cardiovascular & respiratory disorder	Damage cell membrane, inhibits root extension & proliferation, interferes with critical metabolism process, inhibition of growth, loss of fertility, oxidative stress, physiological disorder.	Deactivation of enzymes.	[24, 25]
3	Beryllium	Allergic reaction, cancer, heart disease, berylliosis, lung disease	Inhibit seed germination	Mutation, chromosomal aberration	[26, 22]
4	Cadmium	Bone disease, emphysema, headache, coughing, hypertension, itai-itai, kidney disease, lung & prostate cancer, lymphocytosis, hypochromic anemia, microcytic, testicular atrophy, vomiting	Chlorosis, decrease plant nutrient content, growth inhibition, reduce seed germination	Damage nucleic acid, denature protein, inhibits carbon & nitrogen mineralization, inhibits cell division & transcription	[13,27, 28, 29, 30]
5	Chromium	Broncho pneumonia, reproductive toxicity, lung cancer, chronic bronchitis, diarrhea, emphysema, headache, irritation of the skin, itching of respiratory tract, liver disease, nausea, renal failure, vomiting	Chlorosis, senescence, wilting delayed, biochemical lesions, reduce biosynthesis, germination, stunted growth, oxidative stress	Elongation of lag phase, growth inhibition, inhibition of oxygen in take	[31-33]
6	Copper	Abdominal pain, anemia, diarrhea, liver & kidney damage, metabolic disorders, nausea, vomiting	Retard growth, Chlorosis, Oxidative stress	Inhibit enzyme activities, disrupt cellular function.	[27, 34]
7	Mercury	Ataxia, blindness, attention deficit, decrease			





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		rate of fertility, dizziness, dementia, dysphasia, gastrointestinal irritation, gingivitis, kidney problem, pulmonary edema, loss of memory, reduced immunity, sclerosis	Affects photosynthesis, enhance lipid peroxidation, inhibit plant growth, induced genotoxic effect, oxidative stress	Disrupt cell membrane, decrease population size, denature protein, inhibits enzyme function	[27, 35, 36]
8	Lead	Anorexia, damage to neurons, hyperactivity, insomnia, high blood pressure, chronic neuropathy, reduce fertility, renal system damage, risk factors for alzheimer's disease	Chlorosis, inhibit enzyme activity & seed germination, affect photosynthesis & growth, oxidative stress	Denatures nucleic acid & Protein, Inhibits transcription & Enzyme activities	[27, 37, 38]
9	Nickel	Cardiovascular disease, dermatitis, dizziness, chest pain, dry cough & shortness of breath, headache, kidney disease, nausea, lung & kidney cancer	Decrease chlorophyll content, reduce nutrient uptake, inhibit enzyme activities & growth	Disrupt cell membrane, oxidative stress, inhibit enzyme activities	[27, 28]
10	Selenium	Dysfunction of the endocrine system, gastrointestinal disturbances, liver damage, impairment of natural killer cell activity	Reduction of plant biomass, alteration of protein properties	Inhibits growth rate	[39]
11	Silver	Bronchitis, cytopathologica-I effects in fibroblast & keratinocytes, argyria&argyrosis, emphysema, knotting of cartilage, mental fatigue, nose, throat & chest irritation, rheumatism	Inhibits growth, Affects homeostatis, Decrease chlorophyll content.	Cell lysis, Inhibit cell transduction & growth	[40, 41]
12	Thallium	Ataxia, burning feet syndrome, alopecia, convulsion, coma, delirium, fatigue, gastroenteritis, hair fall, hallucinations, headache, hypotention, insomnia, nausea, tachycardia,	Reduced growth & enzyme activities	Damage DNA, inhibits enzyme activities &	[42]





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		vomiting		growth	
13	Zinc	Depression, ataxia, gastro intestinal irritation, hematuria, kidney & liver failure, lethargy, macular degeneration, metal fume, fever, cancer, vomiting	Affects photosynthesis, reduce chlorophyll content, inhibits growth rate, reduced germination rate and plant biomass	Decrease in biomass Inhibits growth	[28, 43]

TABLE-3

Heavy metal name	Permissible limit				
	WHO	USEPA	ISI	CPCB	ICMR
Chromium (mg/l)	0.1	–	0.05	No relaxation	–
Zinc (mg/l)	5.0	–	5.0	15.0	0.10
Lead (mg/l)	0.05	–	0.10	No relaxation	0.05
Arsenic (mg/l)	0.05	0.05	0.05	No relaxation.	0.05
Cadmium (mg/l)	0.005	0.005	0.01	No relaxation	0.01
Mercury (mg/l)	0.001	0.002	0.001	No relaxation	0.001
Copper (mg/l)	1.0	1.3	0.05	1.5	1.5
Iron (mg/l)	0.1	–	0.3	1.0	1.0

TABLE-4

Name of metal	Concentration of metal
Cr	0.0015–0.0688 mg/l
Mn	0.0038–0.0.0973 mg/l
Ni	0.0066–0.011 mg/l
Cu	0.0013–0.0.0043 mg/l
Cd	0.0001–0.0005 mg/l
Fe	0.0791–0.3190 mg/l
Pb	0.0158– 0.0276 mg/l
Zn	0.0144–0.0298 mg/l

TABLE-5

Name of metal	Concentration of heavy metal
Cr	6.105–20.595 µg/g
Cu	3.735–35.68 µg/g
Mn	134.915–320.45 µg/g
Fe	5051.485– 8291.485 µg/g
Ni	13.905–37.370 µg/g
Cd	0.70–7.90 µg/g
Pb	21.25–92.15 µg/g
Zn	15.72–99.35 µg/g





Computational Fluid Dynamics Model of a Rotary Regenerative Heat Exchanger

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ABSTRACT

Rotary regenerative heat exchanger plays a crucial role in several heat recovery applications due to their compactness, low cost and high performance. They are employed as energy recovery devices in steam power plant, HVAC system and buildings. The use of rotary regenerative heat exchangers, have found interesting applications in mechanical ventilation equipment. They are called as rotary air preheater when they are used in steam power plant to preheat the air by means of exhaust flue gas from boiler. They can be used as a heat wheel for controlling the moisture and energy shaving. In the present work, a numerical simulation of rotary regenerative heat exchanger is carried out by using Computational Fluid Dynamics (CFD). Performance of the rotary regenerative heat exchanger, expressed as effectiveness, is calculated from results of temperature. The effect of rotation of heat exchanger on performance is investigated. The study reveals that speed of rotor has a considerable effect on performance of heat exchanger.

Keywords: Rotary regenerative heat exchanger, Effectiveness, Speed, CFD

INTRODUCTION

Energy recovery is an important technique to deal with energy scarcity in recent times. There are many energy recovery techniques and devices like recuperators, regenerators, economiser, heat pumps, are used in different industries [1, 2]. Rotary regenerators have been used worldwide for energy saving in various fields. They are also called 'thermal wheel' or 'heat wheel'. They can be used in thermal power plant to extract heat from exhaust flue gases of boiler thereby increases the efficiency of power plant. Generally rotary regenerative air preheater is preferred in thermal power plant than other preheater due to its compactness, low cost and better performance [3]. The application of rotary regenerator is not confined to thermal power plant. They can be used in heat recovery applications in air conditioning system, buildings, gas turbines and process industries. In rotary regenerators, as





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shown in Fig. 1, the rotor in the form of a drum consisting of heat storage material called matrix rotates at constant speed in between two fluid ducts. Thus heat is exchanged between hot and cold fluid flowing in counter flow direction. Many researchers paid their attention to develop new studies involving rotary regenerators due to its wide heat recovery applications. Research has been carried out to increase the heat extraction so as to enhance the performance of rotary regenerator. Owing to the difficulty in fabricating the experimental set up, most of the works on rotary regenerator are based on simulation. Sheer et al. [4] developed a simulation model of rotary regenerator for improving the performance and reducing leakage. Al-Kayiem and Mahdi [5] investigated the performance enhancement in rotary air preheater by increasing roughness on surface of heat transfer elements. Many people have carried out their research on rotary regenerator as desiccant wheel to absorb heat and moisture in HVAC system. Yamaguchi and Saito [6] investigated the performance of rotary desiccant wheel used in desiccant air conditioning system both numerically and experimentally. Their numerical model includes the entrance region effect in air channel. Çiftçi and Sozen [7] numerically calculated the thermal performance of a heat wheel employed for dehumidification by using CFD. However, they have got low maximum efficiency from their numerical work. Antonellis et al. [8] optimized the design parameters to improve effectiveness of heat wheel for energy recovery in HVAC system. It has been observed that the heat conduction in radial direction has not been considered in numerical work while calculating heat transfer. In the present paper, the temperatures at outlet of the rotary regenerative heat exchange are obtained by applying computational fluid dynamics (CFD). The effect of rotational speed of rotor on heat transfer is studied.

Mathematical Model

The simplest mathematical model of rotary regenerative heat exchanger is based on the following assumptions:

1. The physical properties of the fluids and solid remain unchanged.
2. Heat transfer coefficient is constant during the process of heat exchange
3. There is no heat conduction in solid in a direction parallel to the flow and heat conduction varies in perpendicular to the flow.

The mathematical modelling involves the following conservation equations.

$$\frac{\partial \rho}{\partial t} + \nabla \cdot (\rho u) = 0, \dots \dots \dots \text{Conservation of Mass (1)}$$

$$\frac{du}{dt} + (u \cdot \nabla)u = -\frac{1}{\rho} \nabla p + F + \frac{\mu}{\rho} \nabla^2 u, \dots \dots \dots \text{Conservation of Momentum (2)}$$

$$\rho \left(\frac{d\varepsilon}{dt} + u \cdot \nabla \varepsilon \right) - \nabla \cdot (K_H \nabla T) + p \nabla \cdot u = 0, \dots \dots \dots \text{Conservation of Energy (3)}$$

The above conservation equations are discretised using Finite Volume Technique. FLUENT software 19.2 is used to solve mass, momentum and energy equations for porous media. Moving Frame Reference (MRF) is used in order to incorporate the effect of rotation of the air preheater. For pressure-velocity coupling, coupled scheme is used while second order upwind scheme is used for discretising momentum governing equations. The residuals of velocity term and other unknown scalars are set as 10⁻³.

The simulation results were obtained as the outlet temperatures of hot and cold fluid coming out of the rotary regenerative heat exchanger. The performance of rotary regenerative heat exchanger is estimated in terms of effectiveness which was calculated by the relation as follows:

$$\varepsilon = \frac{\text{heat transferred}}{\text{maximum possible heat transferred}}$$

$$= \frac{\dot{m}_{\text{cold air}} C_{p,\text{air}} (T_{\text{cold air,out}} - T_{\text{cold air,in}})}{\dot{m}_{\text{hot air}} C_{p,\text{air}} (T_{\text{hot air,in}} - T_{\text{hot air,out}})}$$

As the mass flow rates of hot and cold air are same, the effectiveness can be expressed as:

$$\varepsilon = \frac{(T_{\text{cold air,out}} - T_{\text{cold air,in}})}{(T_{\text{hot air,in}} - T_{\text{hot air,out}})}$$





RESULTS AND DISCUSSIONS

The temperature distribution of the rotary regenerative heat exchanger is displayed in Fig. 3. The hot and cold fluids are supplied with constant temperature at inlet section of the regenerator. As the rotor of the regenerator rotates with constant rpm, the heat received from hot fluid at left side of heat exchanger is given to the incoming cold fluid at right side due to which, the outlet temperature of cold fluid is enhanced. As a result of heat exchange, the hot fluid outlet temperature is decreasing while the cold fluid outlet temperature is increasing. Moreover, the temperature distribution of cold fluid in radial direction is observed along the direction of rotation. The temperature distribution of rotor along the longitudinal direction is also shown in Fig. 4. It can be noted that the temperature of rotor is gradually increasing with increasing in height of rotor along the direction of rotor, which indicates high heat transfer due to the rotation effect.

CONCLUSIONS

Numerical simulation of a rotary regenerator is carried out using computational fluid dynamics (CFD). FLUENT software is used for solving mass, momentum and energy equations. The performance of rotary regenerator is generally evaluated in terms of effectiveness, which is calculated from the expression based on the mass weight average temperatures of fluids. It is observed that the outlet temperature of cold fluid is increasing while that of the hot fluid is decreasing. Therefore, more heat will be transferred from hot fluid to cold fluid due to the rotation effect of rotary regenerative heat exchanger.

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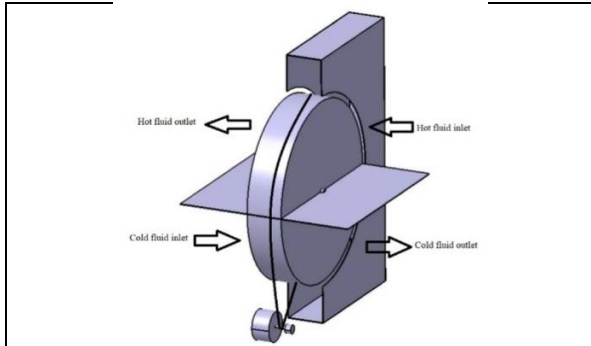


Fig1. Rotary regenerative heat exchanger

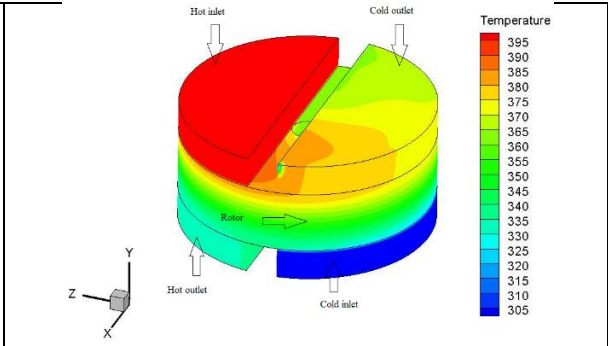


Fig 2. Temperature distribution of rotary regenerative heat exchanger

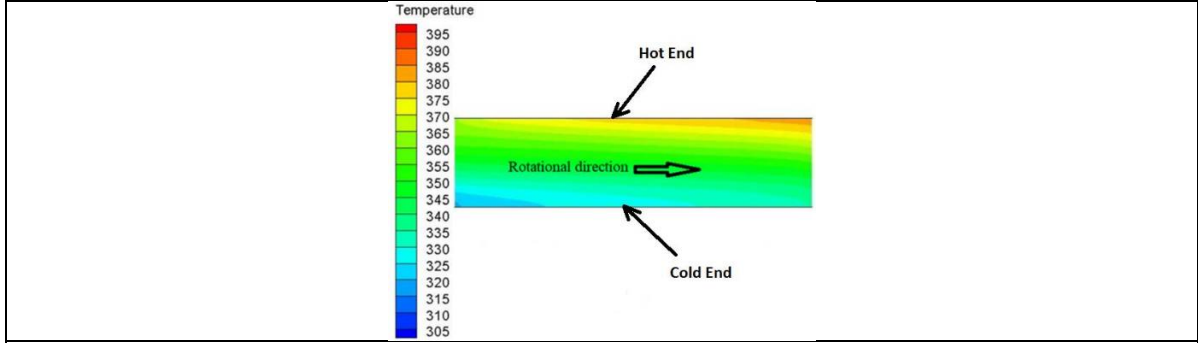


Fig 3. Longitudinal temperature distribution of heat exchanger rotor





Theory of Colors a Case Study

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ABSTRACT

A vital component of visual and realistic correspondences is the tone. It is crucial for all members throughout the time spent arranging, constructing, and progressing realistic objects, and it plays a key role in the overall aesthetic strategy. Tone is important to creators in terms of mental and presentational aspects, and tone is important to technologists in terms of ascribes. It's difficult to choose colours that are pleasing, useful, and effective. In addition, many creators lack basic knowledge of shading theory, which might aid them in tonal selection. As a result, most designers devote a great deal of time and effort to selecting appropriate colour combinations. The importance of shading congruity and how to use it while separating tones, grading, and constructing shading plans is discussed in this article.

Keywords: Color Theory, The fundamentals of Color Theory,

INTRODUCTION

The general principles of colour theory were obvious in Leone Battista Alberti's (c.1435) essays and Leonardo Da Vinci's note books (c.1490). Sir Isaac Newton invented the first colour wheel. This colour wheel was created in 1866 and consisted of a revolving disc with the colours Red, Orange, Yellow, Green, Blue, Indigo, and Violet. Isaac Newton developed a colour disc based on how light bounced off prisms using physics. His observations set the groundwork for what we now know as the colour wheel. The first model is the Red, Blue, and Yellow (RBY) colour wheel, which is commonly recognised as the fundamental colours. Green, Orange, and Purple are the secondary hues that correlate to them. Green-Yellow, Yellow-Orange, Orange-Red, Red-Purple, Purple/Violet-Blue, and Blue-Green are tertiary hues.

The second is RGB, which stands for red, green, and blue in digital colour. Color may be divided into two categories: subtractive and additive. Physical colour is subtractive, and paint is the most prevalent variety. Subtractive colour works by obliterating light, therefore if you kept painting on a canvas with purple paint, it would ultimately turn black. Digital additive colour adds light as you add additional colour. If you keep adding, it will finally turn white.





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What is colour theory and how does it work?

Color theory is a set of guidelines that mixes science and art.

Color theory establishes the ground rules for colour combinations and harmony.

This colour theory may be useful if you're wanting to develop a high-end website or logo for your new business. Before we dig into the rainbow and the world of colour and combinations, it's vital to remember that if handled poorly or carelessly, colour can be damaging to any design or style. We live in a very visual world, and mastering the art of visual communication requires a solid understanding of colour theory. If you want to connect with your audience and followers as a brand, you need become comfortable with the colour spectrum. It is recommended that you start with colour colours and work your way up to a thorough comprehension of colour wheel definitions.

Color Harmony

Consider colour harmony to be the visual outcome of the colour wheel's laws. To comprehend colour theory definitions, you must first comprehend the significance of colour location on the colour wheel.

Nine primary colour wheel rules may be used to describe these guidelines:

1. Primary colors,
2. Secondary colors,
3. Tertiary colors,
4. Intermediate colors,
5. Complementary colors,
6. Monochromatic colors,
7. Analogous colors,
8. Triadic colors and
9. Tetradic colors.

Primary Colors

Primary colours, according to classical colour theory, are the three pigment colours that cannot be blended or created by any other colour.

Secondary Colors

Green, Orange, and Purple are secondary colours. These are the colours that are created by combining primary colours.

Tertiary Colors

Yellow-Orange, Red-Orange, Red-Purple, Blue-Purple, Blue-Green, and Yellow-Green are Tertiary Colors. These are the colours that are created when a primary and a secondary colour are combined.

Intermediate Colors

Intermediate colours are made by blending two main colours in different quantities. Yellow-green, blue-green, blue-violet, red violet, red-orange, and yellow-orange are the intermediate hues. Intermediate colours are found between primary and secondary colours on a colour wheel.

Complementary Colors

This is a way of mixing colours on the colour wheel that are opposite each other on one side of the colour wheel, with warm colours on one side and cold colours on the other. The contrast between these colours will be increased by using one warm and one cool colour.

By mixing the two, the goal is to create a lively, harmonised colour palette. The crucial thing to remember is that those two colours should not be saturated otherwise they will clash and be difficult to look at. Choose one of the two colours to be your primary focal colour, and then choose the second colour to complement the main colour.





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Monochromatic Colors

Monochromatic colours are all the colours created by lightening or darkening a single hue with tints, shades, and tones. In simpler terms, it may be an image of a clear sky and clear water below, with the sky being a pale blue colour and the more defined sections being a dark blue colour, but all of the colours being from the same hue.

Analogous Colors

These are hues on the colour wheel that are next to each other, such as red, red orange, and orange. Things that perform a similar function but have a distinct evolutionary origin are described as analogous. All three hues are close but not identical, and they share some of the same characteristics. Analogous hues may be found practically everywhere and perform wonders in creating a pleasing balance in a picture or in a real-life situation such as a sitting area. When making a design from start using analogous colours, for example, you wouldn't use equal amounts of each colour; instead, you'd pick one 'mother' or 'dominant' colour and use the others to complement it. There are no hard and fast guidelines, but the worst-to-best rule is 3-4 colours.

Triadic Colors

Triadic colour schemes are made up of three hues from the colour wheel that are connected by a triangle. Triadic colour schemes always have rich and brilliant colours with a lot of contrast, so they're the polar opposite of the monochromatic colour scheme we discussed earlier. A trio, for example, may be made up of yellow, red, and blue, but if you don't believe they'll go well together, you could use different hues, tints, and shades of each colour to create a triadic colour scheme.

Tetradic Colors

A tetradic colour scheme is made up of four colours that are made up of two sets of complimentary hues, similar to triadic colours. On the colour wheel, the four hues that make up a rectangle form. Only one colour separates the colours on the short side of the rectangle, whereas three colours separate the colours on the long side. It's ideal to make one colour the dominating or mother colour, much like in the triadic colour scheme.

Combinations of colours

So, now that you've learned the fundamentals of colour harmony, let's go a little deeper into colour combinations. Combining two, three, four, and more colours is a talent in and of itself since the possibilities are limitless. The most essential thing to remember is that colours should be balanced with one another. If you're designing a room, for example, one strong or main colour should be used, with the rest of the colours working in harmony with it. Take, for example, this intriguing colour combination of lime green and grey. If matched with something equally strong, the zesty lime green delivers a major punch and might be gaudy. When combined with a flat dark grey, the result is a truly stylish and contemporary mix.

Visualize in the Design Wizard

This enigmatic deep green paired with a rich rose pink is another balanced combo that works. The balance between the macho green and the feminine pink, neither of which is too severe in any direction, is what works here. This coral, light brown and peach colour combination is a stunning trio. They evoke warm sensations of belonging when listened to together. The harmony is created here by the warmth of each colour. This is a great mix for a living room or bedroom! It's critical to have a clear picture of the ultimate objective once you've gone beyond three colour choices. Harmony and balance are more difficult to establish, so give it a shot before committing. Because it draws influence from many colour families, this purple-hued quadrant is in perfect harmony. The dark inky purple pairs beautifully with the rich raspberry. The lilac and mid-tone blue/purple show off both of these rich colours.

Terms Used in Color Theory

There are a few colour theory concepts you'll see in painting that are frequently misinterpreted and misconstrued.



**Saban Kumar Maharana****Hue**

The term "hue" is frequently used as a metaphor for the word "colour." The dominating wavelength of colour out of the twelve colours on the colour wheel is referred to as hue (being the primary, secondary and tertiary colors). The colour navy, for example, is blue. Burgundy is a reddish-brown colour. Green is the colour of sap green. Hues are the colours seen below.

Saturation

Saturation is a measurement of a color's purity. By using grey or a colour on the other side of the colour wheel, you may lessen the saturation of a colour (which essentially kills the color). The following is what you get if you totally de-saturate the colour wheel:

Tone

Despite its widespread use, tone is a widely misunderstood concept, and many artists are unsure what it implies. Tone is a general word for any colour that isn't a pure hue and isn't black or white. Tone is frequently used by artists to denote a hue that has been greyed down (de-saturated).

Value

On a scale of black to white, value refers to how bright or dark a hue is. One of the most essential factors in determining the success of a painting is its value. To raise (lighten) the value of a colour, add white and/or yellow, and to reduce (darken) the value of a colour, add blue, black, and/or raw umber. This is why sketching is regarded as one of the best ways to improve painting skills since it allows you to comprehend the notion of value without having to worry about colour. Artists commonly believe that the worth of a painting is more significant than the colour utilised in it. This is because value is what gives your artwork its structure. Below is a value scale, with the greatest value (white) at the top and the lowest value (black) at the bottom (black). The area in between is essentially a grayscale. By adding white to increase the value and black to lower the value, you may create a coloured value scale. When you de-saturate (remove the colour), the scale should appear precisely like the value scale below. In painting, it's the translation between colour and value that's the most difficult to master.

Colors and Their Meanings

Green: is typically associated with nature, health, and energy, so it's no surprise that we see it in ecologically friendly items as well as natural beauty and health products. To give your designs a natural vibe, choose colours that are inspired by nature.

Red: is a strong hue that, depending on its context, may express a wide range of emotions and sensations. It can elicit feelings of passion and love in some people, but hatred and rage in others. Red is a universal colour of strength, and brands frequently use it to convey power, even dominance. When I think of red and branding, I immediately think of Coca-Cola, and I'm sure no one would dispute with their market dominance.

Blue: some people think of blue as a peaceful hue, while others think of it as a sorrowful colour. Of course, blue has long been a hue associated with masculinity, and it is frequently used in advertising promoting men's health. Dark navy blue is a popular choice for corporate ads because it expresses seriousness and professionalism. For a business sense and conservative style, use navy blue in your design.

Purple: is a classic royal hue that has been linked with monarchy and grandeur for generations. Purple will always be a colour of luxury and it is often used to show opulence or expense. Purple should be used throughout your designs to give them a luxurious vibe.

Orange: It is claimed that when the cheerfulness of yellow is joined with the vitality of red, the result is orange. The colour orange conjures up images of sunlight, happiness, and the tropics. Happiness, inventiveness, warmth, sunlight, joy, and happiness are all connected with this colour. Orange exudes overall well-being, brightness, and emotional well-being. In stressful circumstances, orange is said to provide emotional strength.

Yellow: Have two distinct connotations. One is that it is a bright, fresh, invigorating hue. Yellow is associated with sunshine and optimism, as well as boosting confidence and encouraging communication. Bright yellow is frequently



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used in items for children since it is both exciting and eye-catching. On the other hand, excessive usage of yellow has negative consequences. Excessive usage of a bright yellow hue can lead to a lack of attention, dissatisfaction, and inability to accomplish activities.

Pink: on the colour wheel conjures up images of femininity and girliness, as well as feelings of peace, love, and kindness. The gentle and romantic colour is really a light shade of red that has become so popular that it has been dubbed "the sweet side of red." Have you ever wondered why the Iowa Hawkeyes' guest locker rooms are pink? (Or did you know they did?) Well, it's widely believed that the pink locker rooms were designed to make the opposition team feel at ease when they saw the colour, and that another belief about the pink locker rooms was that they would mentally beat the opposing team before them onto the field.

Black: For everyone, the colour black evokes a range of feelings and connotations, including power, mystery, aggressiveness, sophistication, evil, anger, mourning, mystery, and even both positive and negative. The hue may also be used to cover up weight, sentiments, worries, and anxieties in rebellious teenagers or anyone who seek to hide their feelings, fears, or insecurities. The colour black is frequently used in brands to contrast with white in order to stand out; you'd think that because they're opposite colours, they wouldn't work well together, but they really do.

White: Purity, innocence, light, safety, brilliance, and cleanliness are all linked with the colour white. Painting your complete house is currently a fad since it has a clean and sophisticated aspect, so a blank canvas that is pure white is pleasing and clear to look at. White provides mental clarity, a sensation of freshness, and a clutter-free appearance. Overuse of white, like other colours, may have detrimental consequences, with white being blinding in intense light. White is a great complementary colour since it goes with practically every other colour on the colour wheel.

Brown: Although it may appear to be boring and serious, brown may be connected with excellent quality, comfort, and friendliness and approachability. Another aspect of brown is its association with wholesomeness, nature, organics, the outdoors, and agriculture. The colour brown is paired with is also determined by the connotation it conveys; for example, brown and white might seem fashionable and sophisticated.

Grey: would have more negative than good features. On the one hand, this timeless and practical hue is emotionless, dark, dreary, and unclean, but in the appropriate environment, it is sophisticated, knowledge, and wisdom. Designers may use this great neutral, intermediate grey hue as a canvas. The 'grey' zone, or the space between black and white and emotionless, is well-known.

Burgundy: A shade lighter than maroon, burgundy is a hue that can be used to indicate power, wealth, and a higher social level. On the colour wheel, this is a refined yet serious colour. Because burgundy belongs to the wine colour family, many wine firms would utilise it in their branding.

Consumer emotions are effectively used in creative marketing to promote a product or service. Using colour as a tool to do so is a simple and low-cost approach to get the message across. Every hue has its unique meaning, as stated in the preceding section. Use this to your advantage as a business owner or marketer. If you're launching a new health drink, you're probably not going to use black as your primary hue since the connections that people make will be off. On the subject of artistic licence, I believe there is place for it. Sometimes a little shock value goes a long way! But always double-check that you know what you're doing and why. From their logo and website to social media and marketing literature, their brand colours can be found everywhere. However, these are just the obvious ones; business owners must also consider employee attire, shop layouts, and advertising. Make sure you've properly considered all of these factors before committing to a colour. Let's take a look at some well-known companies and the reasons why their colours are so effective.

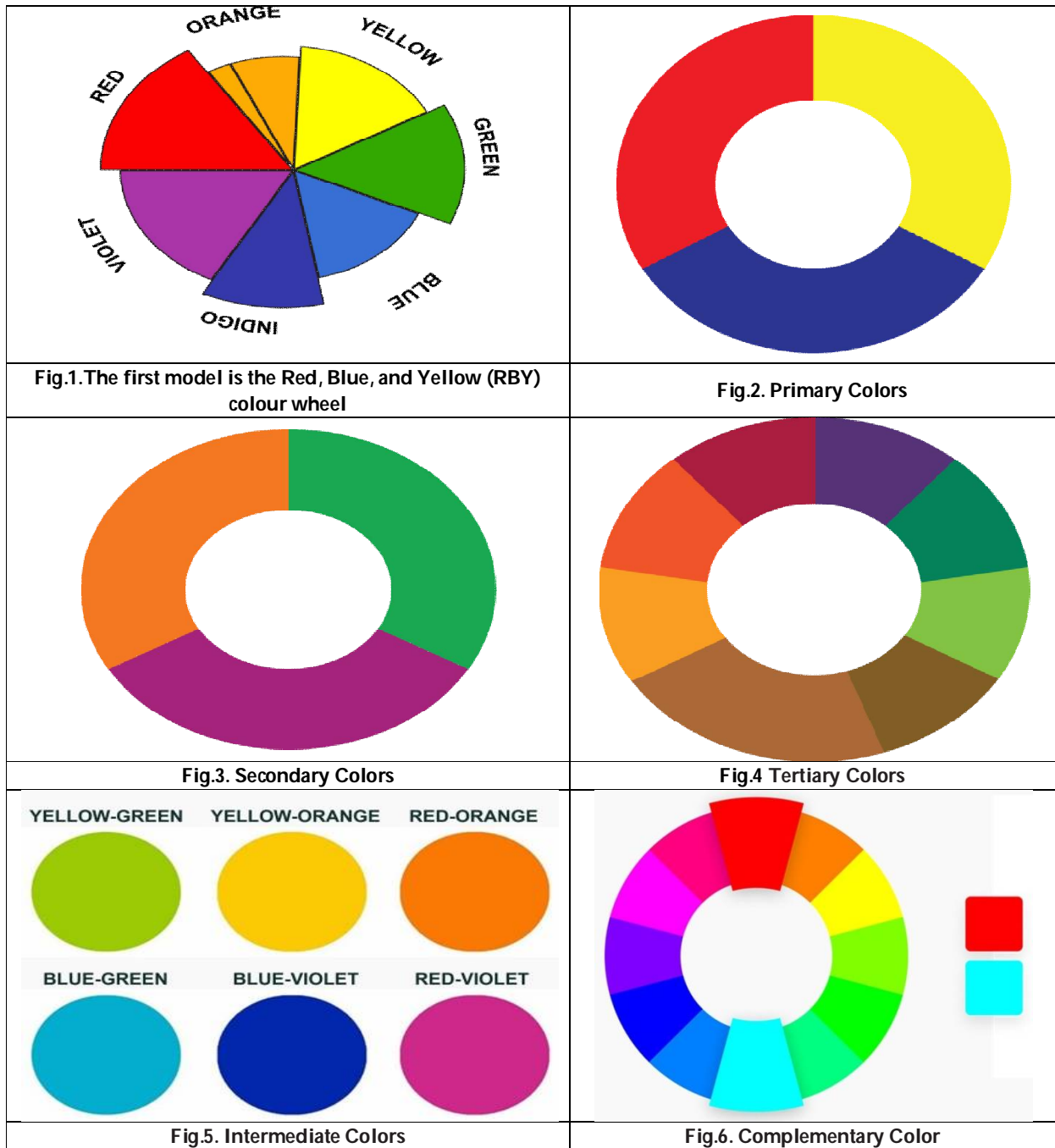
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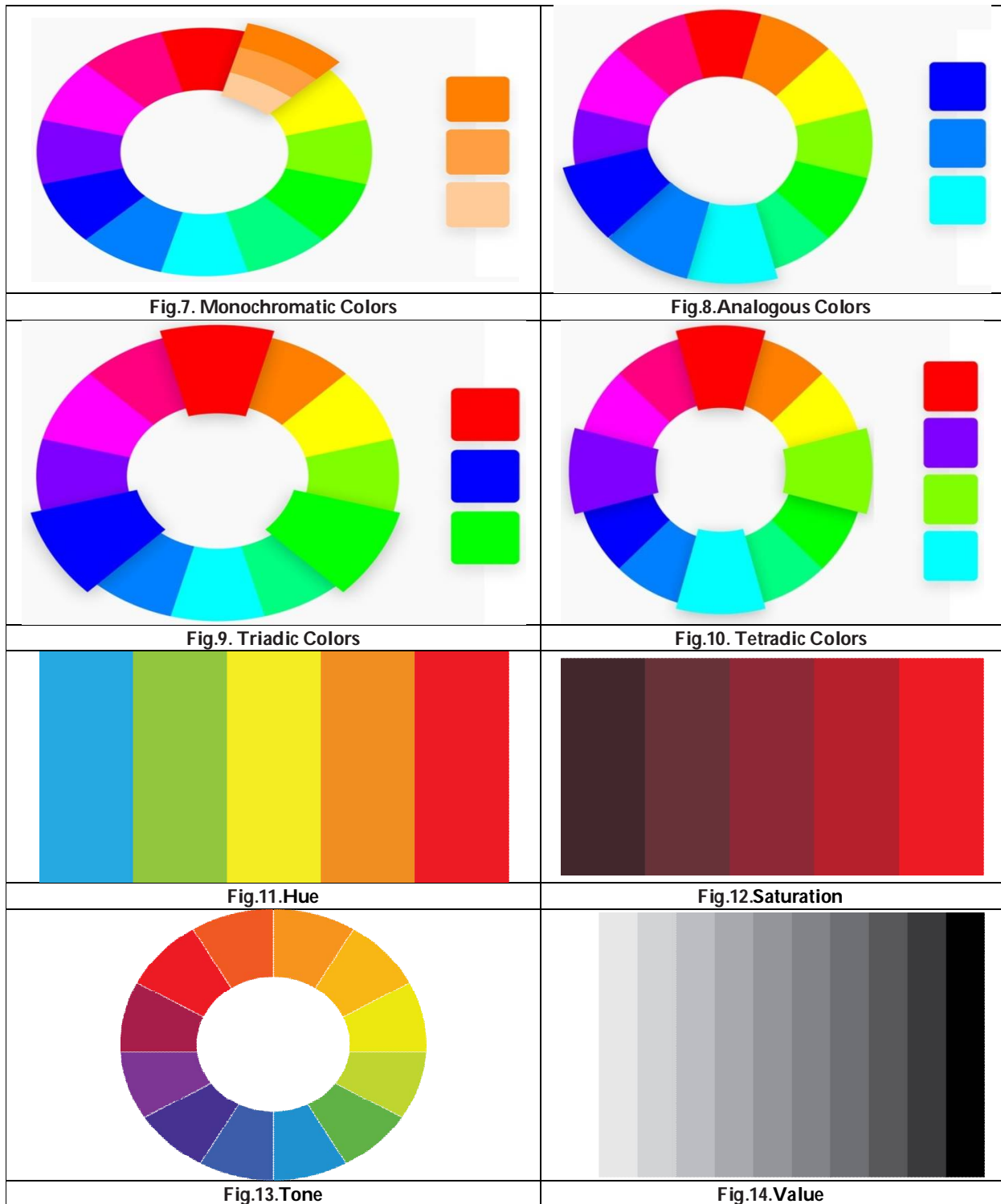


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Carbon Nanotube (CNT) Materials for Li-Ion Batteries: A Brief Overview

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ABSTRACT

Carbon nanotubes (CNTs) are an extraordinary discovery in the area of science and technology. Engineering them properly holds the promise of opening new avenues for future development of many other materials for diverse applications, Carbon nanotubes have open structure and enriched chirality, which enable improvements the properties and performances of other materials when CNTs are incorporated in them. CNTs are basically two types, one is single wall carbon nanotube and multi wall carbon nanotubes. Both single walled and multi walled CNTs are highly investigated in lithium-ion battery either as an anode material or as a conductive additive in the composite electrodes. It is worth mentioning here that the one-dimensional CNTs enable to store higher amount of lithium than the conventional graphitic carbon. In this review paper, a brief idea about the properties of CNTs, their synthetic method and apply for lithium ion batteries were demonstrated.

Keywords: carbon nanotubes (CNTs), energy applications, nanomaterials, lithium ions batteries

INTRODUCTION

Carbon is one of the most important elements on earth and it plays a crucial role in living organisms and modern technological world either as complex compounds or in its elemental form. Carbon has several allotropes (e.g., graphite, diamond, lonsdaleite, Buckyball and amorphous carbon etc)[1] and different morphological textures (nanotube, nanowire and graphene) [2]. Specific applications in devices and other uses are highly specific to the textures and nature of the allotrope of desired properties. Carbon nanotubes can be either as single-walled carbon



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nanotubes (SWCNTs) or multi-walled carbon nanotubes (MWCNTs)[2]. Simply a wrapped graphene sheet with a hollow fiber is the single-walled CNT[3]. On the other hand, a combination and collection of SWCNTs is the multi-walled CNTs. It should be noted that carbon nanotubes are designated as one-dimensional (1D) structures because of the long length-to-diameter ratio (aspect ratio)[4]. The electronic properties of CNTs are associated with the geometrical structure of them which is uniquely specified by a pair of indexes called chiral indexes (n, m). There are three typical types of CNTs can be obtained: armchair (n, n), zigzag ($n,0$), and chiral (n, m), depending on the orientation of the graphene lattice with respect to the tube axis they are twisted[5]. A single-walled CNT can be formed by rolling a single graphene in different directions. The local electronic character of carbon nanotubes is highly dependent on the carbon framework arrangements either zigzag or armchair. Also, there is a long-range defect which is formed by displacement or disorientation of standard nanocarbon structures, including hybridization of carbons, vacancies creation, and bond rotations[6]. It should be noted that graphite and CNTs have some characteristic properties and features, that enable them to be used in the energy storage and conversion systems[7]. It is worth mentioning that the carbon nanotubes (CNTs), have been envisioned to potentially impact different areas of science and technology due to their unique properties and structural features. Specifically, CNTs have very high tensile strength of 60 GPa and high electronic conductivity reported to be 108 Scm^{-1} and 107 Scm^{-1} for single-walled and multi-walled carbon nanotubes, respectively. CNTs have high thermal conductivity, high electrical conductivity, high tensile strength, highly flexible, good electron filed emitters and low thermal expansion[8].

Synthesis of Carbon Nanotube

There are many methods to synthesize CNTs, but these two methods are most important and commonly used methods. They are as follows[9].

Electric Arc Discharge Method

Carbon nanotubes are synthesized by electric arc discharge method which is also called Plasma Arcing method. In this method, a potential of 20–25 V is applied across the pure graphite electrodes separated by 1 mm distance and maintained at 500 torr pressure of flowing helium gas filled inside the quartz chamber[9]. When the electrodes are made to strike each other under these conditions it produces an electric arc. The energy produced in the arc is transferred to the anode which ionizes the carbon atoms of pure graphite anode and produces C^+ ions and forms plasma (Plasma is atoms or molecules in vapor state at high temperature)[10]. These positively charged carbon ions moves towards cathode, gets reduced and deposited and grow as CNTs on the cathode. As the CNTs grow, the length of the anode decreases, but the electrodes are adjusted and always maintain a gap of 1 mm between the two electrodes. If proper cooling of electrodes is achieved uniform deposition of CNTs are formed on the cathode which is achieved by inert gas maintained at proper pressure. By this method multi-walled carbon nanotubes are synthesized and to synthesize single walled carbon nanotubes catalyst nanoparticles of Fe, Co, and Ni are incorporated in the central portion of the positive electrode. The obtained CNTs are further purified to get the pure form of CNTs [11].

Chemical Vapor Deposition (CVD):

CVD is a technique in which the vaporized reactants react chemically and forms a nanomaterial product that is deposited on the substrate Figure 1. CNTs are synthesized by thermal CVD method by using hydrocarbon gas as carbon source[12]. In this method, a quartz tube is placed inside a furnace maintained at high temperature (500–900°C) heated by RF heater[13]. A crucible containing the substrate coated with catalyst nanoparticles is placed inside quartz tube filled with inert gas such as argon gas. The hydrocarbon gas (carbon source) is pumped into the quartz tube which undergoes pyrolysis reaction and forms vapor carbon atoms[14]. These carbon atoms bind to the substrate and join to each other by Vander-Waal force of attraction and grow as multi-walled carbon nanotubes (MWCNTs) on the substrate. To synthesize single-walled carbon nanotubes catalyst nanoparticles of Fe, Co, Ni are used. The obtained CNTs are further purified to get the pure form of CNTs[15].



**Soumya Ranjan Das et al.****CNT for Li-Ion Batteries (LIBs):**

Both single walled and multi walled carbon nano tubes are highly investigated in lithium-ion battery either as an anode material or as a conductive additive in the composite electrodes. It is worth mentioning here that the one-dimensional CNTs enable to store higher amount of lithium than the conventional graphitic carbon (specific capacity of 372 mAh g⁻¹)[16]. The CNTs exhibits reversible capacities range between 300 and 1250 mAh g⁻¹, depending on structure and morphology and defect concentration. The SWCNTs show first discharge capacity around 2500 mAh g⁻¹ with a voltage plateau between 1 and 2 V vs. Li/Li⁺. However, after first charge–discharge cycle the voltage profile varies based on the quality of CNTs and their pre-treatment[17]. It was prepared unetched SWCNTs by co-pyrolysis method and the measured capacity was 170 mAh g⁻¹ and 266 mAh g⁻¹ for differently treated two samples although the theoretical studies indicate that the reversible capacities should be more than 1116 mAh g⁻¹ (LiC₂ stoichiometry) as it is possible for single walled CNTs. Along with SWCNTs, researchers successfully demonstrated the lithium-ion intercalation into MWCNTs. It is interesting to note that the specific capacities around 8500 mAh g⁻¹ was reported for multi-walled CNTs at slow current rate (0.1 mA cm⁻²)[18]. On the Contrary, however, most of the carbon nanotubes show capacities typically less than 4000 mAh g⁻¹. A comparative study has been carried out on highly conductive, binder-free, free-standing flexible films made from three different types of carbon nanotubes (SWCNTs, DWCNTs and MWCNTs). They were able to show that the free standing MWCNT film was retain its capacity after hundreds of cycles, which is better than other CNTs films. It exhibits better specific capacity, at high current rate of 3C and good cyclic stability over 50 cycles. On the other hand, when flexible and free-standing pyridine-B-CNTs film was prepared using one-step floating catalyst chemical vapor deposition method, it delivers high specific capacity with excellent cycle stability of 548 mAh g⁻¹ after 300 cycles at 0.1 A g⁻¹. Up to now discussion was concentrated on the raw CNTs utilization in lithium-ion battery as an anode material[18]. Hereafter the discussion will be focused on the collective data for hybrid nanocomposites by incorporating CNTs into Li-storage compounds as new electrode (anode & cathode) materials. In this composite electrode, significance of π -orbital overlap in metallic type CNTs where electrons can transfer with mean free paths along the length of the nanotube (ballistic transport). So, when it is used as an additive, it will increase rate performance, especially combined with the poor electronic conductive cathode materials. Furthermore, CNTs have the mechanical and electrical properties along with a large surface area which is beneficial for lithium-ion battery composite electrode. The CNT was employed in silicon-based anode consisting of silicon nanowire/graphene sheet (SiNW@G) which was intertwined architectures where CNT can act either as conductive additive or active component depending on the operation voltage of the cell[19]. The application of carbon nanotubes as an additive for anode or cathode has huge advantages compared to other carbon form like amorphous carbon, acetylene black etc. As discussed above the CNTs have a high electrical conductivity at room temperature and very small amount (0.2% w/w) of CNTs will be able to create a percolation network for electronic conductivity and therefore, could increase orders of magnitude in electrical conductivity of composite electrodes and form better percolation network. CNTs have been employed as a conducting additive for LiCoO₂, LiNi_{0.7}Co_{0.3}O₂, LiFePO₄, LiMnPO₄ and LiNi_{0.5}Mn_{1.5}O₄ cathodes; showing better in the reversible capacity of the composite electrodes compared to other carbon polymorphs. The molybdenum dioxide was embedded with multiwalled carbon nanotubes (MoO₂/MWCNT) by hydrothermal process where hybrid composite consists of spherical flowerlike MoO₂ nanostructures interconnected by MWCNTs and exhibits reversible lithium storage capacity of 1143 mAh g⁻¹ at a current density of 100 mA g⁻¹. The zinc oxide was covered by N-doped carbon freestanding membrane electrodes for lithium-ion batteries and the hybrid material shows the high performance with a specific capacity (850 mAh g⁻¹ at a current density of 100 mA g⁻¹) and excellent cycling stability[20]. Figure 2 is represented that the performance of Li-ions batteries by using single and multiwall CNTs.

CONCLUSIONS

One-dimensional carbon nanotubes (CNTs) have been considered as potential candidates for the development of energy storage materials based on their unique chemical and physical properties. The architecture and quality of the CNTs plays a vital role on the electrochemical performances exhibited by Li ions batteries. It is observed that a slight modification (defects creation, heteroatoms doping & controlling the distribution of pore sizes) in the CNT structure



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brings out complementary properties that translate to excellent electrochemical performances. Anchored and directly grown aligned structure of CNTs trends to have high stability and fast ion transportation. The composite electrode with incorporated CNTs is being benefited from the high surface area, excellent conductivity, enhanced specific capacity, better cyclability and rate capability. CNTs can be used as an electrochemically active and inactive electrode component in Li ions batteries.

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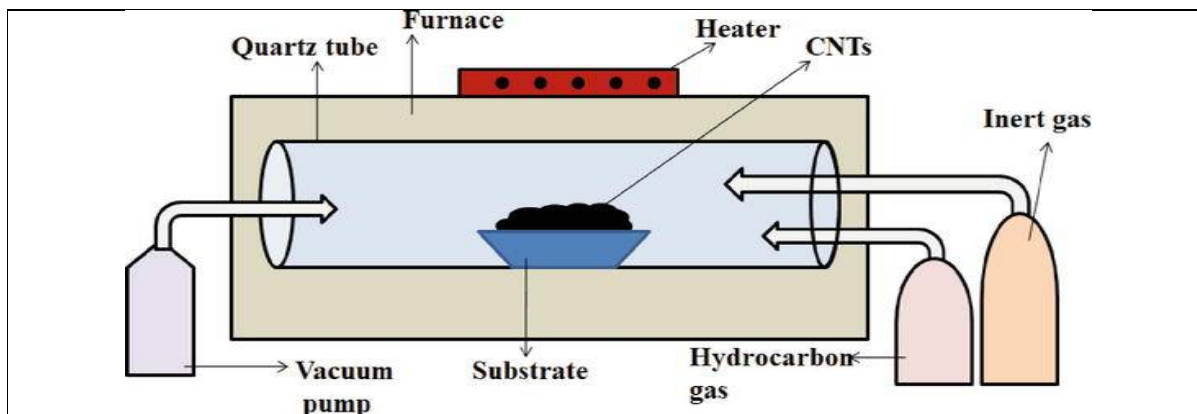


Figure 1. CVD Method [19]

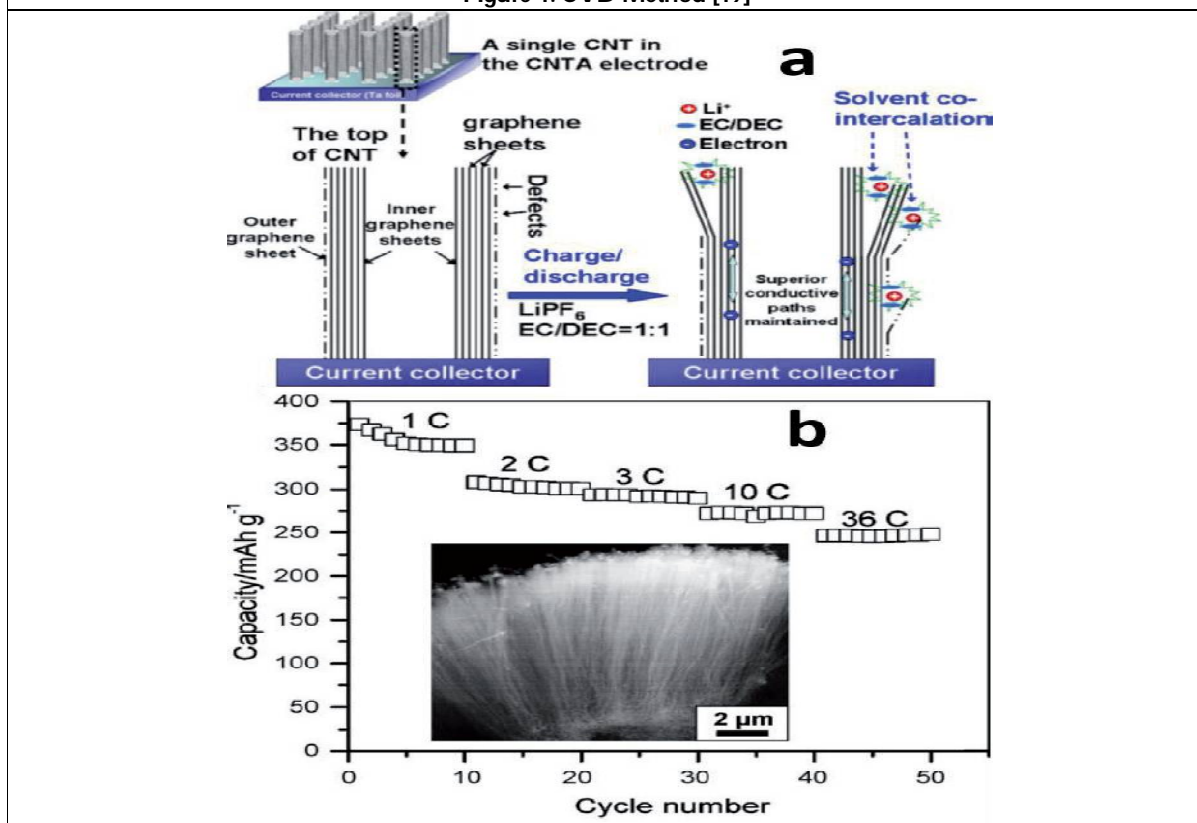


Figure 2. (a) Schematic representation of the microstructure of nanotube array and energy storage mechanism and (b) cycle performance of carbon nanotube array (CNTA) electrodes [19].





Formulation and Characterization of Raloxifene Hydrochloride Solid Dispersion

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ABSTRACT

The main objective of the current research was to enhance the solubility of the less soluble drug raloxifene hydrochloride by formulating solid dispersions. The drug's water solubility was determined to be 4g/mL. By using water-soluble carriers like Gelucire 50/13 and Poloxomer 188 different solid dispersions were. The prepared solid dispersions were characterized for their solubility, flow characteristics, and in vitro drug release studies. The samples were analyzed using a UV/Spectrophotometer and the dissolution efficiency (in vitro) was assessed using distilled water as the dissolution medium. A model diagram showed a linear increase in solubility in the phase diagram. The compatibility of drug excipients was determined using DSC and XRD studies, which revealed the change of crystalline drug to amorphous form. In the FTIR testing, no proof of interaction between the medication and the carriers was found. The solubility and dissolution of raloxifene hydrochloride were significantly improved in in-vitro drug release studies. When compared to pure medication, from solid dispersions. It was also discovered that when solid dispersions prepared with poloxomer 188 were compared to solid dispersions formed with gelucire 50/13, the improvement in solubility and dissolution rate was substantially greater. As a result, it can be inferred that solid dispersions can improve the solubility and dissolution of raloxifene hydrochloride.

INTRODUCTION

Several novel pharmacological compounds are classified as class II by the Biopharmaceutical Classification System (BCS). These Class II drugs are not water-soluble, but once dissolved, they are quickly absorbed via the stomach

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mucosa. As a result, the drug's bioavailability is revealed by its dissolving rate after ingestion [1,2]. The use of solid dispersion demonstrates a possible method to improve the dissolution rate. A drug is typically dispersed in a (hydrophilic) carrier or matrix to form a solid dispersion. The drug may exist as amorphous particles or as small crystals [3, 4]. An enhanced dissolution rate of the drug in the solid dispersion is aided by a porous structure available for dissolution, an enhanced saturation concentration of the material, and a lowered thickness of the diffusion layer. The chemistry of solid dispersions, as well as the manufacturing process, are two essential aspects that influence their dissolving behaviour [4, 5]. Solid dispersions can be beneficial for BCS class IV medications as well as BCS class II medications. Class IV medicines have a lower permeability due to their low solubility and permeability. While improved dissolution rates may not enhance permeability, increased dissolution behaviour provided by solid dispersions may enhance the overall bioavailability of these medicines [6, 7, 8].

The purpose of this research is to see how the type of carrier and other excipients employed in solid dispersions affect their dissolution behaviour. The solvent evaporation method was used to make the solid dispersions studied in this study. The fusion process, hot melt extrusion, solvent evaporation method, spray drying, freeze-drying, or supercritical fluid drying are the most commonly used methods for producing solid dispersions, as defined in the literature [9,10]. The therapeutic effect of drugs is determined by the concentration of the drug at the point of action. Except for drugs which are applied directly at the site of action or which that can be intravenously ingested, To reach the site of action, all drugs must be absorbed into the systemic circulation. Many factors influence bioavailability after oral administration (gastrointestinal route) (fraction of drug reaching the systemic circulation). Because only dissolved medications can pass across the gastrointestinal membrane, this is one of the explanations. On the other hand, drug metabolism in the intestinal lumen, intestinal wall, and liver can diminish its bioavailability. The rate of absorption and thus the onset and duration of the therapeutic effect are influenced by the drug's solubility and subsequent transport past the intestinal membrane and into the liver. The Biopharmaceutical Classification System (BCS), which is integrated, is based on these two aspects [11, 12].

For this study we have taken Raloxifene hydrochloride 2-(4-hydroxyphenyl)-3-((4-[2(piperidinyl)ethoxy]phenyl)carbonyl)-1-benzothiophen-6-ol is solid in nature with light yellow colour having melting point 143-147° C and insoluble in water but soluble in ethanol and DMSO. It's used to prevent and treat osteoporosis in postmenopausal women, as well as corticosteroid-induced bone loss prevention and treatment [13, 14, 15]. It's also used to prevent invasive breast cancer in postmenopausal women with osteoporosis or who are at high risk of developing it. Raloxifene hydrochloride binds to estrogen receptors, causing several estrogen-regulated genes to express differently in various tissues. Raloxifene has estrogen-like actions on bone, decreasing bone loss in postmenopausal women by lowering bone resorption and increasing bone mineral density. The antiosteoclastic effects of raloxifene and estrogens are mediated in part through the control of the gene that encodes the bone matrix protein transforming growth factor-3 (TGF-3). TGF-3 is induced by raloxifene via estrogen receptor-mediated pathways involving DNA regions other than those involved in the estrogen response.

The drug binds to the estrogen receptor in preosteoclastic cells and functions as an estrogen agonist, decreasing their proliferative potential. This inhibition is expected to help the drug's effect on bone resorption. Other mechanisms include inhibiting the promoter action of the bone-resorbing cytokine interleukin-6. Raloxifene often inhibits uterotrophic estrogen responses and antagonises estrogen's impact on mammary tissue. Raloxifene competes with estrogens for estrogen receptors in reproductive tissue, preventing the transcriptional activation of genes containing the estrogen response factor. In vitro, raloxifene fend off MCF-7 human mammary tumour cells from proliferating in response to estradiol. Although the actual mechanism of action of raloxifene is unknown, data suggests that the drug's tissue-specific estrogen agonist or antagonist effect is linked to structural differences in the raloxifene-estrogen receptor complex (particularly the surface topography of AF-2) as well as the estrogen-estrogen receptor complex. However, the presence of at least two estrogen receptors (ER, ER) may improve raloxifene's tissue selectivity [14, 16].





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MATERIALS AND METHODS

Reagents and chemicals

Raloxifene hydrochloride was received as a gift sample from Cipla Limited, Gelucire 50/13, Poloxomer 188, Sylloid, SLS, distilled water, Dichloromethane and chloroform, methanol was purchased from Vitane R& D Lab.

Equipment

Fourier Transform Infrared Spectroscopy, Dissolution apparatus, Differential Scanning Calorimetry, X-ray diffractometer, UV/Visible spectrophotometer.

Construction of standard graph of raloxifene hydrochloride

The drug was dissolved in a small amount of methanol in a volumetric flask (10 ml) containing (60 mg). Finally, 1 percent SLS was used to get the volume up to par. (Stock 1 = 1 mg/ml). From this, the secondary stock was rendered by combining 1 mL of primary stock in 10 ml of volumetric flask and diluting to the desired amount. (100g/ml Stock II) Different concentrations of solutions were prepared from the above stock solutions, namely 2, 4, 6, 8, 10, g/ml [17, 18].

Phase solubility studies

Phase solubility studies (Gelucire 50/13)

The technique defined by Higuchi and Connors was used to conduct the solubility tests. Using distilled water (5ml), different concentrations of Gelucire 50/13 solutions were prepared in concentrations of 2, 4, 6, 8, and 10%. A large volume of the drug was applied to each of these concentrations. The solutions were then shaken for 72 hours on a shaker. After centrifuging the samples for 72 hours, the supernatant was diluted appropriately and the concentration of raloxifene hydrochloride was determined using a UV spectrophotometer set to 284nm [19, 20, 21].

Phase solubility studies (Poloxamer 188)

The method defined by Higuchi and Connors was used to conduct the solubility studies. Using distilled water (5ml), different concentrations of poloxamer 188 solutions (2, 4, 6, 8, and 10%) were prepared. An excess amount of drug substance was applied to each of these concentrations, as well as an inert carrier sylloid. The solutions were then shaken for 72 hours on a shaker. After the samples were centrifuged for 72 hours, the supernatant was diluted appropriately and the concentration of raloxifene hydrochloride was determined using a UV Spectrophotometer set to 284 nm [27].

Preparation of solid dispersions

By using the solvent evaporation method solid dispersions were prepared that can be seen in table 1 and 2 (Table).

Characterization

Fourier Transform Infrared Spectroscopy (FTIR)

To characterize the potential interactions between the drug and the carrier in the solid-state, FTIR spectra were acquired using an IR prestige 21 Shimadzu model FTIR spectrometer. The samples were prepared using the KBr pellet method, and the spectra were obtained in the 4000–400 cm⁻¹ range [20 21].

Differential Scanning Calorimetry (DSC)

A differential Scanning Calorimeter was used to explore the sample's thermal behavior. DSC thermograms were taken with a Perkin-Elmer differential calorimeter to evaluate the DSC thermal traces. Solid dispersions and physical combinations of drug-carrier samples were mounted in a conventional aluminum tray. The instrument was calibrated with indium, and dry nitrogen was applied as a carrier gas at an 80 ml/min flow rate, with a scan speed of 10° C/min up to 300° C. Every sample measured 4.0 mg in weight [22].





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X- Ray Diffraction

Using an Xpert-Pro model X-ray diffractometer, an X-ray diffraction analysis was conducted to describe the physical shape of Raloxifene hydrochloride in samples from different batches. The findings were obtained using a Cu-target X-ray tube and a Xe-filled detector over a temperature range of 2–50° (2). The operating conditions were 45 kV voltage and 40 Ma current [22].

Micromeritic evaluation

Angle of repose: When granular materials in bulk are deposited onto a horizontal surface, they form a conical pile. The angle of repose is the internal angle formed by the pile's surface and the horizontal surface [23, 24].

Carr's index: The Carr index indicates powder's compressibility.

Hausner ratio: The Hausner ratio is a metric that relates to a powder's or granular material's flowability.

Analysis of dissolution data

Dissolution efficiency (DE %): it is outlined as the area under the dissolution curve up to a particular time (t), given as a percentage of the area of the rectangle representing 100 percent dissolution in the same period [19,25,26,28].

Mean dissolution time MDT (min): To determine the proportional degree of a dissolution rate increase from SDs, the mean dissolution time (MDT) was calculated.

In vitro dissolution study

The developed formulation's dissolution was completed. The following conditions are followed for the dissolution procedure.

- Dissolution medium – 1% SLS.
- Dissolution apparatus - USP apparatus II (paddle).
- Rpm was set to 50.
- The temperature of the medium was maintained to 37.5°C ±0.5°C.
- Time intervals - 5, 10, 15, 30, 45, 60, 90 minutes.
- λ_{max} -284nm.

Construction of standard graph of raloxifene hydrochloride by UV/Visible spectrophotometer

The standard graph of raloxifene hydrochloride has shown good linearity over a concentration range of 2-10 μ g/ml with R² of 0.9976. The equation was $y = 0.061x + 0.013$. This was utilized in the estimation of Raloxifene hydrochloride in dissolution samples as shown in table 3 and figure 1 (Table, Figure) [28].

RESULT AND DISCUSSION**Phase solubility study of Gelucire 50/13**

The phase solubility of Raloxifene hydrochloride using Gelucire 50/13 was investigated using various carrier concentrations, with the findings shown in table 4 and figure 2 (Table, Figure). The solubility of raloxifene hydrochloride improved as the concentration of Gelucire 50/13 was increased. The Gibbs free energy of the resultant solution reduces as the carrier saturation increases. The material is becoming more soluble as the Gibbs free energy decreases. The stability constant was determined to determine the stability of the drug-carrier complex. The A_L type phase solubility curve demonstrates the linear rise in solubility of raloxifene hydrochloride. The value of the stability constant 1498.45 shows a satisfactory complexation between the drug and the carrier. When a drug's solubility in water was compared to that of a drug with a 25% carrier, the solubility of the drug was enhanced by 24 times.



**Yashwant Giri et al.,****Phase solubility study of poloxamer188**

The phase solubility of Raloxifene hydrochloride using poloxamer 188 was investigated using various carrier concentrations, with the findings shown in table 5 and figure 3 (**Table, Figure**). As the concentration of poloxamer188 was increased, the solubility of raloxifene hydrochloride climbed. The Gibbs free energy of the resultant solution falls as the carrier concentration rises. The material is becoming more soluble as the Gibbs free energy decreases. The stability constant was calculated to indicate the drug-carrier complex's stability. In the A_L form process, the solubility curve for raloxifene hydrochloride follows a linear increase in solubility. The drug and carrier complexation is stable if the stability constant is 1275.73 (optimum stability constant). When a drug's solubility without a carrier was compared to that of a drug with a 25% carrier in water, the drug's solubility increased by 4.18 times.

Assay of raloxifene hydrochloride

Assay of Raloxifene hydrochloride of physical mixtures and optimized solid dispersions of poloxamer 188 and gelucire 50/13, as shown in table 6 (**Table**).

In vitro dissolution study report

The dissolution test results for the developed solid dispersions of Gelucire 50/13 and (1:5) physical mixture were contrasted to the pure drug outcomes (Raloxifene Hydrochloride), as shown in table 7 and figure 4 (**Table, Figure**). In the case of Gelucire 50/13, an in vitro dissolution analysis revealed that the drug released its full amount at the completion of 90 minutes. At the completion of 90 minutes, pure drug released 71 percent of the drug, while solid dispersion of 1:1, 1:3, and 1:5 released 60.68 percent, 65.38 percent, and 71.85 percent, respectively. However, a 1:5 physical mixture revealed 41% drug release. The heightened solubility and dissolution rate of raloxifene hydrochloride in solid dispersions is suggested by the dissolution efficiency in solid dispersions. At 30 minutes, the Initial Dissolution Rate was found to be 4.28 times higher than that of other solid dispersions and physical mixtures. However, Mean Dissolution Time and Mean Dissolution Rate values are used to compare the increase in Raloxifene Hydrochloride dissolution characteristics in solid dispersions.

Dissolution parameters

For the following in vitro dissolution data, the following dissolution parameters were calculated: Q15, Q90, DE15, DE90, Mean Dissolution Time (MDT), Mean Dissolution Rate (MDR), Initial Dissolution Rate (IDR), and t50 percent. That can be seen in table 8 (**Table**).

Q: What percentage of the drug is released at 15 and 120 minutes

DE: Dissolution efficiency at 15 and 120 min.

MDT, MDR, IDR, and $t_{50\%}$ (min): mean dissolution time, mean dissolution rate, initial dissolution rate and the time taken to release 50% of the drug and respectively.

Numbers denote the weight/weight ratio.

Dissolution profile of the pure drug, poloxamer 188 solid dispersions as well as Physical mixtures

The findings of the dissolution analysis for the developed solid dispersions of Poloxamer 188 and (1:5) physical mixture were in contrast to those of the pure drug (Raloxifene Hydrochloride), as shown in table 9 and figure 5 (**Table, Figure**). In the case of Poloxamer 188, an in vitro dissolution analysis revealed that the drug released its full amount at the end of 90 minutes. After 90 mins, pure drug had a maximum release of 4.74 %, while strong dispersion of 1:1, 1:3, and 1:5 had 63.07 %, 61.52 %, and 82.99 %, respectively. However, 65.01% of the substance was released from a 1:5 physical mixture. The dissolution efficiency in solid dispersions suggests that raloxifene hydrochloride has a higher solubility and dissolution rate in solid dispersions. After 30 minutes, the Initial Dissolution Rate was determined to be 4.28 times higher than that of other solid dispersions and physical mixtures. However, Mean Dissolution Time and Mean Dissolution Rate measurements are used to compare the rise in raloxifene hydrochloride dissolution characteristics in solid dispersions.



**Yashwant Giri et al.,****Dissolution parameters**

For the following in vitro dissolution data, the following dissolution parameters were calculated: Q15, Q90, DE15, DE90, Mean Dissolution Time (MDT), Mean Dissolution Rate (MDR), Initial Dissolution Rate (IDR), and $t_{50\%}$. That can be found in table 10 (Table).

Micromeritic evaluation report

The flow properties of solid dispersions developed with Gelucire 50/13 and Poloxomer 188 as carriers, as well as formulations formulated into capsules, were determined. Angle of repose, Carr's index, and Hausner's ratio are used in the micromeritic evaluation to assess the flow properties of the following formulations, which are described in table 11 (Table). The flow properties of Gelucire 50/13 and Poloxomer 188 solid dispersions indicate a poor flow. Reduced particle size and a lack of excipients may be to blame for the dispersions' weak flow.

Fourier Transform Infrared Spectroscopy

Figures 6 and 7 displayed the FTIR spectrum of pure raloxifene hydrochloride, as well as that of physical mixtures and optimal solid dispersions. The following vibrations have been observed in the spectrum of raloxifene hydrochloride: The length of the NH stretching is 3335.71 cm^{-1} . Stretching at various group vibrations is responsible for other characteristics bands: Stretching of the amide carbonyl is 1694.84 cm^{-1} , the other second amide band is 1526.62 cm^{-1} , the $-\text{SO}_2\text{-N}$ -group is 1433.59 cm^{-1} , and the ortho-disubstituted phenyl is 771.30 cm^{-1} . In both the solid dispersion and its corresponding physical mixture, the characteristic peaks of raloxifene hydrochloride and carriers (Gelucire 50/13, poloxomer 188,) were observed. This indicates that the drug and the carrier have no direct interaction.

Differential Scanning Calorimetry

The thermal behaviour of the samples was investigated using Differential Scanning Calorimetry. The peak for raloxifene was discovered to be around 260°C , while the peak for gelucire 50/13 was discovered to be around 55°C . The drug peak's intensity was reduced in a physical combination, and the drug peak was completely absent in solid dispersions. This could be because the drug has changed from a crystal to an amorphous state.

X-Ray Diffraction

High-intensity peaks were seen in the diffraction pattern of raloxifene at 2 theta values of 14.12° , 16.01° , 12.09° , 14.95° , 18.13° , and 27.82° . The sharp, powerful peaks could be explained by the drug's crystalline structure. Gelucire 50/13 and poloxomer 188 had intensity peaks at 27.73° , 22.34° , and 21.78° , respectively, in their diffraction patterns, When compared to the plain drug, the XRD pattern of developed physical mixtures and solid dispersions revealed a drop in both the number and intensity of peaks, indicating a fall in crystallinity or partially amorphization of the drug. The solid dispersions' peaks have decreased substantially, indicating that they are more amorphous than the physical mixture. In addition, no further peaks in the PMs and SDs could be attributed to the pure gelucire 50/13, poloxomer 188, implying that there was no chemical interaction between the two entities in the solid form. Aside from the potential of a chemical interaction and the development of a complex between the drug and the carrier, the positions of the gelucire 50/13 and poloxomer 188 patterns in the PMs and SDs were similar and superimposable. The data indicate that raloxifene hydrochloride is present in amorphous solid dispersion.

CONCLUSION

In all carriers investigated at increasing concentrations, the solubility of less soluble raloxifene hydrochloride enhanced, revealing an A_L type phase solubility diagram. The dissolution parameters revealed higher raloxifene hydrochloride dissolution in solid dispersions. The change of crystalline drug to amorphous form was demonstrated by DSC and XRD tests. In the FTIR investigations, there was no proof of interaction between the drug as well as the carriers. As a result, the solubility and dissolution rate of raloxifene hydrochloride were improved.





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Table 1. Formulation of Solid dispersions with Gelucire 50/13

FORMULATION	RALOXIFENE HYDROCHLORIDE	GELUCIRE 50/13	RATIO
PMG1	1	5	1:5
SDG1	1	1	1:1
S	1	3	1:3
DG2	1	5	1:5
SDG3	1	5	1:5

PMG=Physical mixture with Gelucire 50/13, SDG=Solid dispersion with Gelucire 50/13.

Table 2. Formulation of Solid dispersion with Poloxomer 188

FORMULATION	RALOXIFENE HYDROCHLORIDE	POLOXOMER 188	RATIO
PMP1	1	5	1:5
SDP1	1	1	1:1
SDP2	1	3	1:3
SDP3	1	5	1:5

PMP=Physical mixture with poloxomer 188, SDP=Solid dispersion with poloxomer 188.

Table 3. Standard graph of Raloxifene Hydrochloride in methanol

The concentration of Raloxifene hydrochloride ($\mu\text{g/ml}$)	Absorbance
2	0.1390
4	0.2687
6	0.3933
8	0.4939
10	0.6163

Table 4. Raloxifene Hydrochloride phase solubility research with varied concentrations of Gelucire 50/13

Polymer Concentration (% w/v)	Drug concentration (mg/ml)	ΔG°_{tr} (J/mole)
2	0.191	-
4	0.088	-0.34
6	0.142	-1.57
8	0.351	-2.74
10	0.360	-2.89
Stability Constant (ml/g)	1498.45	-





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R ²	0.995	-
Slope	0.074	-
Type of curve	A _L	-

Table 5. Phase solubility study of raloxifene hydrochloride using various concentrations of poloxamer188

Polymer concentration (% w/v)	Drug concentration (mg/ml)	ΔG° _{tr} (J/mole)
2	0.191	-
4	0.296	-1.24
6	0.315	-2.71
8	0.484	-2.93
10	0.567	-3.04
	0.595	-3.19
Stability Constant (ml/g)	1275.73	-
R ²	0.9861	-
Slope	0.4204	-
Type of curve	A _L	-

Table 6. Drug content of formulations

FORMULATIONS	DRUG CONTENT
PMG (1:5)	88.05± 1.63
PMP(1:5)	96.12±1.95
SDG (1:1)	73.83±1.85
SDG (1:3)	81.90±3.98
SDG (1:5)	92.31 ±2.91
SDP (1:1)	79.31±2.64
SDP (1:3)	91.52±1.90
SDP (1:5)	98.78±0.93

Table 7. Dissolution profile of the pure drug, Gelucire 50/13 solid dispersions and Physical mixtures

Time(mins)	Percentage drug release				
	P.D	P.MG (1:5)	SDG (1:1)	SDG (1:3)	SDG (1:5)
5	1.74±1.41	29.43±0.43	26.21±2.11	31.20±0.92	37.91±0.3
10	1.80±0.38	39.46±3.21	39.46±1.21	41.63±3.15	41.63±1.5
15	2.84±2.23	44.38±0.25	44.60±0.56	45.93±1.43	45.90±3.84
30	3.59±1.02	49.86±3.85	61.22±0.51	54.54±0.98	58.35±0.46
45	3.93±1.28	53.58±1.97	59.40±1.4	63.51±4.39	68.5±2.82
60	4.45±1.16	56.77±0.69	56.04±0.98	62.06±0.57	69.81±1.48
90	4.74±0.41	60.68±1.52	60.68±0.52	65.38±2.25	71.85±0.46

Table 8. Dissolution parameters of raloxifene hydrochloride, Gelucire 50/13 solid dispersions and Physical mixtures

Parameters	Q ₁₅	Q ₉₀	DE ₁₅	DE ₉₀	MDT	MDR	IDR	t _{50%} (min)
Raloxifene Hydrochloride	0.873	3.25	0.015	0.36	77.80	0.00	0.00	>90





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PM (1:5)	19.87	48.05	16.4	35.17	19.61	0.76	2.19	>90
SDG(1:1)	19.8	50.8	13.40	23.7	10.65	0.59	1.79	>90
SDG(1:3)	20.6	53.29	31.3	77.4	24.47	1.54	4.18	30
SDG(1:5)	20.08	57.9	32.1	78.8	28.15	1.53	4.28	15

Table 9. The dissolution profile of the pure drug, poloxamer 188 solid dispersions and Physical mixtures

Time(mins)	Percentage drug release				
	P.D	P.MP (1:5)	SDP(1:1)	SDP (1:3)	SDP (1:5)
5	1.04±1.41	28.45±0.82	21.63±1.34	25.40±1.64	27.24±1.59
10	1.80±0.38	38.80±2.28	28.67±2.13	46.47±3.41	44.23±2.77
15	2.04±2.23	41.58±1.97	33.95±1.02	54.07±3.77	59.78±1.69
30	2.59±1.02	44.82±2.87	60.95±2.02	62.87±3.05	97.83±2.44
45	4.93±1.28	49.45±0.82	60.07±3.77	62.36±0.66	90.17±1.54
60	4.45±1.16	59.38±2.25	60.27±0.49	63.54±0.98	87.38±3.85
90	4.74±0.41	65.01±2.39	63.073±2.77	61.52±4.59	82.99±1.18

Table 10. Dissolution parameters of raloxifene hydrochloride, poloxamer 188 solid dispersions and Physical mixtures

Parameters	Q ₁₅	Q ₉₀	DE ₁₅	DE ₉₀	MDT	MDR	IDR	t _{50%} (min)
Raloxifene hydrochloride	0.573	2.77	0.52	2.77	14.27	0.83	0.68	>90
PM (1:5)	19.87	48.05	16.4	35.17	16.21	2.76	2.19	>90
SDP(1:1)	19.8	50.8	13.40	23.7	12.65	1.87	1.79	>30
SDP(1:3)	62.6	69.29	31.3	77.4	11.47	1.94	4.18	15
SDP(1:5)	20.08	57.9	32.1	78.8	10.15	2.63	4.28	15

Q: Percent drug released at 15, and 120 min.

DE: Dissolution efficiency at 15 and 120 min.

MDT, MDR, IDR, and t_{50%} (min): mean dissolution time, mean dissolution rate, initial dissolution rate, and time is taken to release 50% of the drug and respectively.

Numbers represent the weight/weight ratio.

Table 11. Flow properties of Solid dispersions and formulations

Formulation	Angle of repose	Carr's index	Hausner ratio
SDG1	45	36	1.65
SDG2	43	37	1.67
SDG3	44	36	1.70
SDP1	43	34	1.73
SDP2	42	34	1.66
SDP3	43	35	1.72
	36	25	1.34





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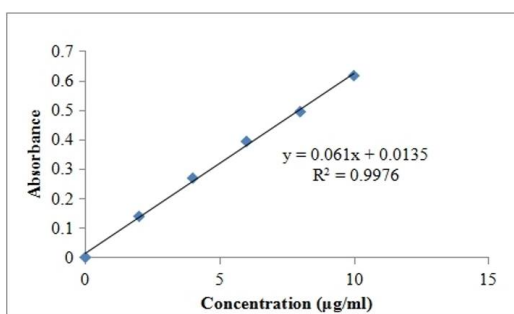


Figure 1. Standard calibration graph of raloxifene hydrochloride in 1% SLS.

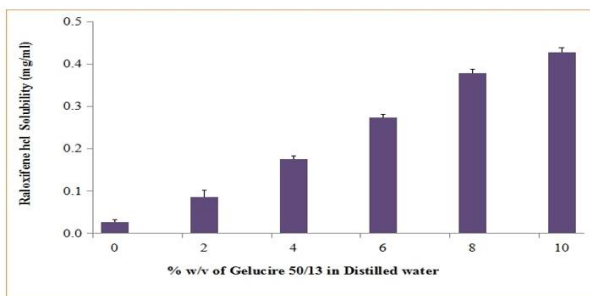


Figure 2. Gelucire 50/13 concentration-dependent solubility of raloxifene hydrochloride

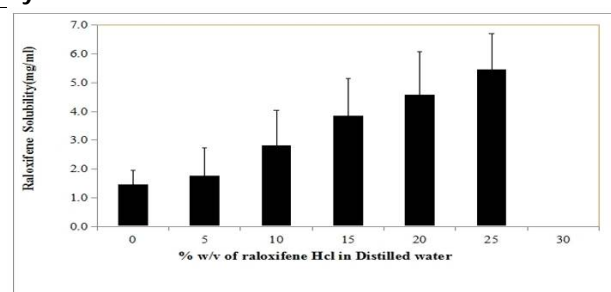


Figure 3. Poloxamer 188 concentration-dependent solubility of raloxifene hydrochloride.

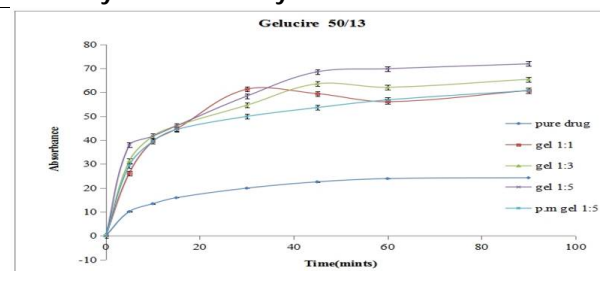


Figure 4. Dissolution profile of raloxifene hydrochloride/gelucire 50/13 at 1:1, 1:3, and 1:5 ratios in a prepared formulation, a physical mixture (PM of 1:5), and a solid dispersion (SD). Each point represents the standard deviation of the mean (n=3).

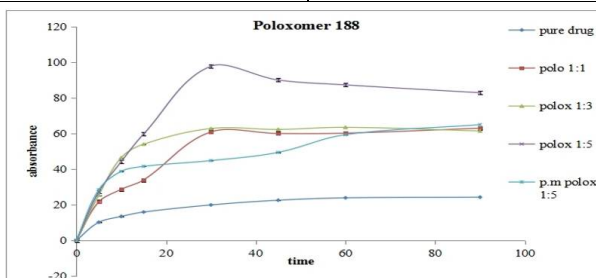


Figure 5. The dissolution profile of prepared formulation of raloxifene hydrochloride, physical mixture (PM of 1:5 ratio), and solid dispersion (SD) of raloxifene hydrochloride / poloxamer 188 at 1:1, 1:3, and 1:5 ratios. Each point represents the mean ± S.D. (n=3).





Design of an Electrically Powered Air Conditioned Electric Rickshaw

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ABSTRACT

Auto Rickshaws are a part of life of many Indian. Almost every city in India has them. They are found on the road ferrying passengers from one place to another. Electric Rickshaw has become very popular in recent times due to low running and maintenance cost, low noise and zero pollution. In this project an attempt has been made to incorporate an air conditioner of 1 TR in an E-rickshaw which is designed by using CATIA V6 software and fabricated in workshop. The cooling load has been properly estimated by calculating the dimensions of the inner space of rickshaw. Air conditioned temperature is found to be maintained at about 24°C with speed of around 40 km/hr. The maximum distance coverage capacity with a full charged battery is found to be 80 km.

Keywords: Design, Air-Conditioned, Electric rickshaw, Cooling effect

INTRODUCTION

One of the first attempts to design electric rickshaws was done by Nimbkar Agricultural Research Institute in late 1990s. They modified the cycle rickshaw and then converted to an electric one [1]. In India they are popularly known as E-rickshaws and are widely spread all over India [2]. They started to gain popularity in India since 2011. The design is now much different from cycle rickshaws. They have provided with services to city and have also contribution in providing livelihood to people in India. Due to their low cost and high efficiency they are accepted on the Indian streets. In India almost all claimed to be manufacturing the vehicle are merely importing it from China and assembling them. Those the manufactures in India are less in number, Manufactures claim that in the vehicle production is less and cost is a little at higher but they offer higher quality products and also offer services and warranty, these manufacturers market the product as an Indian make and are also popular because of uniqueness in their product and providing a branded better quality product. The Fibre reinforced polymer body E-rickshaw are also popular in India and are manufactured in India due to high shipment cost from china they are cheaper to Indian manufacturer, where Chinese version of Fibre reinforced polymer Rickshaw will cost 1.5 times more than an Indian manufacturer [3]. These are issues with services due to lack of established companies and just about everyone importing and selling them from china, resulting in problems to their customers, this is the reason consumers have



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started gaining knowledge and prefer more durable version From well established companies and Indian manufacturer. Since 2011 E-rickshaws are became popular cause of commercial use, but as we know these vehicles are not much comfortable as compare to conventional 3 wheelers or commercial vehicles. So this Air conditioning E-Rickshaw is the solution for this type of problems. It enhances the overall experience of passenger as well as driver [4]. Due to more comfortable seating position and Air conditioning system passenger will get a good ride experience. We can regulate the temperature as per our requirements. Use of Fibre gives an attractive visual effect with much lighter weight than regular metal body E-rickshaw.

Concept of the Product

The E-rickshaw with air conditioning system is a one driver and two passenger vehicle types. It has two doors. Fibre body has been used rather than metallic body to reduce the weight of the vehicle. Due to the low budget of the E-rickshaw, lead acid batteries are preferred rather than Li-ion battery because Li-ion battery costs 2.5 times more than lead acid batteries. BLDC motor is used to drive the vehicle along with differential unit to cause the speed difference of rear wheel while taking a turn. As per the simplicity of design, it has been decided that the compressor and the condenser to be placed in the rear side of the vehicle. The power source and the components like evaporator, blower and the expansion valve are placed inside the cabin. The evaporator unit is installed on the ceiling in between driver and passenger.

Design of the Product**Design of air conditioning system**

To get a good amount of cooling effect, the Heat load calculation is done as shown in table-1.

Dimension inside of the compartment. Height – 1.45meter, Length – 2.1 m, Width – 1m

Capacity of air conditioner= Total heat load/3000

Therefore the capacity of air conditioner is 0.4 TR

Specification of other Components

Compressor – 1/6th H.P. Rotary

Condenser – 250 x 150 mm

Evaporator – 200x 150mm

Drier Filter – XH-7 activated alumina

Capillary tube – 0.031 inch diameter length 1.5 m.

Discharge tube – 1/4th inch diameter

Suction tube – 5/16th inch diameter

Evaporator Fan – Box type fan ac

Condenser fan – High speed fan ac

Inverter – 1500 kVa

Battery – 1500 Mh 12 V dc

Insulation – As required

Wire – 1.5 mm² as required

Refrigerant – R134a as required

RESULTS

The testing results obtained were as follows:

- 25 km was the maximum speed that can be achieved from the vehicle.
- A range of 60-80 km was obtained on a single charge.
- It took 7 to 8 hours to fully charge the vehicle.
- Got approximately 24 to 25 degree Celsius from the AC unit.
- Took 5 to 10 minutes to get a good cooling effect for passenger





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CONCLUSION

The design and development of air conditioned electric rickshaw was successfully completed. The testing results obtained are acceptable considering the present capacity of battery. Some unwanted leakages which can be filled to get a better cooling effect. A major issue during the testing of the vehicle that the circulation of the cooling air was not so impressive due to that the driver was not getting more cooling effect. It could be solved by adding one extra blower towards driver side.

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Table 1: Heat load calculation chart

OBSERVATION	COMPONENTS	MULTIPLIER	HEAT LOAD in KCal
	A	B	C = A x B
Wall - West	1.45 m ²	35	50.75
Wall – South	3.045 m ²	35	106.575
Wall – East	1.45 m ²	25	36.25
Wall – North	3.045 m ²	25	76.125
Window (glass)West	0 m ²	300	0
Window (glass)South	0.32 m ²	175	56
Window (glass)other	0	150	0
Glass panels Internal	0	100	0
Ceiling exposed	2.1 m ²	60	126
Ceiling unexposed	0	30	0
Flooring	2.1 m ²	10	21
Occupants	3 Numbers	125	375
Lighting	0	1	0
Elect. Appliances	0	900	0
Volume of fresh air	3.045 m ³	6	18.27
Sub-total			865.97
Allowance*			86.597
Total heat load			952.567
Allowance**			346.388
Total heat load			1212.358

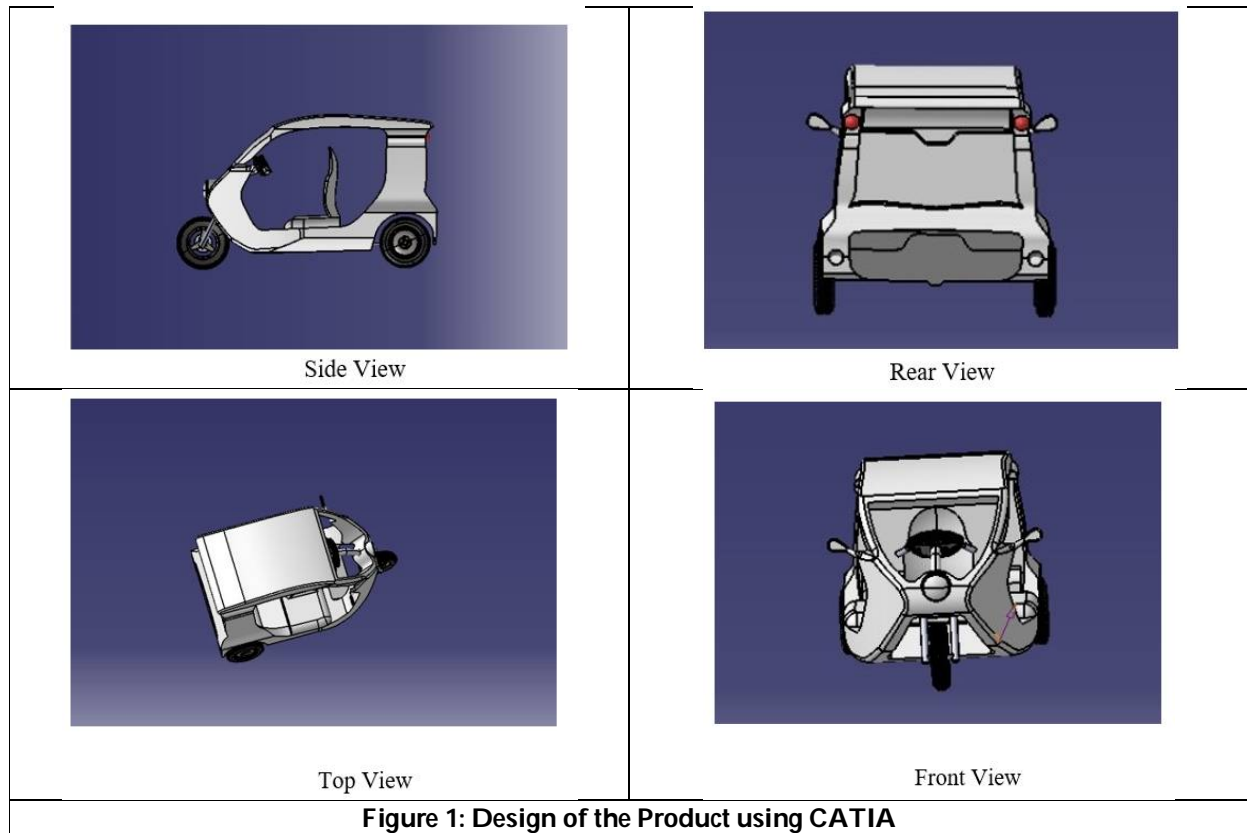
Allowance*: 10% for towns where air temp. is upto 35C & high humidity.ex. Mumbai, Chennai, Cochin, Kolkata. etc.

Allowance**: 40% for towns where air temp. is above 35C & low humidity. Ex. Ahmedabad, Bhopal, Nagpur, Jaipur. etc.





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Differential Interaction of Functional Domain Mutants of SMC1A with RAD21

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ABSTRACT

In all species, the structural maintenance of chromosomes (SMC) proteins are required for effective chromosomal transmission during genome replication and segregation. SMCs are found in bacteria as single proteins, and in eukaryotic as at least six different proteins. The proteins are between 110 and 170 kDa in size and include five different domains: amino- and carboxy-terminal globular domains, which contain ATPase sequences, two coiled-coil sections separating the terminal domains, and a central flexible hinge. SMC proteins collaborate with other proteins in chromosome condensation, sister-chromatid cohesion, recombination, DNA repair, and epigenetic gene silencing, among other chromosomal transactions. The SMC complexes, which comprise cohesin, condensin, and the Smc5/6 complex in eukaryotic cells, are essential regulators of chromosomal dynamics, controlling sister chromatid cohesion, chromosome condensation, DNA replication, DNA repair, and transcription. In this study, the H-DOCK module was used to predict the docking scores for protein-protein interactions and it was observed that the docking score for wild-type SMC1A-RAD21 was -236.31. The docking score for SMC1A (Δ 1-100)-RAD21 was -233.89. The docking score for SMC1A (Δ 101-200)-RAD21 was -251.74. The docking score for SMC1A (Δ 201-300)-RAD21 was -228.93. The docking score for SMC1A (Δ 301-400)-RAD21 was -222.71. The docking score for SMC1A (Δ 401-500)-RAD21 was -222.59.

Keywords: SMCs, DNA repair, H-DOCK, Docking score



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INTRODUCTION

At least six genes encoding structural maintenance of chromosomes (SMC) proteins have been found in eukaryotes, and they are conserved from yeast to humans [1, 2]. In rare cases, additional genes have been identified with tissue-specific expression patterns or additional activities. The SMC genes were discovered in the budding yeast *Saccharomyces cerevisiae* using genetic screening [3]. Defects in SMC proteins disrupt chromosomal segregation, as their original name "stability of minichromosomes" implies, and hence SMCs are almost always required for survival. Both biochemical and genetic techniques have been used to identify SMC genes in vertebrates, including yeasts (*Saccharomyces cerevisiae* and *Schizosaccharomyces pombe*), worms (*Caenorhabditis elegans*), insects (*Drosophila melanogaster*), and plants (*Arabidopsis thaliana*). The evolutionary conservation of SMC genes extends to prokaryotes; several prokaryotic species have a single gene, though *Bacillus subtilis* has two genes (encoding proteins that are 95 percent identical to each other) and *Aquifex aeolicus* has a second potential SMC gene (the two encoded SMC proteins are only 20% identical to each other). Although *Escherichia coli* lack a gene producing a true SMC protein, it does contain a functionally conserved gene called mukB [4, 5]. SMC proteins are big (between 110 and 170 kDa) and are divided into five distinct domains. Several SMC dimers include amino- and carboxy-terminal globular domains, separated by a rod with a central, flexible hinge, as revealed by rotary shadowing electron microscopy [6]. The rod domain is predicted to be an extended coiled-coil based on sequence analysis. The dimers are stacked in a counter-clockwise direction. The proteins are present in eukaryotic cells as heterodimers of SMC1 and SMC3, SMC2 and SMC4, and SMC5 and SMC6 (previously known as Rad18) [1, 7]. The amino- and carboxy-terminal globular domains of SMC proteins have a lot of amino-acid sequence similarities between species. The amino-terminal domain comprises a nucleotide-binding domain known as 'Walker A' (GxxGxGKS/T in single-letter amino-acid coding), which has been demonstrated to be crucial in various proteins through mutational investigations. A region (the DABox) in the carboxy-terminal domain resembles a 'Walker B' motif and a motif with a resemblance to the characteristic sequence of the ATP-binding cassette (ABC) family of ATPases. Inside the SMC1-SMC4 group, sequence homology within the carboxy-terminal domain is rather strong, but SMC5 and SMC6 exhibit some divergence in both of these regions. When the amino- and carboxy-terminal domains of two SMCs bind together in a heterodimer, they have not only sequence but also structural similarities with ABC proteins. DNA is bound by SMC proteins, and the DNA-binding region of SMC1 has been localized to the carboxy-terminal domain [8]. The six eukaryotic core SMCs (SMC1-SMC6) interact with other proteins to generate functional complexes. The cohesin complex, which includes two additional proteins (sister-chromatid cohesion proteins Scc1 and Scc3) and is essential for sister-chromatid cohesion during mitosis, comprises SMC1 and SMC3. During replication, the cohesin complex is loaded onto DNA [2]. SMC2 and SMC4 are members of the condensin complex, which also includes three additional proteins (CAP-D2/Cnd1, CAP-H/Cnd2, and CAP-G/Cnd3) and are involved in chromosomal condensation during mitosis [1, 2]. During mitosis, condensin is found along chromosomes. In *C. elegans*, proteins similar to SMC2 and SMC4 (MIX1 and DPY-27, respectively) have been demonstrated to inactivate gene expression on the X chromosome in XX hermaphrodites, a mechanism known as dosage compensation [9, 10]. In *Drosophila*, which also requires topoisomerase II, another important enzyme, for chromosomal condensation, a silencing role for the condensin subunit Barren (CAP-H/CND2) has been discovered [11]. The function of the SMC5 and SMC6 proteins is much less understood. In *S. pombe*, the SMC6 corresponds to the Rad18 protein, and hypomorphic mutations cause DNA repair and checkpoint signaling problems, while SMC6 appears to be involved in recombination-based repair mechanisms in yeast and *Arabidopsis* [7, 12, 13, 14, 15]. Although the essential function of the proteins is unknown, the SMC5 and SMC6 genes are necessary in yeast. Although rad18 mutants in *S. pombe* demonstrate genetic connections with topoisomerase II and Brc1p, a BRCT-domain protein, the identity of their binding partners is unknown [12, 16]. SMC5 and SMC6 are also members of a multi-protein complex, but the identification of their binding partners is unknown. SMC6 is found on chromatin in both *S. pombe* and human cells, albeit it is not found on mitotic chromosomes in the latter [7, 12]. In the late meiotic prophase, murine SMC6 localizes to the sex chromosomes and is strongly expressed in the testis [7]. SMC1 and SMC3 are thought to form an antiparallel heterodimer as the core of the cohesin complex, which is needed for sister chromatid cohesion during replication and also participates in recombination as part of the RC-1 complex with DNA polymerase and ligase III [2, 17, 18, 19, 20, 21]. SMC1A and



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SMC1B are two distinct isoforms of SMC1 that have been found in humans. The mitotic cohesin complex, which consists of SMC1A, SMC3, Rad21, and SA1 or SA2, has SMC1A as its main component. SMC1B, also known as SMC1B, REC8, or STAG3, is a meiotic-specific member of the cohesin complex that plays a vital role in sister chromatid pairing and limiting telomere shortening. SMC1B is also expressed in somatic mammalian cells as a component of a mitotic cohesin complex that maintains genome stability in response to irradiation, according to recent research. SMC1A is an important regulator of cell cycle progression. SMC1A is thought to have a role in cancer development, according to recent research. SMC1A is a key player in the development of colorectal cancer (CRC) and might be a predictor of CRC in individuals. It promotes early tumor growth and tumorigenesis by affecting epithelial-mesenchymal transition (EMT), producing inflammatory mediators, and attracting downstream target molecules. Hepatocellular carcinoma (HCC) is malignant cancer with a dismal prognosis that affects people all over the world. In human malignancies, the structural maintenance of chromosomes (SMC) gene family has been demonstrated to play a significant role. Nonetheless, the involvement of SMC members in HCC remains a mystery. SMC1A, SMC1B, SMC2, SMC4, and SMC6 mRNA expression levels are considerably overexpressed in HCC, while SMC1A, SMC2, SMC3, SMC4, SMC5, and SMC6 protein levels are similarly raised, according to studies. Furthermore, HCC patients with high SMC2 and SMC4 expression have a bad prognosis. The current study emphasizes the importance of SMC1A and RAD21 in maintaining cellular homeostasis and thus aligns with one of the objectives on United Nations formulated Sustainable Development Goals (SDGs); SDG3 which ensures healthy lives and promotes well-being for all at all stages. In this study, we focused on the structural and functional aspects of various domains and motifs of SMC1A, primarily involved in interaction with RAD21.

METHODOLOGY**Determination of protein sequences and putative protein partners**

Freely accessible database of protein sequence and functional information is found from Uniprot. It contains a large amount of information about the biological function of proteins derived from the research literature. It is also a database which comprises many other databases such as Uniprot knowledgebase (UniportKB), the Uniprot reference clusters (UniRef) and the Uniprot Archive (UniParc). The Uniprot consortium collaborated with the European Bioinformatics Institute (EBI), the Swiss Institute of Bioinformatics (SIB) and the Protein Information Resources (PIR). EBI developed large resources of bioinformatics databases and services. SIB is the founding centre of the swissport group and maintains the EXPASY (Expert Protein Analysis System) server a central resource for proteomics databases and tools. Likewise PIR is the oldest sequence which to be considered as analysis and sequences the structure of protein. Also classifies the protein sequences in this tool. It is the database finds out from uniprot shows that how one protein interacts with more than one protein. It is the functional protein association networks which also opened in NCBI by the server <https://string.db.org/>. Protein sequences and putative protein partners of SMC1A and RAD21 were retrieved from UniportKB and STRING.

Determination of three-dimensional configurations of proteins

Protein Data Bank (PDB) was used for retrieving the protein structures. Swiss model is the part of Swiss-ProtKB is used as a structural bioinformatics web server dedicated for homology modeling of 3D protein structure. Homology modeling is currently the most accurate methods to generate reliable 3D protein models and is routinely used in many practical applications. Homology modeling method makes use of experimental protein templates to build models for evolutionary related targets. Three dimensional configurations of proteins of SMC1A and RAD21 were obtained from Swiss-Prot. It is accessed in the web server <https://swissmodel.expasy.org/>.

Visualization of three dimensional protein structures

The three dimensional structures of native proteins and interaction of proteins were primarily visualized by PyMOL. PyMOL is an open source but proprietary molecular visualization system created by Warren Lyford DeLano. The private software company by DeLano scientific LLC dedicated to creating useful tools that become universally accessible to scientific and educational communities. Currently it is commercialized by Schrodinger,inc.as original



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software license was a permissive license they were able to remove it, new versions are no longer released under the python license, but under a custom license and some of the source code is no longer to be released. PyMOL can produce high quality 3D images of small molecules and biological macromolecules such as proteins. According to original author by 2009, almost a quarter of all published images of 3D protein structures in the scientific literature were made using PyMOL. It is one of the few mostly open source model visualization tools available for use in structural biology. It uses OpenGL Extension wrangler library (GLEW) and free GLUT and can solve poisson Boltzmann equation using adaptive poisson Boltzmann solver. Anyone can either compile an executable from the python licensed source code or pay for a subscription to support service to obtain access to precompiled executable.

Protein-protein interactions

Protein-protein and protein-DNA/RNA interactions play a fundamental role in a variety of biological processes. Determining the complex structures of these interactions is valuable in which molecular docking has played an important role. HDock is the novel web module of our hybrid docking algorithm of template based modelling and free docking in which cases with misleading templates can be rescued by the free docking protocol. We retrieve our data of protein-protein interaction by using the server <https://hdock.phys.hut.edu.in/>.

RESULTS AND DISCUSSIONS**Domain organization and putative protein partners of SMC1A**

Structural maintenance of chromosome protein 1A, (SMC1A) is involved in chromosome cohesion during the cell cycle and in DNA repair (Figure 1). The cohesin complex is required for the cohesion of sister chromatids after DNA replication. At anaphase, the complex is cleaved and dissociates from chromatin, allowing sister chromatids to segregate. SMC1A has 1233 amino acid residues, whereby the "Hinge" regions spread from 515 to 629 amino acid residues (Figure 1). The putative protein partners of SMC1A were found to be NDC80, RAD21, RAD21L1, SMC3, STAG1, STAG2, STAG3, NIPBL, PDS5B, and PDS5A out of which RAD21 was taken for our study (Figure 1).

The protein-protein interaction of Wild-type SMC1, mutants with RAD21

Using the H-DOCK module, the docking scores for protein-protein interactions were predicted. The Wild-type and domain mutants of SMC1 were included for this study. It was observed that the docking score for Wild-type SMC1A-RAD21 was -236.31 (Figure 2). The docking score for SMC1A(Δ 1-100)-RAD21 was -233.89 (Figure 3). The docking score for SMC1A(Δ 101-200)-RAD21 was -251.74 (Figure 4). The docking score for SMC1A (Δ 201-300)-RAD21 was -228.93 (Figure 5). The docking score for SMC1A (Δ 301-400)-RAD21 was -222.71 (Figure 6). The docking score for SMC1A (Δ 401-500)-RAD21 was -222.59 (Figure 7). The docking score for SMC1A (Δ 1-100)-RAD21 was -233.89 (Table 1; Figures 2-7). The N-terminal 100 amino acids of SMC1A are vital for interaction with RAD21 since the deletion of initial amino acid residues resulted in weak interaction between SMC1A (Δ 1-100)- and RAD21 with respect to wild-type SMC1A-RAD21 interaction. However, it was observed that the docking score for SMC1A (Δ 101-200)-RAD21 interaction was slightly elevated to -251.74 suggesting that the amino acid residues spreading from 101-200 residues did not affect the strength of interaction between two proteins rather it is quite relevant that this domain might regulate the interaction of SMC1A with RAD21. Interaction between SMC1A and RAD21 (Wild Type) was carried out using HDock and their Docking Score was retrieved.

CONCLUSION

Using the H-DOCK module, the docking scores for protein-protein interactions were predicted and it was observed that the docking score for Wild-type SMC1A-RAD21 was -236.31. The docking score for SMC1A (Δ 1-100)-RAD21 was -233.89. The docking score for SMC1A (Δ 101-200)-RAD21 was -251.74. The docking score for SMC1A (Δ 201-300)-RAD21 was -228.93. The docking score for SMC1A (Δ 301-400)-RAD21 was -222.71. The docking score for SMC1A (Δ 401-500)-RAD21 was -222.59. The docking score for SMC1A (Δ 1-100)-RAD21 was -233.89. The N-terminal 100 amino acids of SMC1A are vital for interaction with RAD21 since the deletion of initial amino acid residues resulted



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in weak interaction between SMC1A ($\Delta 1-100$)- and RAD21 with respect to wild-type SMC1A-RAD21 interaction. However, it was observed that the docking score for SMC1A ($\Delta 101-200$)-RAD21 interaction was slightly elevated to -251.74 suggesting that the amino acid residues spreading from 101-200 residues did not affected the strength of interaction between two proteins rather it is quite relevant that this domain might regulate the interaction of SMC1A with RAD21. Our results steps way forward in improving our understanding on the functional aspects of critical protein factors such as SMC1A and RAD21.

Statements and Declarations

Competing Interests

The authors declare that they have no conflict of interest.

Ethical Approval and consent to participate

No ethics approval is required.

Consent to publish

Not applicable.

Human and animal rights

No animals were used in the study.

Availability of data and materials

Not applicable.

Credit authorship contribution statement

All the authors have substantial contribution for the preparation of the manuscript. Gagan Kumar Panigrahi conceived the idea. Data curation and writing: Abhijeet Pattjoshi, Ankita Priyadarshini, Roshni Prinkit Bal, Annapurna Sahoo, Tan Thakur and Gagan Kumar Panigrahi. All the authors have read and approved the final manuscript before submission.

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Table 1: Docking score of protein-protein interactions of wild-type and mutants of SMC1A with RAD21

SI.NO	INTERACTION OF SMC1A WITH RAD21	DOCKING SCORE
1.	SMC1A - RAD21	-236.31
2.	SMC1A (Δ 1-100) – RAD21	-233.89
3.	SMC1A (Δ 101-200) – RAD21	-251.74
4.	SMC1A (Δ 201-300) – RAD21	-288.93
5.	SMC1A (Δ 301-400) – RAD21	-222.71
6.	SMC1A (Δ 401-500) – RAD21	-222.59



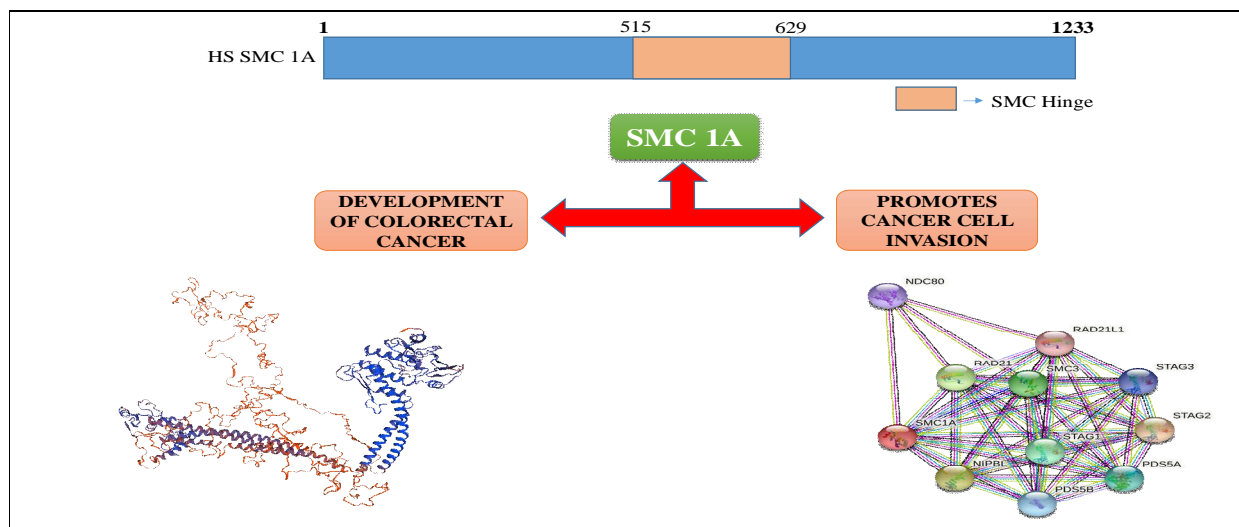


Figure 1: Domain Organization, 3D structure, and Putative partners of SMC1A

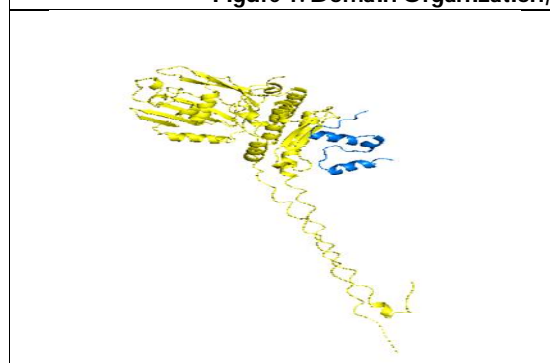


Figure 2: Interaction between SMC1A and RAD21: The docking score for the interaction between SMC1A and RAD21 was found to be: -236.31.

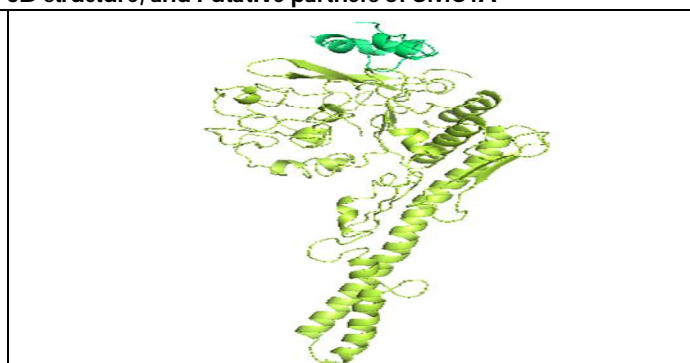


Figure3: Interaction of SMC1A (Δ1-100) with RAD21: The docking score for the interaction between SMC1A (Δ1-100) and RAD21 was found to be: -233.89.

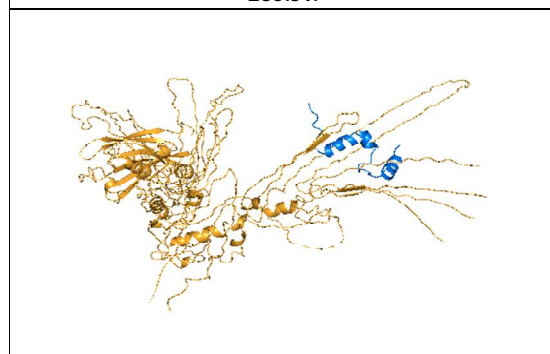


Figure 4: Interaction of SMC1A (Δ101-200) with RAD21: The docking score for the interaction between SMC1A (Δ101-200) and RAD21 was found to be: -251.74.

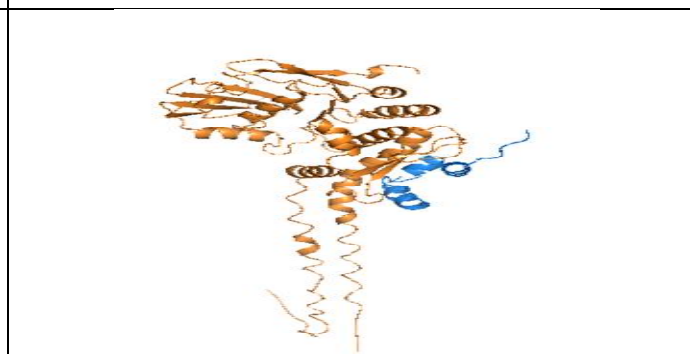


Figure 5: Interaction of SMC1A (Δ201-300) with RAD21: The docking score for the interaction between SMC1A (Δ201-300) and RAD21 was found to be: -288.93.





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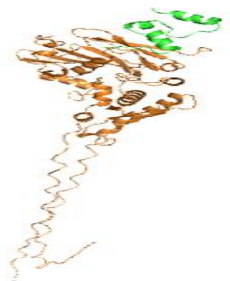


Figure 6: Interaction of SMC1A ($\Delta 301-400$) with RAD21: The docking score for the interaction between SMC1A ($\Delta 301-400$) and RAD21 was found to be: -222.71.

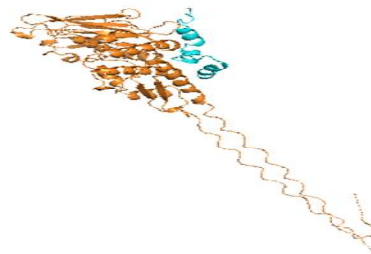


Figure 7: Interaction of SMC1A ($\Delta 401-500$) with RAD21: The docking score for the interaction between SMC1A ($\Delta 301-400$) and RAD21 was found to be: - 222.59.





JAYA based Functional Link Artificial Neural Network for Identification of Real-time Maglev Plant

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ABSTRACT

In the recent past identification of nonlinear plant is a significant work has done by many researcher and it is found to be an emerging area for further research due to its wide application. In this article, the characteristics and behavior of a real time maglev plant has been identified using an efficient Artificial Neural Network (ANN) based on functional expansion technique i.e. functional link artificial neural network (FLANN). The weights of FLANN has been iteratively updated by a heuristic optimization algorithm i.e. JAYA. So that the error needs to minimized, which is considered as a cost function. To demonstrate the robust identification performance of the Maglev plant Mean square error (MSE) and CPU time is considered for analysis. The simulation results justify the proposed model robustly identifies the characteristics and parameters of non-linear dynamic maglev plant.

Keywords: Non-linear System; System Identification; FLANN; Maglev plant; Chebyshev Expansion; JAYA

INTRODUCTION

The principle of identification is to formulate a mathematical modeling of plant by taking its input-output data. A mathematical modeling of a system can be determined by using laws of nature or through the experimentation. Out of many techniques to find out the mathematical modelling (using parameter estimation) of the system, direct modeling and inverse modeling, have most attractive features [1], [2]. As maximum plants are non-linear and dynamic in nature, their identification is a thought provoking. Accurate and fast identification of above system is still a nightmare. Identification of non-linear plants finds application in the area of control system, power system, communication, instrumentation and many other fields. This technique helps to design an identification technology for wide range of nonlinear system for sustainable development.





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To perform the above task in highly non-linear environment, an ANN is the best solution for it. As ANN can take the non-linear decision based on the objective. Pao et al. have proposed FLANN to overcome the above issue [3], [4], [5]. The FLANN is one of its kind and it holds the advantages of both single layer and multi-layer network. Mainly the FLANN is popular for its simple structure and less computation complexity due to absence of the hidden layer. The input of the FLANN gets functional expanded and combined to a linear combiner. The functional expansion of inputs gets by different expansion method like power series expansion, trigonometric expansion and Chebyshev expansion [6]. In this article, the Chebyshev expansion has been used to functionally expand the input. The FLANN model has been trained by using the JAYA technique. This is a random search algorithm, which is based on the achieving the best arrangement to avoid failure to get optimal solution. Using these steps, the cost function is minimized. Here, the error is considered as the cost function. The performance of the proposed identification technique has been studied in terms of error, MSE and the CPU time. This paper layout having, Section 2 presents the model of maglev plant. In Section 3 deals with the principle of system identification. Section 4 explain the basics of JAYA. The proposed JAYA based FLANN structure is discussed in section 5. The simulation result is discussed in section 6. Finally, the concluding remarks of the paper is outlined in section 7.

The Magnetic Levitation System

Magnetic levitation (Maglev) has been extensively accepted due to its contactless, low noise and low friction behavior and has application in many engineering field [7], [8]. Basically, Maglev plant is a highly non-linear plant and their control and identification is still a problem. The Maglev setup consist of two parts i.e. a physical Maglev plant and a computer interface. The Maglev plant is consist of electromagnet, IR sensor, amplifier and control objects. The electromagnet helps to control the steel ball in moving up and down from the equilibrium position. When current flows in the electromagnet, then their induces an emf, which controls the position of the steel ball. The steel ball is balanced by electromagnet force and gravitational force to keep it in the desired position. The IR sensor helps to measure the position of the ball and send a signal to input. The amplifier used to improve the level of the input voltage. The Maglev laboratory setup used for experimentation is manufactured by Feedback Instrument Ltd. and it works with MATLAB environment. where, m is the mass of the ball, $y(t)$ is the distance between ball and electromagnet, g is the acceleration constant, F indicates electromagnetic force, $i(t)$ is the current through the coil. The physical parameters of Maglev plant is given in Table 1.

System Identification Overview

System identification is a technique that helps to estimate a mathematical modeling for any system from its input-output data. The proposed ANN based FLANN model is a single layer network with absence of hidden layer and the weights are updated by a nature-inspired algorithm JAYA [9], [10], [11]. Here, $u(k)$ represents the input, $y(k)$ is output, $\hat{y}(k)$ indicates the estimated output and $e(k)$ is the error. The cost function is taken as error for the identification of Maglev plant. The cost function need to minimize to get an efficient identified model whose response efficiently track the real-time Maglev plant response. This technique helps to design an identification technology for wide range of nonlinear system for sustainable development.

The JAYA Algorithm

JAYA is a heuristic population-based optimization technique. The algorithm always endeavors to get closer to success (i.e. achieving the best arrangement) and endeavors to avoid failure (i.e. moving away from the most exceedingly terrible arrangement). This algorithm always trying for the victory by getting the optimal solution [12], [13]. So, it named as Jaya (a Sanskrit word meaning victory).

$$z = W_i^n + r_d * (b_v - \text{abs}(W_i^n)) - r_d * (w_v - \text{abs}(W_i^n)) \quad (1)$$

$$W_i^{n+1} = z \quad (2)$$





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Where, r_d represents the random number between 0 to 1. b_v is the best value, which represents the weights having the lowest cost function value. w_v is the worst value, which represents the weights having the highest cost function value.

In this algorithm, a random set of weights are generated to choose the best value and worst value depending on the cost function value. By using equation (1), the weights are updated using the best value and worst value. If the new set up of weights gives the effective result than the previous one, then the new set up weights are considered for the next iteration as given in equation (2) else weights are left unchanged.

Proposed JAYA based FLANN Network

Pao et al. has proposed a single layer ANN i.e. functional link artificial neural network (FLANN), in which the inputs are expanded functionally. It generates the decision boundaries, which is capable of taking complex decision. Mainly the FLANN improves the learning rate with less computational complexity for identification problem. The proposed FLANN model with input signal $x(k)$ is functionally expanded to a number of non-linear components which is given as input to a linear combiner with weights are associated with it as shown in Figure 3. The functional expansion of inputs gets by different expansion method like power series expansion, trigonometric expansion and Chebyshev expansion. In this article, the Chebyshev expansion has been used to functionally expand the input. Mathematically, Chebyshev expansion can be written as,

$$\begin{aligned} T_0(x_k) &= 1 \quad \text{for } k = 0 \\ T_1(x_k) &= x_k \quad \text{for } k = 1 \\ T_2(x_k) &= 2x_k^2 - 1 \quad \text{for } k = 2 \\ T_{k+1}(x_k) &= 2x_k T_k(x_k) - T_{k-1}(x_k) \quad \text{for } k > 2 \end{aligned} \quad (3)$$

where, $x(k)$ is the input and $w(k)$ is the weights of the model. The output of the proposed model is given as

$$\hat{y}(k) = \sum_{m=1}^{Q-1} s_m(k) w_m(k) \quad (4)$$

The weights of the proposed FLANN model are updated by JAYA algorithm for identification of Maglev plant.

RESULT AND DISCUSSION

The proposed method is simulated and test by using acer Aspire V, 8 GB RAM, intel CORE i5 processor, 1.80GHZ with Windows 10. For identification of real time Maglev plant 5000 no. of samples have been taken, out of that in 8:2 proportion is taken for training and testing with 10 no. of iteration. The performance of the proposed FLANN network updated by JAYA algorithm is analysed in terms of error, MSE and CPU time. Here, the error is 0.0011, MSE is 0.00001 and CPU time is 23.012 sec. From Figure 6, it shows that the high convergence rate of MSE curve.

CONCLUSIONS

In this paper, the proposed model successfully identified the real time Maglev system based on the input-output data. Here, JAYA technique has play the important role to update the weights of the FLANN model. A simulation study is carried to check the effectiveness of proposed JAYA based FLANN network. The efficacy of proposed model found from the closed fitting of identified model response and actual model response, which exhibit that the proposed model using JAYA is more suitable for identification of highly nonlinear Maglev plant. The research work in this area includes efficient neural network structure optimized by efficient nature inspired algorithm for further development to enhance its robustness and efficiency. This technique helps to design an identification technology for wide range of nonlinear system for sustainable development.





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Table 1. The physical parameter of MAGLEV plant

Sl. no.	Parameters	Value
1	m—Steel ball mass	0.02kg
2	g—Acceleration Constant	9.81m/s ²
3	i ₀ — Current value at equilibrium	0.8 A
4	x ₀ —Equilibrium position	0.009m
5	Control input (u)	±5 v
6	output voltage (x _v)	+1.25v to -3.75 v





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<p>Figure 1. Block diagram of the MAGLEV system</p>	<p>Figure 2. Schematic diagram of Maglev plant identification</p>
<p>Figure 3. Structure of FLANN Model</p>	<p>Figure 4. Actual and identified model response (position of the ball)</p>
<p>Figure 5. Identified model response generated by FLANN-JAYA</p>	<p>Figure 6. MSE plot of FLANN-JAYA</p>





A Study on Entrepreneurial Behaviour of Chickpea Seed Producing Growers

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ABSTRACT

The Chickpea or Gram is considered as an annual legume crop and it is one of the most oldest pulse crop which is grown in Asia and Europe country. India contributes 70 per cent of total world chickpea production of 116.2 lakh tonnes cultivated area under 112 lakh hectares with productivity of 1036 kg/hectare in 2020-21. In India with Madhya Pradesh ranking first in production followed by Rajasthan, Maharashtra, Uttar Pradesh and Karnataka. Development of economy of any nation depends mainly on the important role played by entrepreneurs. The entrepreneur is an economic person, who tries to maximize his profits by innovations. The study was conducted to assessing entrepreneurial behaviour of chickpea seed producing farmers. The consequence of the study reveals that 40.00 per cent of the growers belonged to the high level of entrepreneurial behaviour category. Whereas, 32.50 and 27.50 per cent of the growers were belong to the medium and low level of entrepreneurial behaviour category, respectively. The component wise results of the study reveals that majority seed producing growers had high (40.00%) innovativeness, 40.00 per cent of the chickpea seed producing growers belonged to rational decision making ability, 37.50 per cent of the seed producing growers had high economic motivation, more than half 57.50 of the seed producing growers had medium level of leadership ability and nearly half (47.50%) of the seed producer had medium level of cosmopolitaness.

Keywords: Chickpea, entrepreneur, innovativeness, decision making ability, economic motivation, technology and leadership ability



**Ashokkumar And Akkamahadevi Naik****INTRODUCTION**

The world total area under pulses is about 85.40 Mha with production of 87.40 Mt at 1023 kg/ha of average yields level. India is largest pulse producing country in the world and having pulse cultivation area about more than 29 Mha. It ranks first in area and production with 34 per cent and 26 per cent respectively. In India, total pulse area and production during 2017-18 has been more 293 lakh hectares and 245 lakh tonnes respectively. Out of the total area, more than 73 Lha is in Madhya Pradesh alone, earning a 25 per cent of the country's pulse area with 33 per cent production followed by Rajasthan in respect of area (16%) and Maharashtra in case of total production (13%). More than 90 per cent of total pulse production has been the contribution of 10 states namely, Madhya Pradesh, Maharashtra, Rajasthan, Uttar Pradesh, Karnataka, Andhra Pradesh, Gujarat, Jharkhand, Tamil Nadu and Telangana states. The Chickpea or Bengalgram or gram is an annual legume crop and it is one of the most oldest pulse known and cultivated in Asia and Europe. Globally, chickpea is grown in an area of 137 lakh hectares with a production of 142.4 lakh tonnes and productivity of 1038 kg/ha (FAO STAT, 2019). India contributes 70 per cent of total world chickpea production of 116.2 lakh tonnes cultivated under 112 lakh hectares with productivity of 1036 kg/hectare in 2020-21 (agricoop.nic.in). In India with Madhya Pradesh ranking first in production having 39.97 lakh tonnes followed by Rajasthan (18.39 lakh tonnes), Maharashtra (13.97 lakh tonnes), Uttar Pradesh (7.28 lakh tonnes) and Karnataka (5.74 lakh tonnes). Production potential exhibited under different crops in analysis of yield gaps among major states, districts and within district under the FLDs were considered. Here complete package of technology i.e. integration of all components viz. timely sowing, high yielding varieties, fertilizer management based on soil testing (including foliar nutrition), rhizobium inoculation, weed management, IPM etc., programme were felt necessary to be pursued vigorously for adaptation. Development of economy of any nation depends mainly on the important role played by entrepreneurs. The entrepreneur is an economic person, who tries to maximize his profits by innovations. However, the entrepreneurs are not simply innovators but are the persons with a will to act, to assume risk and to bring about a change through organization of human efforts. The part played by such entrepreneurs in agriculture is of vital importance in developing country like India, where there are ample opportunities for using innovations to exploit the available resources. Thus, there is great importance of entrepreneurs in agriculture for adoption of new technologies in crop production. In a heterogeneous and stratified society like India, it is not adequately realized by the people that, the characteristics which differentiate entrepreneurship may not be because of its different strata. Therefore, the entrepreneurial activity in a particular section of the population has to be considered. Presently, the development of pulse seed producing by the farmers is the primary concern of the country. The seed production subsidy was one of the major initiatives during 2016-17. The quality pulse seed produced by various public sector/central agencies has been about 2.65 lakh qtls during 2016-17 and >6.00 lakh qtls in 2017-18. The new/promising varieties were made available to the farmers. *NFSM Cell, Min. of Agri. & FW (DAC&FW)*. The role which had been played by the entrepreneurs are also assumes greater importance. In this context, there is a need for an accompany research on the entrepreneurial behaviour of pulse seed growers. Keeping this in view, the present study was undertaken with the objective of assessing entrepreneurial behaviour of chickpea seed producing farmers in Washim district of Maharashtra.

MATERIALS AND METHODS

The current study was conducted in Washim district of Maharashtra. Washim district is one of the seed producing district of chickpea and many government and private seed company were involved in seed production. The study was conducted to assessing entrepreneurial behaviour of chickpea seed producing farmers. The research study conducted in mainly in Washim during the year 2019-20. The total sample size is 40, in each district 2 taluks were selected and from each taluka 4 village were selected for the study. Thus, 20 chickpea seed producing farmers were selected from one taluka. In each village, 05 chickpea seed producing farmers were purposively selected. Ex-post fact research design suitable for the study and employed. Personal interview method was used for data collection. Data were tabulated, analysed and interpreted in the light of objectives of the study.





RESULTS AND DISCUSSION

Overall entrepreneurial behaviour of chickpea seed growers

It is noted from the Table 1 and Fig.1. shows that, around 40.00 per cent of the growers belonged to high level of entrepreneurial behaviour category. Whereas, 32.50 and 27.50 per cent of the growers were medium and low level of entrepreneurial behaviour category, respectively. The possible reason for above result may be due to seed producing growers have high knowledge in seed production techniques and good contact with seed Production Company and also high risk orientation, achievement motivation and management orientation. Some of the other reason might be, their regular contact with agriculture specialists like KVK's scientist and SAU's Scientists, regular contact with seed producing company representative or may be due to their regular participation in various extension activities like training programmes, krishimelas, exhibitions, demonstrations, field visit and field days. The results are in conformity with the findings of Archana *et al.*, (2014) and Wankhade *et al.*, (2013).

Component wise entrepreneurial behaviour of chickpea seed growers

Innovativeness

Data in Table 2 reveals that above majority seed producing growers had high innovativeness, followed (40.00%) followed by low (35.00%) and medium (25.00%) innovativeness, respectively. The high innovativeness of seed producing growers might be due to their age, young and middle age farmers always try to use new things in their field and their high risk orientation and achievement motivation encourage them to adopt innovative techniques. Some of the other reason may be theirlike high income level and their size of land holding. The outcomes are in accordance with the findings of Raghavendra (2010) and Y. D Chithra*et al.*, (2018).

Decision Making Ability

It is noted from the Table 2 that, 40.00 per cent of the chickpea seed producing growers belonged to rational decision making ability and followed by less rational (35.00%) and Intermediate(25.00%) decision making ability level of categories. May be due to their size of land holding. The other possible reason might be that decision making in farming related activities, especially in Indian the situation is very difficult due to the ever changing of agro-climatic conditions and lack of stabilized price policy. Decision making ability is depend on the foresight and confidence of an individual. The results are in conformity with Satish*et al.*, (2017).

Economic motivation

It is noted from the Table 2 reveals that, 37.50 %of the seed producing growers had high economic motivation, followed by 32.50.00 and 30.00 % of the growers were belonged to the medium and low economic motivation categories, respectively. The most probable reason is that majority of the seed produce high economic motivation because they have better vulnerability with various private companies and their representative and close interaction with extension personnel. Other reason may be due to village and other surrounding environment like relatives, neighbors, companion were having high standard of living and their income which leads for high level of economic motivation. The outcomes are in accordance with the findings of Mehta *et al.*, (2012).

Leadership ability

It is noted from Table 2 that, more than half 57.50of the seed producing growers had medium level of leadership ability, followed by medium (25.00%) and low (17.50%) leadership ability. The chickpea seed growers are lack in adoption of good management practices, full knowledge, good supervision and management at emergency condition etc. The possible reason strength due to their socio-economic status and majority were in middle age group, and having contact with progressive farmers which leads them to fall in medium leadership ability level.. The outputs are in conformity with the finding of Y. D Chithra*et al.*, (2018).





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Cosmopoliteness

It is found from the Table 2 that, nearly half (47.50%) of the seed producer had medium level of cosmopoliteness, followed by 32.50 and 20.00 per cent of the growers having low and high level of cosmopoliteness, respectively. Cosmopoliteness is the degree to which a any crop growers is oriented outside his community to seek information related to farming. Majority fall under medium because, due to their high level of economic condition and medium size land holding and because they are in contact with private companies officials and their representatives. The outcomes are in conformity with the findings of Y. D Chithraet. *al.*,(2018).

CONCLUSION

The result reveals that 40.00 per cent of the growers were belonged to the high level of entrepreneurial behaviour category. Whereas, 32.50 and 27.50 per cent of the growers were medium and low level of entrepreneurial behaviour category, respectively. Thus, it is concluded from the result that, majority of the chickpea seed growers had high entrepreneurial behaviour which can clearly indicate the progressiveness of the chickpea seed producer. As seed production “enterprise” is one of the most important economically viable enterprise and that will be maximize the “returns” in agriculture sector, therefore more number of agriculture and horticulture graduates should come forward, organize, create a farmer producer group and tap this opportunity and address the present problem of unemployment in agriculture sector. As most of the other farmers are unaware of seed production techniques so still there is a need to expose the chickpea seed producer to recent developments in “agricultural technologies” and motivate them to adopt the new technologies by organizing training, group discussions, meetings and field trips to government and private seed production units and need to encourage the chickpea growers to become a successful entrepreneur.

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Table 1: Distribution of chickpea seed growers according to their Overall Entrepreneurial behaviour (n=40)

Sl. No.	Categories	Frequency	Percentage
1	Low (Mean - 0.425*SD)	11	27.50
2	Medium (Mean ± 0.425*SD)	13	32.50
2	High (Mean + 0.425*SD)	16	40.00
	Mean	60.88	
	SD	7.20	

Table 2: Component wise entrepreneurial behaviour of chickpea seed growers (n=40)

Sl. No.	Components	Category	Frequency	Percentage
1	Innovativeness	Low (mean - 0.425 SD)	14	35.00
		Medium (mean ± 0.425 SD)	10	25.00
		High (mean + 0.425 SD)	16	40.00
		Mean=5.15SD=1.51		
2	Decision Making Ability	Less rational (mean - 0.425 SD)	14	35.00
		Intermediate (mean ± 0.425 SD)	10	25.00
		Rational (mean + 0.425 SD)	16	40.00
		Mean=16.78 SD=3.62		
3	Economic Motivation	Low (mean - 0.425 SD)	12	30.00
		Medium (mean ± 0.425 SD)	13	32.50
		High (mean + 0.425 SD)	15	37.50
		Mean=23.20 SD=4.92		
4	Leadership Ability	Low (mean - 0.425SD)	7	17.50
		Medium (mean±0.425SD)	23	57.50
		High (mean+0.425SD)	10	25.00
		Mean= 10.90 SD=2.74		





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5	Cosmopolitaness	Low (mean – 0.425SD)	13	32.50
		Medium (mean±0.425SD)	19	47.50
		High (mean+0.425SD)	8	20.00
		Mean=4.82 SD=0.77		

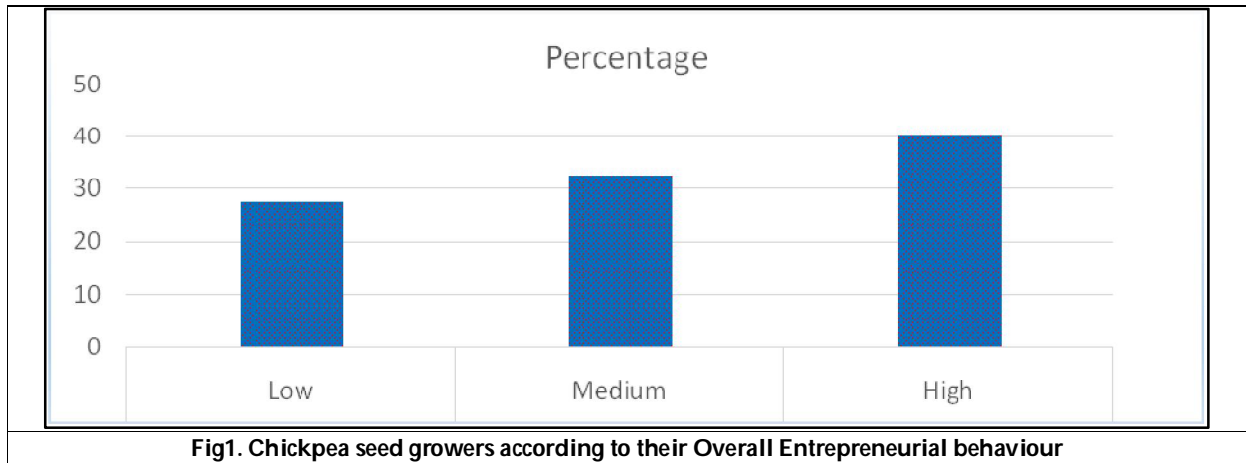


Fig1. Chickpea seed growers according to their Overall Entrepreneurial behaviour





Molecular Insight in to Wild Life Crime: Rapid Forensic Identification of Indian Crocodiles

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ABSTRACT

The biodiversity of India consists of enormous wildlife species including crocodiles. Of the 23 existing crocodile species, India harbors three crocodile species: *Crocodylus palustris*, *Crocodylus porosus* and *Gavialis gangeticus*. All three crocodile are protected under Schedule I of wildlife protection act, 1972 and also listed in the Appendix I of CITES. Despite these strict conventions, illegal trade continues till date of threaten the survival of these ancient species. Conservation strategies require for effective enforcement of laws, but lack of these ancient species. Conservation strategies require for effective enforcement of laws, but lack of appropriate identification techniques impede the legal agencies to prove the crime. In lieu of this, we developed a multiplex PCR technique for the effective identification of Indian crocodile species and validated according to the Scientific Working Group on DNA Analysis Methods. In this study we have tested the sensitivity of this assay to identify the species using teeth as well as degraded tissues samples. The current study provides promising results to use this multiplex PCR assay to identify Indian crocodile species in forensic examinations to assist the conservation agencies to conserve these endangered species.

Keywords: Indian crocodiles; poaching; species identification; DNA analysis; PCR amplification; conservation.

INTRODUCTION



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India is one of the twelve-mega diversity countries that harbor 8% of world's biodiversity (1), the wildlife species in India are the source of various lucrative products, which attract the poachers. The recent reports describe most of the species at the verge of extinction due to poaching and habitat destruction (2). The Indian crocodiles, *Crocodylus palustris* (Mugger), *Crocodylus porosus* (Saltwater crocodile) and *Gavialis gangeticus* (Gharial) are among these threatened species and need conservation prioritization. The conservationists doubt about the future existence of these species and insist for the implementation of proper conservation plans. In this regard many conservation strategies has been implemented which have raised their population size (3). In addition the wildlife Protection Act, 1972 prevents all kind of illegal hunting still persists intimidating their existence (4, 5). Thus poaching needs to be prohibited to conserve the ancient species. Poaching can be prevented by proper implementation of laws, which in turn can be attained by proper species identification. Hitherto, only morphological features are being used in forensic identification of the crocodylians. However, laboratories often receive highly degraded materials that may not have left any morphological features of the species. Therefore, the conventional methods fail to reveal the species identity (6, 7) and thus lack of proper identification techniques remain the major constrain in the enforcement of laws against poaching. This implies the urgent need for the development of the novel markers and techniques to identify Indian crocodile species to control poaching for their better conservation.

The molecular techniques like PCR-RFLP, PCR-RAPD, AFLP, SSCP, DNA sequencing and multiplex PCR assay have been developed in the past for species identification and proved to be effective in forensic analyses (8). We have already developed DNA sequencing (9) and PCR-RFLP techniques (10), for the identification of Indian crocodile species. However, the conservation strategies need further rapid and simple method for forensic usage for early enforcement of the law. The multiplex PCR techniques has been effectively employed in forensic examinations than any other technique because of its nominal requirement of DNA template as well as its utility in degraded DNA samples (11, 12, 13). Therefore, we have developed a novel method based on DNA i.e. multiplex PCR assay with species specific primers for the identification of Indian crocodile species and also validated this technique for forensic usage. Herein, we evaluate the usefulness of this multiplex PCR assay to identify the Indian crocodile species using the teeth samples as well as tissues with various degree of degradation. This study provides promising results of this multiplex PCR method in the forensic identification of Indian crocodile species. We trust that this strategy will usher in better conservation of the Indian crocodylian species.

MATERIALS AND METHODS

Sample collection and DNA isolation

The teeth samples as well as highly putrefied tissue samples in various stages of degradation of dead Gharial were obtained from National Chambal Sanctuary Project, Agra, Uttar Pradesh, India. The control samples (liquid blood) of *Crocodylus palustris* (Mugger), *Crocodylus porosus* (Saltwater crocodile) and *Gavialis gangeticus* (Gharial) were obtained from Madras Crocodile Bank Trust (MCBT), Centre for Herpetology, Mamallapuram, Tamil Nadu, India. All the biological samples are maintained in the repository of Central Forensic Science Laboratory, Kolkata, West Bengal, India. Genomic DNA extraction from blood samples was carried out by standard Phenol: Chloroform procedure (14) DNA extraction from tissue samples was performed using Qia tissue DNA extraction kit (Qiagen, Valencia, CA) as per the manufacturer's guidelines.

Multiplex PCR amplification

The multiplex PCR was performed for all the DNA samples and the amplification was performed in 25µl reaction volume containing 2.5µl of 10X buffer (200mM Tris-HCl, pH 8.4 and 500mM KCl) (Invitrogen™ life technologies), 0.2µM each of the forward primers (MUG: 5'-TAC GTG GGA AAC TCA ATC GTG G-3'; SAL: 5'-AGC TTC CCT ATT CTT CCT ATG CAC A-3'; and GHA: 5'-TCA TCC TGC TCC TCT TAT TAA TAG CG-3'), 0.4µM common reverse primer (UNI: 5'-GTG TAG GCG AAT AGG AAG TAT CAT TC-3'), 1 mM dNTPs, 0.2 µM of each primer, 2.5µl 10x buffer and 1.5U of *Taq* polymerase (Invitrogen Life Technologies, Brazil) on GeneAmp® PCR system 9700 (Applied Biosystems). The PCR conditions were: initial denaturation at 94°C for 4 min followed by 35 cycles of denaturation



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(94°C for 30s), annealing (48°C for 1 min) and extension (72°C for 30s) with a final extension of 72°C for 5 min followed by 4°C hold. The amplified fragments were detected on 2% agarose gel using ethidium bromide stain (0.5 µg/ml). The electrophoresis was performed at 5V/cm for 1 hour.

DNA sequencing and data analyses

In order to confirm the species the PCR products were sequenced as follows. The PCR products were purified twice by precipitation with 100% Ethanol (2.5 volume) and 3M Sodium acetate, pH 5.6 (0.1 volume) using standard procedure (14). Cycle sequencing was performed following the standard protocol of BIG-DYE version 3.1 cycle sequencing kit (Applied Biosystems, Foster City, CA) using both forward and reverse primers. The products were sequenced on ABI PRISM 3100 Avant Genetic Analyzer (Applied Biosystems). The resulted sequences were edited by Bioedit (15) and aligned using MEGA 3.1 Software (16).

RESULTS AND DISCUSSION

All the Indian crocodile species are under serious threat of extinction due to illegal poaching and habitat destruction. In order to conserve the antiquities, they have been encompassed in Schedule I of Wildlife Protection Act, 1972. However, illegal hunting continues to exacerbate the survival of all these species and effective conservation strategies are required for the proper enforcement of legislations to control the illegal trade. However, the lack of effective identification techniques proves to be major hurdle in the enforcement laws. Therefore, we have developed an easy and sensitive multiplex PCR assay for the identification of Indian crocodile species and in this current study we have evaluated the use of this multiplex PCR assay with teeth as well as highly putrefied tissue samples of dead gharials.

The multiplex PCR assay contains specific forward primers for each species (MUG for *C.palustris*, SAL for *C.porosus*, GHA for *G.gangeticus*) and common reverse primer (UNI). The forward primers were carefully constructed to be specific to a particular species by utilizing the intraspecific variations in the sequences whereas the conserved region was taken to construct the common reverse primers. The primers constructed to amplify shorter amplicons (373 bp for *C.palustris*, 486 bp for *G.gangeticus* and 578 bp for *C.porosus*) as the forensic samples yield degraded DNA, which cannot amplify larger gene fragments (17, 18). The multiplex PCR resulted in the expected amplification products, 373 bp for *C.palustris*, 486 bp for *G.gangeticus* and 578 bp for *C.porosus*, from the control samples (Figure 2). A 486 amplification product (that corresponds to Gharial) was obtained from all the teeth and highly putrefied samples of dead gharials. The resulted fragment was also sequenced further to confirm the species identity. None-theless, 100% similarity was observed between the sequences obtained from PCR fragments and the control sequences of *G.gangeticus*.

The essential need for a forensic laboratory is an effective technique that provides flawless result within shortest time. The multiplex PCR assay developed in our previous study differentiates the three Indian crocodile species in simple agarose gel electrophoresis without the aid further laboratory analyses and this method requires only ~ 2hrs and 30 min to identify /differentiate Indian crocodile species after isolation of genomic DNA. Further, this multiplex PCR method has already been validated as per the Scientific Working Group on DNA Analyses Methods (SWGDM) to be used in forensic examinations. Herein, this technique proved to be efficient evening the case of teeth samples as well as highly degraded tissue samples, which add further advantage to this multiplex PCR assay to identify the Indian crocodile species in forensic analyses for an effective enforcement of wildlife laws in place against the crocodilian poachers.

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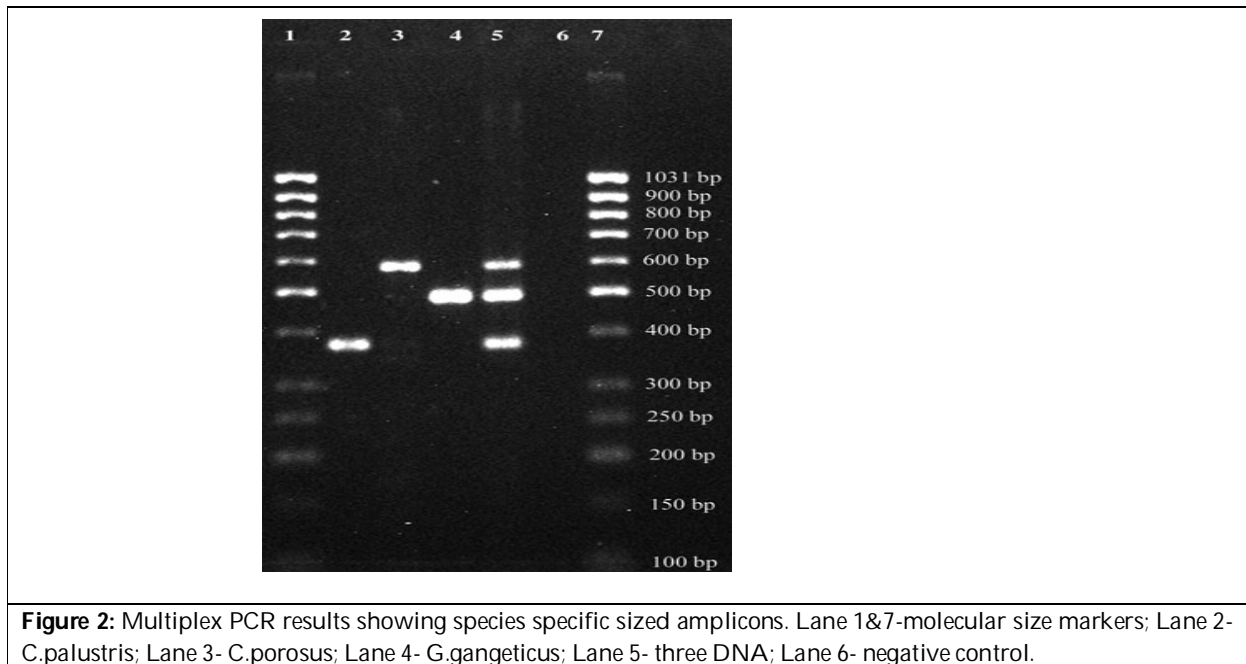
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Preparation and Evaluation of Herbal Hair Oil using *Hibiscus rosasinensis*

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ABSTRACT

Herbal formulations have satisfactory activity with minimal side effect when compared with synthetic formulation. For the above said reason herbal products have greater importance and acceptability. Current research aimed to prepare and evaluate herbal hair oil using flowers of *Hibiscus rosasinensis*. The plant material was dried, crushed and passed through 80 mesh size. The base used was olive oil. Direct boiling method was followed for the formulation. The formulated oil than subjected to both physical (specific gravity, refractive index, pH, Viscosity and acid value) and biological (primary skin irritation test, hair growth initiation test, hair growth activity) evaluation. Minoxidil 10% was taken as standard drug for evaluation purpose. The hair growth studies was a suggestive evidence of formulated hair oil as herbal alternative to minoxidil. The formulation not only show promising activity but also free from any potential side effects than that of synthetic one.

Keywords: Herbal formulation, Industrial use, *Hibiscus rosasinensis*, Primary health.

INTRODUCTION

Medicinal agents extracted from nature has been the main source in replacing many synthetic drugs that may cause side effects[1-3]. Hair loss is a distressing condition for greater number of men and women. Therefore it is of great importance to develop new theories for the treatment of hair loss. These days large number of herbal oils are formulated, of which very few are reported to show maximum activity[4-6]. Hair oils are the hair care preparations used for the prevention and treatment of baldness or other ailments, aggression of hair[7]. Hair care products are categorized into two main categories, hair tonics and hair grooming aids. Hair oil those which contains herbal drugs





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are called hair tonics, these are formulated by herbal extracts in an oil base[7-9]. Herbal hair oil not only moisturizes scalp but also reverse dry scalp and dry hair conditions. Tannins and minerals such as phosphorus, iron and calcium which provide nutrition to hair and also causes thick and dark hair [10-11]. It contains essential fatty acids which strengthen hair follicles and is an effective agent against dandruff. It have high iron and carotene content, it stimulates hair growth[12].

Hibiscus rosasinensis of family Malvaceae and used as Aphrodisiac, aperient, antiscorbutic, diuretic, depurative, emollient, brain tonic, anodyne, menorrhagia⁷ and also used in the treatment of bronchial catarrh, Emmenagogue, laxative, skin diseases, growth of hair, blackening of hair, luster of hair[12-15]. Hibiscus consists of calcium, phosphorus, iron, copper, zinc, vitamin B1, riboflavin, niacin and vitamin C, used to stimulate thicker hair growth by strengthening the strands and prevents premature graying of hair[16]. Oil of hibiscus effectively revives the scalp and prevents it from turning dry. Hibiscus shows potential for cancer treatment and as a weight loss aid, along with other uses[17,18]. The active ingredients in this herb can affect hormonal balance in the body and positively impact the balance of stress hormones in our body. The rich biochemical compound in the form of antioxidants prevents temporary or permanent baldness fights against dandruff and infections of the scalp[18]. In our study, we have prepared hair oil from the extracts of hibiscus flowers. The formulated oil was evaluated for different properties[19]. There are various methods available for the preparation of hair oils direct boiling method, paste method and cloth method. After preparation second main step is evaluation of preparation. The next final step is determination of its therapeutic efficacy [20,21].

METHODOLOGY AND MATERIALS

Collection of plants

Flowers of *Hibiscus rosasinensis* were procured form local area. The various part of the plant drug are crushed in a mixer and pass through sieve number 80. The crushed flowers are dried at room temperature till all the moisture are removed from it.

Animals

Male Wister albino rats, weighing 150-200 gm and rabbits were obtained from animal house of sps. The protocol of the experiment was approved by the Institutional animal ethical committeeas per the guidance of the committee for the purpose of control and supervision of experimentson animals (Regd. No-1171/C/08/CPCSEA), ministry of social justice and empowerment, Government of India.

Preparation

First is the direct boiling method in which the drug were powdered, weighed and directly boiled in coconut oil with continuous stirring and heating until the drug had completely extracted in the oil base. 1,2,3% of drugs containing oils were prepared.Quantitative modified model for the study of hair growth initiation was followed[8] .

Evaluation of hair oil

The prepare oil were subjected to physical and biological evaluation.

Physical evaluation

pH test: pH meter was dipped in the oil and 3 consecutive readings are taken and the mean should be the ph of the oil.

Specific gravity: Specific gravity was measured by Hydrometer. First sterilized the hydrometer and dry it. Then it was dipped in the water solution at the room temperature for calibration. Then it was put in the prepare oil solution at the room temperature. Three consecutive readings are taken and mean should be the specific gravity of the solution.





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Refractive index: Refractive index was measure by refractometer. The refractive meter was dipped in the preparedsolution and consecutive readings are taken, mean should be the refractive index.

Acid value: Acid value (or neutralization number or acid number or acidity) is the mass of potassiumhydroxide (KOH) in milligrams that is required to neutralize one gram of chemical substance. It is determined by titrating a solution of the prepare oil in diethyl with an alcoholic solution of sodium or potassium hydroxide. It is expressed as the amount of KOH (in mg) to neutralize 1 g of oil.

Biological Evaluation

Primary skin irritation test: The prepared formulations were assessed for primary skin irritation test. Four healthy rats wereselected for the study. Each rat was caged individually food and water given during the testperiod 24 hrs prior to the test. The hair from the back of each rat of 1cm² was shaved on theside of the spine to expose sufficiently large test areas, which could accommodate three test sites were cleaned with surgical sprit. Measured quantity (1ml) (5% w/w) of the formulationsOD1, OD2 and OD3 were applied over the respective test sites on one side of the spine andobserved for erythema and edema for 48hrs after application.

Hair growth initiation test: Quantitative model by Uno was used with slight modification for the study of hair growthinitiation. The mousewere divided in 4 groups of 1 mouse each and 2 cm² areas wereshaved to remove hairs. Eleven patches were developed on each mouse. Mouse of group Awas treated with prepared hair oil 2.5% concentration on individual patches keeping first patch. In group B was treated with 5% concentration, in group C was treated with 7.5% and in group C was treated with minoxidil. This treatment was continuedfor 15 days and during the course the hair growth initiation pattern was observed andreported.

Hair Growth Activity

The rats were divided into 5 groups of 5 rats each and 2 cm² area of the dorsal portion of eachof the rats was shaved. Group 1 was kept as control, where there was no drug treatment andin Group 2 the standard 2% minoxidilethanollic solution was applied. In the remaininggroups 3, 4, 5 the three different concentrations; 2.5% (OD1), 5% (OD2) and 7.5% (OD3) ofthe herbal oil formulations were applied once a day respectively. The treatment wascontinued for 30 days and during this course the hair growth pattern was observedqualitatively and recorded.

RESULT AND DISCUSSION

Table 1 & 2 summarizes the results of proximate and chemical analysis respectively.Petroleum ether extract of the drugs were subjected to qualitative thin layer chromatographicsscreening and the results obtained are summarized in table 3. Table 4 summarizes the variousvalues obtained in the physical evaluation of the formulations.The significant quantitative changes shown by hibiscus hair oil prompted the hair growthactivity screening of the herbal hair oil formulation. It was observed that the herbalpreparation showed excellent activity at a concentration of 7.5% better than the standard drugminoxidil. While minoxidil showed complete hair growth in 19 days, OD3 gave similarresults in 18 days.The quantitative study revealed that formulation OD3 showed considerable increase innumber of hair follicle in anagen phase of hair growth cycle when compared to control andstandard. In standard group, percentage of population of anagen follicle was 67% while inOD3 it was 89% and OD2 it was 87%. The formulation OD1 and OD2 were shown time ofinitiation of hair growth late when compared with standard and control. It also observed thatthe time taken for complete hair growth the late initiation and completion of hair growth was25days in OD1 and 23days in OD2 indicating late initiation and completion of hair growth.

The result shows that formulation OD3 have contributed in most significant hair growthactivity. Similarly, the way of method of preparation of OD3 (7.5% concentration of alldrugs) boiling in pouch method showed maximum extraction of active principles responsiblefor hair growth. The hair growth studies finally prove that formulation OD3 have significantincrease in hair growth activity when compared to the standard. It holds the promise of





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potentherbal alternative for minoxidil. Also suggest excellent results of hair growth in formulaprepared by cloth pouch boiling method.

CONCLUSION

The hair growth studies showed that formulation OD 3 has excellent potential to be developedas herbal alternative to minoxidil. The various constituents of the herbal extracts such asminerals and amino acids may be the cause for the significant hair growth activity. All thesedrugs not only show remarkable activity but are also devoid of potential side effects ascompared to synthetic drugs.

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CONFLICTS OF INTEREST

The authors of the article have no conflicts of interest to declare.

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Table 1: Result of proximate analysis

Name of analysis	Hibiscus (<i>Hibiscus rosasinensis</i>)
Moisture content	8.4%
Total ash	20.35%
Acid insoluble ash	4.9%
Water soluble ash	31.5%
Water insoluble ash	4.5%
Sulphated ash	3.15%

Table 2: Result of qualitative chemical test

Constituents	Hibiscus (<i>Hibiscus Rosa sinensis</i>)
Alkaloids	-
Carbohydrates	+
Phytosterols	+
Proteins	+
Saponins	-
Pectin	-
Glycosides	+
Vitamin C	+

Table 3: Evaluation of physical parameters

Physical parameter	Concentration		
	2.5%	5%	7.5%
Specific gravity	0.928	0.9348	0.9432
pH	9.1	8.4	7.5
Refractive index	1.492	1.472	1.435
Acid value	2.49	2.18	1.558





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Table 4: TLC Screening of petroleum ether extracts of drugs

Solvent system used	Detection Reagent	Observation	Inference	Petroleum etherExtract of hibiscus oil
	Dragendorff reagent	Orange brown (vis)	Alkaloid	-
Ethylacetate:Methanol:Water 100:13.5:10	Vanillin sulphuric acid	Blue (vis)	Saponin	-
N,N dimethyl formamide:Benzene7:93	Alcoholic NaOH	Yellow	Glycoside	+

Table 5:Quantitative observations of hair growth

Formulation	Number of rats	Time taken to initiate growth (in days)	Time taken for complete growth (in days)
Control(untreated)	5	8	24
Standard(10%minoxidil)	5	7	19
OD ₁	5	10	25
OD ₂	5	9	23
OD ₃	5	8	18

Table 6: The rate of hair growth in different phases of hair growth cycle

Formulation	Mean length (mm±50)				Population %			
	Anagen		Catagen	Telogen	Anagen		Catagen	Telogen
	A3	A5			A3	A5		
Control	-	0.60±0.14	0.11±0.03	0.20±0.06	-	47	4	49
Standard	0.48±0.14	0.69±0.12	0.1	0.21±0.05	19	50	1	32
2.5%(OD ₁)	0.39±0.03	0.62±0.11	-	0.22±0.04	26	48	-	19
5%(OD ₂)	0.42±0.06	0.70±0.11	0.1	0.21±0.04	23	64	2	29
7.5%(OD ₃)	0.44±0.05	0.71±0.13	-	0.24±0.04	22	67	1	17





Detection of the Bloodstain on Different Fabrics after Washing with Commercial Detergent

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ABSTRACT

The Criminals generally attempt to remove or destroy the blood stained evidence by washing it. The objective of this research was to examine and compare the characteristics of the blood stain on different fabric after washed with commercial detergent and soap and also to study the impact of Presumptive test and Confirmatory test. Four type of Fabric were stained with blood and allow drying. Blood stained fabrics were washed with normal water and with available detergent. Tetra-methyl Benzidine and Luminol were used for preliminary test. Takayama were used for confirmatory test to detect the presence of blood on these washed fabrics. These studies also reveal that Takayama test is found effective in determining the blood stains from washed fabrics. It is also found that Ariel detergent shows the highest percentage in removing the bloodstain from all fabrics. Among all of the fabrics, cotton shows maximum percentage of bloodstain retention after washing with all the detergent. The study also provides information on how many days blood stains could be detected from the samples and their variations.

Keywords: Fabric, Detergent, Takayama, Tetra-methyl Benzidine, Luminol.

INTRODUCTION

Forensic scientist is more often encountered this situation where the criminal knowingly ruined the evidence to hide the crimes. Tampering with evidence, or evidence tampering, is an act in which a person alters, conceals, falsifies, or



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destroys evidence with the intent to interfere with an investigation (usually) by a law-enforcement, governmental, or regulatory authority. Blood is one of the most important physical evidence which is frequently encountered at the crime scene on clothing [1] or weapons associated with such as murder, assault, and sexual offenses against the person, pool of blood, droplet, stains etc. Bloodstains can provide crucial information about what has truly happened during the commission of a violent crime which resulted with different shapes of blood pattern on various kinds of surfaces. Such crucial information can point criminal investigation in the right direction and help solve the crime. In the forensic aspect, the preliminary test or presumptive test recommended for the possible presence of blood that also overlooked because presumptive tests are less precise and indicate that an illegal substance may be present. In some cases, attempts may have been made to clean up the blood [2, 3], at a crime scene before to the arrival of the investigation authorities. The confirmatory test is the next step provides a positive identification of present fluid or stain. After that it goes for the origin test of blood, weather the present fluid or stain belongs to human origin or not. And after that we proceed for study further.

Blood is the most common and important evidence in the world of criminal justice today. . Its presence always links suspect and victim to one another. Especially the bloodstains on the fabrics or other fabric materials such as carpets, cushions, cloths etc. and so on will directly link the suspects to the victim and the offence that has been took place. Most of the time, criminals use detergents to clean bloodstains from their clothes. Therefore, criminal is often attempt to remove the bloodstains from their clothing [5,7,8] with the thought of release themselves from the occurred crime. Basically criminal commit this act without knowing the fact that the washed bloodstains are still can be detected prior to applying many presumptive of bloodstain identification [4,6] , then further confirmatory test and also DNA analysis would occur. In this research we will study those reliable methods for the detection of bloodstains on different fabrics after being washed with commercial detergent and soaps. For evaluation of suspected bloodstains, many reagents such as Tetra methyl Benzidine, Luminol, Takayama can be used.[9].

RESEARCH METHODOLOGY

Sample Collection

Intravenous whole blood was collected from Calcutta National Medical College and Hospital, Park Circus. Sterilized 2ml eppendorfs (2 for blood groups A, B and O each) were used for collection. No preservatives were used to preserve the blood samples. Fabrics that are used are Cotton, Jeans, Wool and Sponge; all the given fabrics are absorbent in nature. Detergents that used for washing are Dettol soap, Surf excel detergent, Ezee liquid detergent and Ariel detergent

Sample Preparation:

- Blood were applied on different fabrics i.e. Cotton, Jeans, Sponge, Wool.All the fabrics are being absorbent. After drying it at room temperature for 4-5 hours, fabrics were hand washed with normal water and detergent solution i.e. Dettol soap, Surf excel detergent, Ezee liquid detergent and Ariel detergent. NOTE: A general washing methodology was applied every time.

- For extraction small piece of the washed clothes are taken in an ependroff tube and dip in minimum amount of normal saline solution (0.18g NaCl in 20ml distilled water). It is then vortexes for several minutes and kept at room temperature for a minimum of 3 hours for total extraction to get light brown coloured solution. Then centrifuge at 350 rmp for 1 min and used the supernatant.

Preliminary Examination of Blood

For presumptive test of blood, Tetra Methyl Benzidine (TMB) and Luminol were used.

- Tetra Methyl Benzidine: 1.5gm of benzidine solution and 13ml of glacial acetic acid is taken. 57ml of distilled water is adding on it. After shaking solution is ready for test. Then washed fabric sample is taken in a spot plate and one drop of TMB reagent was added followed by one drop of hydrogen peroxide.Blue green colour indicates presence of blood.



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• Luminol: For preparation of luminol solution, 0.9ml of luminol powder and 50ml of Distilled water was added. Then, 1.50ml of sodium hydroxide solution and 1ml of Hydrogen peroxide solution is added on it. After vortex solution is ready for test. Then washed sample of fabrics is taken on petri plate and luminol solution is sprayed on it. Appearance of chemiluminescence (blue/Green colour of fluorescence) is observed in 100% of darkness.

Confirmatory Examination of Blood:

• Takayama Test: For takayama test, 3ml of glucose solution, pyridine solution and NaOH solution is taken along with 7ml of Glacial acetic acid and mixed uniformly. One drop of extracted sample is taken on slide and cover slip is placed on top. One drop of freshly prepared Takayama reagent is allowed to flow through from the side. The slide is kept on a hot plate at 65°C for 10 to 20 seconds. Then it is kept in a humidity chamber for about 10 minutes. Allow cooling and observed under microscope. The appearance of pink needle shaped of pyridine Haemochromogen (Pyridineferroprotoporphyrin) is positive reaction for haeme and confirms the presence of haemoglobin.

Instrument used:

- Vortex
- Centrifuge
- Hot air oven
- Weighing machine
- Compound microscope

OBSERVATION

All the fabric samples were spotted with blood and it was left for drying in atmospheric condition. After drying, the clothes were washed with commercial soap and detergent solution. These clothes were subjected to different presumptive tests and Confirmatory test. In all positive controls, blood was detected with Tetra methyl bezidine test, Luminol and Takayama test. None of the negative controls gave positive results after washing in water or with the detergent. Tests are performed after intervals of (1 day, 1 week, 2 weeks, 1 month and it is continued if the test shows negative result and the result is noted). The final observed results are following:

Dettol Soap**When washed from Dettol:**

- Blood sustain on cotton after washing from Dettol upto 37 days;(1 month+7 days)
- Blood sustain on jeans after washing from Dettol upto 30 days;(1 month)
- Blood sustain on sponge after washing from Dettol upto 30 days;(1 month)
- Blood sustain on wool after washing from Dettol upto 14 days;(2 weeks)

Surf Excel Detergent:**When washed from Surf Excel:**

- Blood sustain on cotton after washing from Surf Excel upto 14 days;(2 weeks)
- Blood sustain on jeans after washing from Surf Excel upto 14 days;(2 weeks)
- Blood sustain on sponge after washing from Surf Excel upto 14 days;(2 weeks)
- Blood sustain on wool after washing from Surf Excel upto 30 days;(1 month)

Ezee liquid Detergent:**When washed from Ezee Liquid Detergent:**

- Blood sustain on cotton after washing from ezee liquid detergent upto 7 days;(1 week)
- Blood sustain on jeans after washing from ezee liquid detergent upto 7 days;(1 week)
- Blood sustain on sponge after washing from ezee liquid detergent upto 7 days;(1 week)
- Blood sustain on wool after washing from ezee liquid detergent upto 7 days;(1 week)





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Ariel Detergent:

When washed from Ariel Detergent:

- Blood sustain on cotton after washing from ariel detergent upto 14 days;(2 weeks)
- Blood sustain on jeans after washing from ariel detergent upto 7 days;(1 week)
- Blood sustain on sponge after washing from ariel detergent upto 7 days;(1 week)
- Blood sustain on wool after washing from ariel detergent upto 14 days;(2 weeks)

RESULT & DISSCUSION

The presence of blood stain in the clothes is very important evidence to investigate about pattern and time of crime committed. Our study is completely based on result and discussion is to detect the highest possibility of blood stain from washed fabrics. All the commercial detergents used for washing contains a special agent called surfactant and some alkalis. This surfactant contains in each detergent are varying depends on the manufacturing of those detergent, which are tend to remove dirt, stains. Cotton fabrics have maximum ability sustain blood on their surface upto 37 days after being washed by Dettol Soap because it has very low amount of surfactant. Cotton is the most prevalent and quite distinctive in appearance. The absorbency and moisture retention of cotton is high. Dense amount pink needle shaped hemochromogen crystals of Takayama test is found generally in cotton fabrics upto 1-2 week. Jeans fabrics have maximum ability to sustaining blood on their surface upto 30 days after being washed by Dettol Soap, while washed with Surf Excel Detergent it shows positive result upto 14 days and after washed with Ezee Liquid Detergent and Ariel Detergent it shows minimum positive result upto 7 days.

Sponge has good ability to soak the blood after washing because of the porous surface that quickly absorbed the fluid. Sponge fabrics have highly absorbent capacity then other fabrics. The absorbency and moisture retention of sponge is high. Sponge fabrics have maximum ability to sustaining blood on their surface upto 30 days and the minimum ability is shown in Ariel detergent upto 7 days. Wool can sustain the blood on their surface after washing with Surf Excel Detergent is maximum 30 days and it shows positive result upto 14 days on the observation of Dettol Soap. Ezee Liquid Detergent is specialized for mainly winter wear or woolen cloths. It is also absorbent in nature. These fabrics tend to retained moistures and resist some alkalis and chemicals that are present in the detergents and it show minimum positive result.

Dettol Soap is disinfectant multi use Hygiene easily found in almost all the houses for hand washed purposes, while it has a possibility that criminal tried to remove evidence such as blood and washed with that they can found easily. A single simulated hand wash procedure in tap water was not sufficient to remove the bloodstain from cotton fabric or completely destroy original contour of the bloodstain, regardless of drying time lapsed from the deposition of blood on fabric until washing. According to our study Dettol Soap remove less number of the blood stain from all the fabric we used by yielding the more no. of positive samples. Surf Excel Detergent is currently marketed as the counterpart brand of OMO detergent in the India, Pakistan, Bangladesh, Nepal, Bhutan and Sri Lanka markets, so it is easily encounter in houses. According to our study all the fabric used has maximum capacity of 14 days after being washed by surf Excel. Ezee Liquid Detergent has a special 'No Soda', pH neutral and specialized for wools. It has low amount of surfactant. It removes most of the bloodstains from all the fabrics by yielding the least number of positive samples when the Takayama test was took placed. Ariel Detergent was used as the most reliable detergent for removing bloodstains from all fabric.

CONCLUSION

Forensic scientist is more often encountered this situation where the criminal knowingly ruined the evidence to hide the crimes. The presence or absence of blood stains often provides important information about crime, suspect, victim and the method of committing crime. Criminals generally attempt to eliminate bloodstains evidence by washing it.



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Suspects, their associates, or victims may wash clothing following bloodshed, thereby destroying blood evidence and complicate the reconstruction process. By considering this situation, this research was mainly conducted in an attempt to detection of the blood stain on different fabrics after being washed with commercial detergent and soap. In order to identify it, different presumptive tests and confirmatory test were used to detect the bloodstains on clothes. Tetra-methyl Benzidine test and Luminol test were used to detect the presence of blood on these washed clothes. Tetra- methyl bezidine test shown least number of negative results upto 2 weeks. Luminol test was the most sensitive to detecting the washed stains on clothes upto 1-2 weeks of being washed. For confirmatory test we used Takayama test is most reliable, as it can show positive result only if blood is present. we can conclude that different fabrics have different capabilities for sustaining blood on their surfaces. But all of them can carry the blood upto a certain amount of time. Hence they should not be ignored. Investigators may be presented with washed clothing that is believed to contain bloodstains from violent acts such as homicide, assault, or sexual assault. From the study it could be made possible to identify the blood stains from the suspect's clothes even after washing it repeatedly for a number of days or though the case is registered after a long time since the crime has been committed. This study develops new approach for detection of blood even after washing with detergents, which could prove to be beneficial in solving the criminal cases of forensic importance for conclusive serological examinations like blood grouping and origin and especially for DNA analysis.

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Fig :- Extracted Fabrics	Fig :- Positive TMB of Sponge
Fig: -Blue/Green Colour of Fluorescence	Fig.Pink Needle Shaped of Pyridine under 10X and 40X
Fabrics washed from Dettol soap:	
Fig.: TMB of cotton (1 day), Fig.: Pink haemachromogen crystals of Cotton (1 day)	Fig.: Pink haemachromogen crystals of Cotton (37 days) Fig.: Luminol fluorescence of Cotton (37 days)





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Fig.: TMB of Jeans (1day)



Fig.: Pink haemachromogen crystals of Jeans (1 day)



Fig.: Pink haemachromogen crystals of Jeans (1 month)

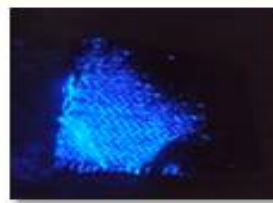


Fig.: Luminol fluorescence of Jeans (1 month)



Fig.: TMB of Sponge (1day)



Fig.: Pink haemachromogen crystals of Sponge (1 day)

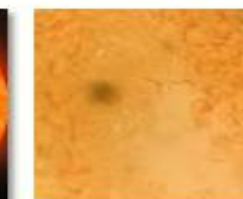


Fig.: Pink haemachromogen crystals of Sponge (1 month)

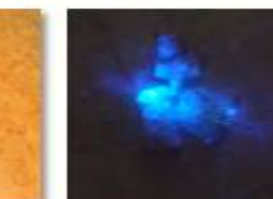


Fig.: Luminol fluorescence of Sponge (1 month)

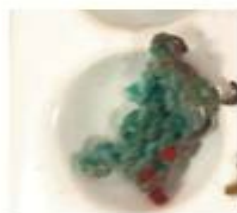


Fig.: TMB of Wool (1day)



Fig.: Pink haemachromogen crystals of Wool (1 day)



Fig.: Pink haemachromogen crystals of Wool (1 month)



Fig.: Luminol fluorescence of Wool (1 month)

Fabrics washed from Surf excel Detergent:



Fig.: TMB of Cotton (1day)

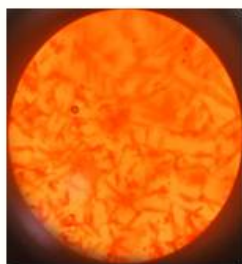


Fig.: Pink haemachromogen crystals of Cotton (1 day)

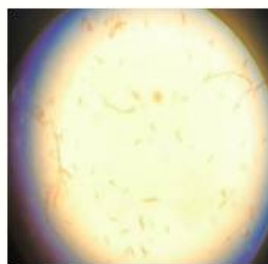


Fig.: Pink haemachromogen crystals of Cotton (14 days)

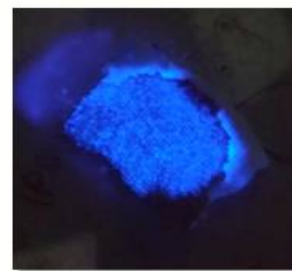


Fig.: Luminol fluorescence of Cotton (1 month)





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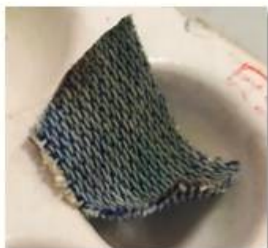


Fig.: TMB of Jeans (1day)

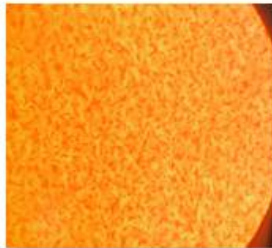


Fig.: Pink haemachromogen crystals of Jeans (1 day)

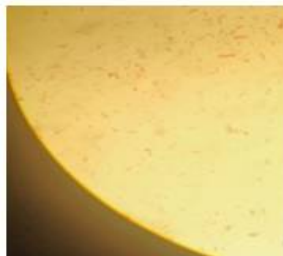


Fig.: Pink haemachromogen crystals of Jeans (14 days)

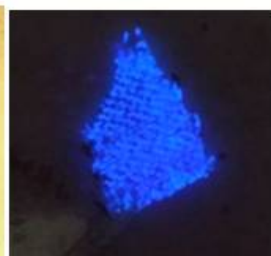


Fig.: Luminol fluroscence of Jeans (14 days)

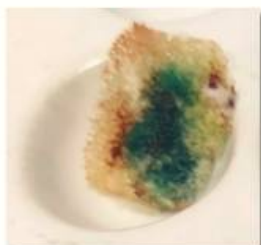


Fig.: TMB of Sponge (1day)



Fig.: Pink haemachromogen crystals of Sponge (1 day)



Fig.: Pink haemachromogen crystals of Sponge (14 days)

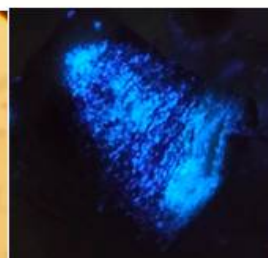


Fig.: Luminol fluroscence of Sponge (1 month)



Fig.: TMB of Wool (1day)

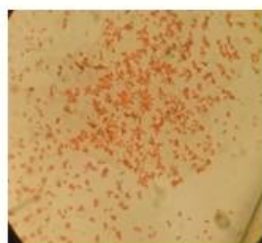


Fig.: Pink haemachromogen crystals of Wool (1 day)

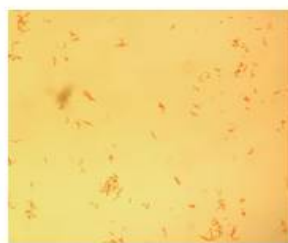


Fig.: Pink haemachromogen crystals of Wool (1 month)



Fig.: Luminol fluroscence of Wool (1 month)

Fabrics washed from Ezee Liquid Detergent:





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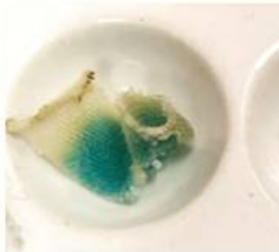


Fig.: TMB of Cotton (1day)

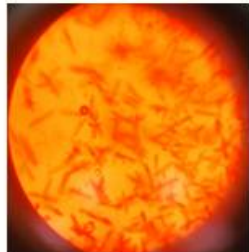


Fig.: Pink haemachromogen crystals of Cotton (1 day)

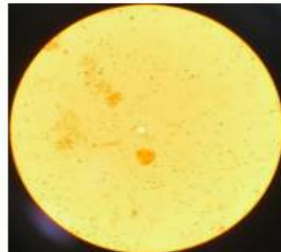


Fig.: Pink haemachromogen crystals of Cotton (14 day)



Fig.: Luminol fluorescence of Cotton (14 days)



Fig.: TMB of Jeans (1day)



Fig.: Pink haemachromogen crystals of Jeans (1 day)

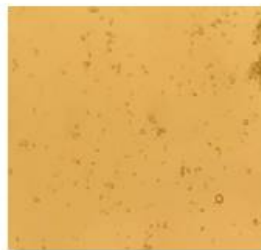


Fig.: Pink haemachromogen crystals of Jeans (7 day)



Fig.: Luminol fluorescence of Jeans (14 days)



Fig.: TMB of Sponge (1day)



Fig.: Pink haemachromogen crystals of Sponge (1 day)



Fig.: Pink haemachromogen crystals of Sponge (7 day)

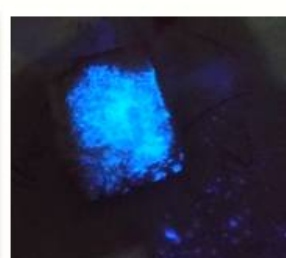


Fig.: Luminol fluorescence of Sponge (1 month)



Fig.: TMB of Wool (1day)

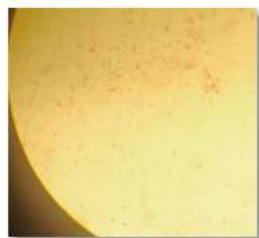


Fig.: Pink haemachromogen crystals of Wool (1 day)

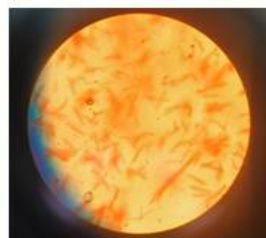


Fig.: Pink haemachromogen crystals of Wool (7 day)

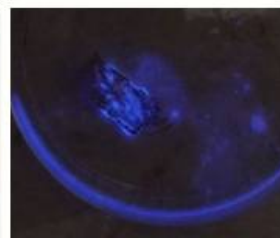


Fig.: Luminol fluorescence of Wool (14 days)

Fabrics washed from Ariel Detergent:





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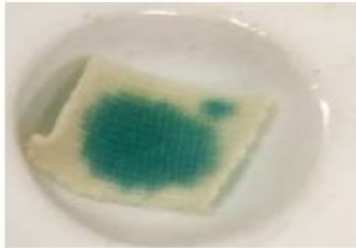


Fig.: TMB of Cotton (1day)



Fig.: Pink haemachromogen crystals of Cotton (1 day)



Fig.: Pink haemachromogen crystals of Cotton (14day)



Fig.: TMB of Jeans (1day)



Fig.: Pink haemachromogen crystals of Jeans (1 day)

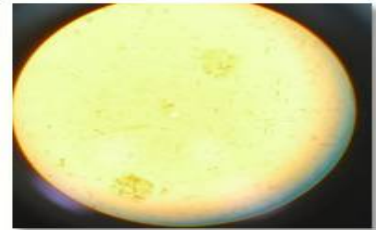


Fig.: Pink haemachromogen crystals of Jeans (7 day)



Fig.: TMB of Sponge (1day)



Fig.: Pink haemachromogen crystals of Sponge (1 day)

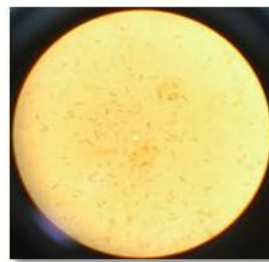


Fig.: Pink haemachromogen crystals of Sponge (7 day)



Fig.: Luminol fluorescence of Sponge (14 days)



Fig.: TMB of Wool (1day)

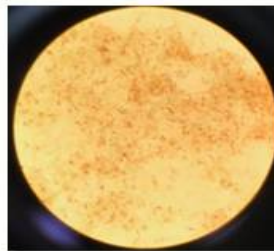


Fig.: Pink haemachromogen crystals of Wool (1 day)

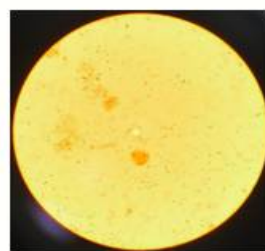


Fig.: Pink haemachromogen crystals of Wool (7 day)



Fig.: Luminol fluorescence of Wool (14 days)





Effect of Citric Acid on Photo Degradation of Drug Compounds Exposed to UV-B Emission

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ABSTRACT

When exposed to UV-B radiation, the inhibitory effect of citric acid (CA) on some of the most commercialised pharmaceutical compounds was investigated. The statin atorvastatine, the nonsteroidal anti-inflammatory drugs (NSAIDs) paracetamol, ibuprofen, and ketoprofen, the fluoroquinolones ciprofloxacin and moxifloxacin, and the fluoroquinolones ciprofloxacin and moxifloxacin, and the nonsteroidal anti-inflammatory drugs (NSAIDs) paracetamol, ibuprofen. The constant and percentage of photodegradation of pharmaceutical solutions without and with CA were assessed after they were bombarded with a 216W cm² irradiation dosage. With the exception of paracetamol, which remained stable after 120 minutes of irradiation, the majority of pharmaceutical solutions are unstable to UV-B radiation. The ketoprofen and ciprofloxacin solutions were the most photodegradable, with a 100% photodegradation rate. In all medicinal solutions, the addition of CA reduces the percentage and photodegradation constant. The capacity of this vitamin to operate as a screener or UV light absorbers, or react with free radicals and reduce reactive oxygen species, which would cause the structural destruction of pharmaceuticals, could explain its inhibitory action on UV-B radiation.

Keywords: Citric acid, Inhibitory effect, Pharmaceutical industry, Photo degradation, Radiation UV-B, Good health.

INTRODUCTION

Pharmaceuticals are chemical substances that are used to treat, halt, or prevent disease, as well as to relieve symptoms and aid in the diagnosis of ailments. Pharmaceuticals are consumed in large quantities around the world, with certain countries consuming hundreds of tonnes per year. These figures will continue to rise as health-care systems around the world improve and people live longer lives. Despite of its large use one of the main

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disadvantages of the pharmaceuticals compounds is their decomposition through oxidation and hydrolysis chemical reactions [1], there are a large number of pharmaceutical compounds that are sensitive to ultraviolet radiations (UVA or UVB) or visible are called photosensitive compounds. These radiations can interact directly with the molecule, causing molecular vibration, leading to the breaking of bonds that may lead to free radical formation [2] or active oxygen species, superoxide anion, hydroxyl radicals or singlet oxygen, which in turn can generate photodegradation compounds toxic [3], that could cause reactions of photosensitivity to the skin [4,5]. On this matter, Kabawata et al. studied the photodegradation of paracetamol (Apa) exposed to ultraviolet (UV) irradiation at 254 nm for up to 96 h. In this work it was observed that Apa was degraded by 50% after 24 h of radiation.

Likewise, the examination of toxicity by means of a luminescent bacteria test indicated that Apa solution was nontoxic, whereas photo-exposed Apa solution was toxic with a median effective concentration (EC₅₀) of 29.46 mg L⁻¹ [6]. The study photodegradation of ibuprofen (Ibu) under UV-Vis irradiation and the evaluation of the toxicity of the photolysis products utilizing *Vibrio fischeri*, were investigated by Li et al. [7]. The author indicated that Ibu generated a number of intermediate products that were more toxic than the base compound during photodegradation. The photostability of two fluoroquinolones, gemifloxacin (GFLX) and lomefloxacin (LFLX) antibacterial agents in dilute aqueous solutions against UV light, was studied by Tammam in 2014 [8]. The results showed that both fluoroquinolones are photolabile and that the photodegradation process can be described as a first order kinetic. In the present investigation was evaluated the inhibitory effect of Citric Acid on some pharmaceuticals more commercialized in Chile when are exposed to the UV-B radiation. We studied the nonsteroidal anti-inflammatory drugs (NSAIDs) paracetamol, ibuprofen, and ketoprofen, the fluoroquinolones ciprofloxacin and moxifloxacin and the statin atorvastatine.

Experimental**Reagents and materials**

Paracetamol (Apa) ibuprofen (Ibu) and ketoprofen (Ket) were obtained from Sigma-Aldrich with a grade of 98% purity. Ciprofloxacin (Cip), moxifloxacin (Mox), atorvastatine (Atr) and Citric Acid (CA) were obtained from Reutter S. A. with a grade of 99% purity.

Preparation of pharmaceutical solutions

50 mL of solutions of Apa, Ibu and Ket were prepared in Saline Phosphate Buffer (PBS) at pH ≈7.4 at 10 μg mL⁻¹ concentrations and diluted to obtain a concentration of 5 μg mL⁻¹ corresponding to the plasma concentration reached at daily consumption of 1.0 g of Apa, 0.40 g of Ibu and 0.10 g of Ket. 50 mL of solutions of Cip and Mox were prepared in Saline Phosphate Buffer (PBS) at pH ≈7.4 at 20 μg mL⁻¹ concentrations and diluted to obtain a concentration of 10 μg mL⁻¹ corresponding to the plasma concentration reached at daily consumption of 0.5 g of Cip and 0.40 g of Mox. 50 mL of a solution of Atr was prepared in a mixture acetic acid (Merck) acetonitrile (Merck) (in the ratio 30:70 V/V) at 4.0 μg mL⁻¹ concentration corresponding to the plasma concentration reached at daily consumption of 0.080 g. 50 mL of a solution of CA was prepared in Saline Phosphate Buffer (PBS) at pH ≈7.4 at 20 μg mL⁻¹ concentrations that corresponding to the plasma concentration reached at daily consumption of 0.09 g of CA.

UV irradiation experiment

The drug solutions without and with CA were irradiated in a quartz flask (50 mL) under continuous magnetic stirring, with UV-B light irradiation from a UVB Broadband TL (Philips) UV spectrum (280 to 315 nm) with irradiation dose of 216 μW cm⁻² (distance from the lamp about 50 cm). Samples were collected each 10 min, for 120 min after initial irradiation. Non-irradiated drug solutions were used as control. Each experiment was performed in triplicate, and all results were expressed as a mean value of the three experiments [9].

Analytical methods

The drug solutions concentrations were quantified by HPLC (PerkinElmer Series 200 Total Chrom v6.2.0.0.1, (4.6 ×250 mm, 5 μm)). The conditions of each of the drugs are detailed below:



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Apa: The mobile phase was water then acetonitrile (Merck) mixture (40:60 in volume), UV absorbance detection at 240 nm, flow rate of 1.0 mL min⁻¹ and an injection volume at 10 μ L. Ibu: The mobile phase was methanol (Merck) (80%) then phosphoric acid (Merck) (in water 0.1% w/v) mixture (80:20 in volume), UV absorbance detection at 214 nm, flow rate of 1.0 mL min⁻¹ and an injection volume at 10 μ L. Ket: The mobile phase was water at pH \approx 3.0 then acetonitrile (Merck) mixture (50:50 in volume), UV absorbance detection at 250 nm, flow rate of 1.0 mL min⁻¹ and an injection volume at 10 μ L. Cip: The mobile phase was PBS at pH \approx 2.8 then acetonitrile (Merck) mixture (77:23 in volume), UV absorbance detection at 277 nm, flow rate of 1.5 mL min⁻¹ and an injection volume at 90 μ L. Mox: The mobile phase was PBS at pH \approx 2.8 then acetonitrile (Merck) mixture (62:38 in volume), UV absorbance detection at 290 nm, flow rate of 1.5 mL min⁻¹ and an injection volume at 130 μ L. Atr: The mobile phase was acetic acid (in water 0.1 % w/v) then acetonitrile (Merck) mixture (25:75 in volume), UV absorbance detection at 238 nm, flow rate of 1.0 mL min⁻¹ and an injection volume at 5 μ L. Based on this data, we calculated the photo degradation rate constants assuming first-order kinetics [10].

RESULTS AND DISCUSSION

Effect of UV-B radiation on structural stability of pharmaceutical results and discussion

Nonsteroidal anti-inflammatory drugs (NSAIDs) solutions

The radiation range used in this work was in the UV-B region (280- 315 nm) because it is the one that most frequently reaches the Earth's surface, while UV-C radiation is filtered by the layer of ozone and UV-A region have a minor energy. The results demonstrated that the structure of Apa remains unchanged after exposure to UV-B light, for an approximate period of 2 hours of irradiation. This behavior may be due to the fact that Apa has a light absorption range between 220 and 290 nm with a maximum at 243 nm, which corresponds to a very narrow region in the radiation range in the UV-B region. Similar results were obtained by Gonzalez et al. finding that irrespective of the pH value, the degradation rate of paracetamol at $\lambda > 280$ nm was almost negligible, due was achieved only a maximum conversion of 4.2% after 5 hours irradiation. Similarly, other works confirmed that at pH between 3.7 and 5.5 UV-Vis radiation only results in a poor removal of this molecule, as a consequence of its weak absorption within the range 300 to 800 nm.

Despite to the stability demonstrated by this drug in this range of irradiation, the degradation of this compound can be obtained using other mechanism, such as the application of irradiation in the UV-C range, advanced oxidation processes (AOPs) or the photocatalysis using catalyst based on inorganic supports[11]. In this figure can be view that the concentration of Ibu solution remains unchanged until 60 minutes of irradiation and at longer times, the concentration decrease reaching a value of 28 %. Despite the Ibu have a similar light absorption range than Apa, between 240 and 282 nm the low structural instability observed of this compound can be due to that the maximum of absorption (264 nm) of Ibu is closer to the UV-B region than the maximum of absorption of Apa[12]. However, it is not excluded that the presence of a propionic acid chain with an aromatic substituent attached to a carbon atom in the structure of Ibu could generate $n \rightarrow \pi^*$ and $\pi \rightarrow \pi^*$ transitions that could favour the degradation of this molecule. Previous research has shown that the Ibuphotodegradation mechanism involves: (a) direct photodegradation: Ibu transforms into excited Ibu (Ibu*) subsequent to absorbing photons, followed by direct photodegradation; (b) self-sensitization: Ibu* transfers energy to dissolved oxygen in solution and generates ROS, which subsequently causes the photooxidation of Ibu. However, the direct photolysis is more rapid than the self-sensitization process [13].

The Fig. 1 shows the effect of the irradiation UV-B on the concentration of Ket. Unlike Apa and Ibu, the structure of Ket was very unstable to exposure to UV-B light, observing a photo degradation close to 100% after only 10 minutes of irradiation. The comparison of the photo degradation rate obtained for Ket with the Ibu indicates a value of photo degradation for Ket approximately 55 times higher, evidencing the great instability of their structure against UV-B light. This behavior can be due to the light absorption range of Ket, between 240 nm and 360 nm, is mostly matches with the to the UV-B region. On the other hand, Ket has a more complex structure than Apa and Ket due that have a 2-arylpropionic acid with a benzophenone nucleus in its structure. These groups can generate different transitions of



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type $\pi \rightarrow \pi^*$ (aromatic groups), which would explain this greater instability against UV-B radiation [14]. The primary reaction involved in the photo degradation of Ket by UV radiation is the intermolecular electron transfer from the carboxyl to the carbonyl groups, leading to decarboxylation. The radical formed upon electron release is believed to lose a molecule of CO₂, thereby producing the benzylic radical.

Effect of Citric Acid on the photo degradation of the pharmaceutical

Due to the structural instability of some this drugs against UV-B radiation observed in this work, was studied effect of the addition of an inhibitor agent that have functional groups that allow the absorption of light in the UV-B region or that react with free radicals or reducing reactive oxygen species, that could causes of the structural degradation of drugs [15]. In this investigation, Citric acid (CA) was used as a photodegradation inhibitor, due to proven reactivity with aggressive oxygen radicals, do not generating harmful by-products for the human organism and their absorption range is between 220 and 300 nm.

CONCLUSION

The incorporation of Citric Acid to solutions of pharmaceuticals drug most commercialized in Chile decreases their structural photo degradation when are exposed to the UV-B radiation. The ability of this vitamin of react with free radicals and reducing reactive oxygen species or acting as light screeners or UV absorbers could explain the inhibitory effect of this molecule.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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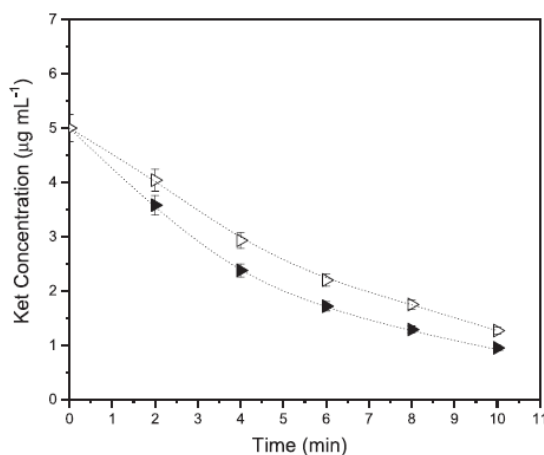


Fig. 1. Effect of the UV-B irradiation on concentration of Ket without CA (▲) and with CA (▷).





Emerging Computational Trends for Nanoscale Data Analysis with Nanoinformatics

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ABSTRACT

Numerous key challenges in nanotechnology research specify a need for nanoinformatics that uses informatics practices to process and manage information on nanobiomolecules and nanomedicines in particular and nanomaterials in general. Nanoinformatics being a subset of materials informatics, allows discovery of hidden information and patterns in nanoscale data. Usually nanomaterials datasets are small with considerably both large dimensionality and variance. Analysis of such nanoparticles datasets using existing big data analytics is a challenging and computationally intensive task. This study has been focused on survey of emerging databases and computational tools for the progress of nanotechnology research and exploring nanoinformatics that can be optimally used to address the challenges on nanolevel data analysis.

Keywords: Nanotechnology, nanoinformatics, computational tools, nanomedicine, nanomaterials, machine learning.

INTRODUCTION

Nanoinformatics deals with nanoscale information and aims to develop tools for its management and application in nanotechnology research [1]. The integration of nanobiotechnology, bioinformatics and computational material science with machine intelligence in nanoinformatics enables to study structure-function relation and properties of nanomaterials. Nanotechnology allows the handling of particle of scale ranging from 1 to 100 nanometers [2]. The behavior of such nanoparticles is subjected to molecular, atomic and ionic interactions and hence nanoparticles exhibits variable properties with the effect of quantum mechanics [3]. These effects alter the electrical, magnetic and optical properties of nanomaterials due to the random activities of the electrons. Informatics practices on material science enable the study of nanostructures and properties of these smart nanomaterials. Nanoinformatics is a subclass of informational materials science that allows uncover of significant information and patterns from the



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existing data. The advancement in nanoinformatics develops computational methods for the study of smart materials property, characterization and hyperspectral image data analysis [4].

Computational tools used in bioinformatics and computational chemistry have standardized the analyses and manage the nanobiotechnological information [5]. Several computing tools have emerged in the field of biomedicine and bioinformatics resulting into medical informatics. Nanoinformatics can address the problems that can be computationally handled at the nanolevel particularly focused on nanomedicine [6]. Nanomaterials can not only enable opportunity for developing applications for industry and scientific research fields but also promote innovation on the treatment of diseases. The development in nanotechnology has unlocked the scope for nanomedicine in which informatics practices for DNA computing can enable health care uses at nanobiomolecular scales. Thus nanoinformatics could accelerate developments in nanomedicine and its applications into clinical practice called translational nanoinformatics. Thus nanoinformatics and DNA computing together can impact strongly the existing model and practice the information in biomedicine. [7].

Machine learning computation can handle large data sets having lesser numbers of features. However nanomaterials datasets are attributed as small with both large dimension and variance and also affected by many destructive biases [8]. Analysis of such nanomaterials datasets using existing data analytics along with machine learning methods is a challenging and computationally intensive task. In this review, it has been focused on survey of emerging databases and computational tools that can help in growth of nanotechnology research.

Emerging Nanoinformatics Databases

Informatics practices have been implemented to accelerate the nanomaterials research exploration. Being a subcategory of materials informatics, nanoinformatics is an significant tool for characterization and design of nanostructures that play vital roles in the study of materials properties [4]. *Nanoparticles database* aims at collecting, analyzing, and publishing the information on nanomaterials in several aspects of research in nanotechnology. The nanomaterials such as nano-objects possesses multidimensional nanoscale structures whereas the nanostructured materials dimensions have a microscopically or morphologically nanoscale structure [9]. Nanoinformatics practices allow discovery of meaningful information and patterns from the databases. The analysis of such digital data with machine-learning allows exploring the structural characteristics of materials and extracting hidden information and patterns from current datasets [4, 10].

The availability of DNA and protein structures publicly in GenBank [11] and Protein Data Bank [12] respectively have motivated researchers for biomolecules bigdata analysis. Progression in computational platform has driven a new direction for bimolecular data analysis. Bioinformatics has emerged with publicly available large databases along with plenty number of bioinformatics tools. The informatics practices used for growth of bioinformatics has led to the development of nanoinformatics [13]. Nanotechnology has become a vital performer in the arena of nanomedicine. Biomolecules are the nanomaterials such as proteins that can be designed for biomedical applications such as drug delivery and other medical applications [14]. Computational practices enable binding models of protein nanoparticle like molecular modeling and docking and simulate for molecular dynamic in the binding processes. The nanoinformatics databases like ISA-TAB-Nano, nanowerk, NBI and caNanoLab help in not only data sharing and data standards but also assists to develop tools relating to the growing nanoscale data. An indication of some of the nanomaterial related databases related to nanomaterials is accumulated in Table 1.

Computing Tools in Nanoinformatics

The need of computing applications at the nanolevel is addressed by the nanoinformatics tools. Much of the research analysis performing nano-scale experimentation is computer-driven due to the physical scale of nanotechnology. Thus computational tools that includes data analytics tools have been developed to address the needs of the nano-scale research to make advances in nanotechnology [17]. The commonly used nanoinformatics tools based on



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relevant computational tasks such as molecular modeling, visualization, molecular docking and molecular dynamics have been discussed as follows.

Molecular Modeling

Molecular modeling is increasingly used as a vital methodology for bionanotechnological activity. It predicts the interaction of various blends of biomolecules [18]. The structures of biomolecules are obtained by complex methods like crystallography, electron microscopy and nuclear magnetic resonance etc. The study of structural information of biomolecules by structural biology can only offer static nature. However biomolecules seems to be highly dynamic in nature which is extremely related to their functions. Experimental techniques can offer to make analysis of dynamics of biomolecules with its own limitations. But recently computational technique is gradually increasing to solve these problems. The theoretical and computational methods used to model the structural and functional properties of molecules constitute molecular modeling. The 3D structures of molecules can be visualized and analyzed using software tools available. The commonly used visualizing software for macromolecules is shown in table 2.

Molecular Docking

The nanomedicine for targeted drug delivery is a growing field of research with application to several biomedical problems. The information revolution with biomolecular data mining and advanced machine learning has been applied to drug delivery [20]. Computational methods allow studying many protein-nanoparticle interactions effectively. Docking allows predicting protein-ligand interactions in the drug discovery process by detecting the low-energy binding modes ligand within the active site of a macromolecule. The degree of interaction or binding of ligand with receptor related with a disease may inhibit its function and thus act as a drug [21]. The performance of docking software is attributed by docking accuracy. The commonly used docking software is are included in Table 3.

MD Simulations

The dynamic structure-function relationships in biomolecules are established using computational technique called as molecular dynamics (MD) simulation. MD simulation describes the atomic motion and the forces acting on atoms over time at a given temperature are computed using force field [22]. Molecular docking is an instance of MD simulation which is used on intervals to replace lengthy segments of MD simulation trajectories of certain domains undergoing large translations, rotations and conformation changes, like biological interactions in large protein folding [23]. The some frequently used molecular modeling tools are shown in Table 4.

CONCLUSIONS

The databases and computational tools specific to the nanoscale data used in nanoinformatics are increasing exponentially that are helpful to the nanotechnology research community. Nanoinformatics could accelerate developments in nanomedicine by molecular modeling tools and simulation methods. The informatics practices used in genomic research projects has also transformed progress in biomedicine. Since nanomedicine and hence the nanomaterial data seems to be more complex than sequence or molecular data, an upcoming research evolving from the nanotechnology community are promising to address additional challenges in future.

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Table 1. Nanomaterial databases.

Database	Brief Report
Nanowerk (www.nanowerk.com)	The Nanoparticle Database includes the information of various nanoparticles. Currently, there are about 2860 nanoparticle products in database.





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NBI Knowledgebase (nbi.oregonstate.edu)	It works for repository of nanomaterial data, synthesis methods, and nanomaterial-biological interactions.
InterNano (www.internano.org)	It presents progress in applications, devices, and materials required for nanomanufacturing community.
NIL (nanoparticlelibrary.net)	The Nanoparticle Information Library offers links to databases with health and safety information of nanotechnology to health authorities, industrial operators and researchers.
nano-HUB database (nanohub.org/resources/databases)	It provides searchable database and nanoBIO tools.
BioPortal (www.bioontology.org)	“National Center for Biomedical Ontology” Bioportal includes the organization and analysis of data resulting from experiments
ISA-TAB-Nano (nci.nih.gov/display/ICR/ISA-TAB-Nano)	It represents and shares nanomaterials information and biological specimens with their assay characterization.
caNanoLab (cananolab.nci.nih.gov/caNanoLab/)	It helps by sharing the information to accelerate the practice of nanotechnology in the field of biomedicine and supports annotation of nanomaterials with characterizations.
Toxicology Data Network (toxnet.nlm.nih.gov)	Toxnet includes information on hazardous chemicals, environmental health, toxicology and toxic releases and provides references from the toxicology literature.
NanoParticle Ontology (nano-ontology.org/)	The NPO provides information on description, preparation, and characterization of nanomaterials in cancer nanotechnology research.
Nanodatabase (http://nanodb.dk/)	DTU Environment is involved in development of database, the data collection, the scientific assessments of the nanomaterials used in the several consumer products.

Table 2. Visualization tools

Visualization tools	Description
RasMol/ RasWin (bernstein-plus-sons.com/software/rasmol)	It is the software intended for visualization of graphics structure of nucleic acids, protein and small molecules.
PyMOL (www.pymol.org/)	PyMOL is commercial software used for visualization of complex molecules.
Raster3D (skuld.bmsc.washington.edu/raster3d)	It is used for creating high quality raster images of proteins or other molecules.
UCSF Chimera (cgl.ucsf.edu/chimera/index.html)	This program is used for the interactive visualization of high-quality images and animations and analysis of molecular structures, density maps trajectories and sequence alignments.
Cn3D (ncbi.nlm.nih.gov/Structure/CN3D/cn3d.shtml)	Cn3D allows viewing 3D structures of “NCBI’s Entrez” database.
Chemkit (sourceforge.net/projects/chemkit)	chemkit is used for applications in cheminformatics, molecular visualization and modeling.
ChemSketch (acdlabs.com/resources/freeware/chemsketch)	This drawing tool is used to draw structure of organics, organometallics, polymers and helps for calculation of molecular weight, density, molar refractivity etc.
Jmol (jmol.sourceforge.net/)	It allows viewing 3D chemical structures with features for chemicals, crystals, materials and biomolecules.





Jayakishan Meher

Table 3. List of Docking Software Tools

Docking software	Brief Description
Biovia Discovery Studio (3dsbiovia.com/products/collaborative-science/biovia-discovery-studio/)	BIOVIA's Discovery Studio acts as predictive tool for the Life Science problems. It is a graphics visualization tool that can analyze protein and modeling data with interactive 3D visualization and docking.
MOE (chemcomp.com/Products.htm)	Molecular Operating Environment is a <i>molecular modeling</i> tool that allows handling large biological molecules.
Autodock 4 (autodock.scripps.edu)	This automated docking tool can predict small molecules bind to a receptor of known 3D structure.
AutoDockVina (vina.scripps.edu/)	It is from the Molecular Graphics Lab that undertakes advances in accuracy of binding predictions and two orders of magnitude faster than AutoDock 4.
Dock (dock.compbio.ucsf.edu)	DOCK addresses the problem of docking molecules to each other.

Table 4. List of tools available for molecular modeling

Molecular modeling tools	Brief Description
YASARA	YASARA is a molecular modeling and simulation program that allows visualizing the large proteins and allows interactive real-time simulations with accurate force fields.
Amber (http://ambermd.org/)	Amber consists of biomolecular simulation programs with source code and demos. It allows simulation of biomolecules.
NAMD (ks.uiuc.edu/Research/namd/)	NAMD performs efficient simulation of large biomolecular systems.
Gromacs (www.gromacs.org/)	GROMACS is a software tool that simulates the Newtonian equations of motion for systems with hundreds to millions of particles.
LAMMPS (http://lammmps.sandia.gov/)	It is used to model atoms as a parallel particle simulator at the atomic, meso or continuum scale.
VMD (ks.uiuc.edu/Research/vmd/)	It allows visualizing, animating, and analyzing large biomolecular systems using 3-D graphics program and built-in scripting.





Graphene As An Advanced Material For Solar Cell Application

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ABSTRACT

Recently graphene and graphene-based materials have created an incredible study interests due to its extremely good physical, chemical, and physiochemical properties, which delineated graphene as an extremely good cloth for future electronics, optics, and electricity-harvesting gadgets. Generally, graphene has high mobility and optical transparency along with super mechanical strength and chemical inertness. Single-layer graphene exhibits ultrahigh optical transmissivity (98%), which permits passing via wide variety of mild wave lengths, for this reason designated as an ever-suggested fabric for an optically undertaking window. Moreover, graphene's optical, electric, and electrocatalytic properties may be tuned through applying extraordinary chemical functionalization protocols, which make it one of the most suitable candidates for advanced applications in optoelectronic and electricity-harvesting devices. This evaluation is meant to summarize the maximum essential experimental effects from the recent guides concerning the fascinating properties of graphene electrodes and their programs in numerous sorts of sun cells. Furthermore, the kingdom of the art of various graphene synthesis processes and functionalization for the applications in sun cells also are mentioned on this evaluation.

Keywords: Graphene, Chemical Vapor Deposition (CVD), Pyrolysis, Exfoliation, Silicone solar cells, Dye Sensitized, Quantum dot.

INTRODUCTION

Graphene is a single atom, thick two-dimensional (2d) fabric (Fig. 1), for this reason, exhibiting 97.7% transmittance at some stage in the whole visible mild spectrum. Additionally, graphene has a flat transmittance spectrum from the ultraviolet (UV) vicinity to the long wave duration infrared (IR) area, for this reason displaying a huge window that

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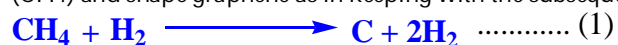
lets in a comprehensive range of photon wave period exceeded via it. Unconditionally, besides graphene, these combos of incredible optical properties are yet to be located in any forms of materials until date. similarly, graphene has uncommon electronic delivery residences, which follows the characteristics of 2nd Dirac fermions, quantum hall effects, Landau stage quantization, and so forth. consequently, graphene's free expenses are motionless in a single spatial dimension but cellular in different dimensions, and as a consequence, free carrier mobility is $>10^6 \text{ cm}^2/\text{V}\cdot\text{s}$ in unfastened-standing graphene. similarly, graphene also famous top notch mechanical and thermal properties ($k = 3000\text{--}5000 \text{ W/mK}$) and chemical inertness. subsequently, these kinds of homes coupled with the optical homes put together graphene a more potent candidate for packages in transparent carrying out electrodes (TCEs), bendy optoelectronics, energy harvesting devices, photodetectors, and many other optical devices[1]. moreover, graphene is expected as a rising alternate for traditional obvious conductive metallic oxides, mainly, indium tin oxide (ITO), which contains indium as a poisonous, high-priced, and scarce detail. especially, the graphene-based totally TCE for application in solar cells with more desirable efficiency is of extreme interest to this point, graphene electrodes have been carried out for extraordinary forms of sun cells, particularly, solid-kingdom suncells, electrochemical solar cells, quantum dot solar cells (QDSCs), and polymer sun cells[2,3]. the main benefits of making use of graphene in one of a kind solar cells are: (i) it creates a window for inducing extensive tiers (from UV to far IR areas) of photon power within the sun cells, (ii) it famous better price transfer (CT) kinetics on the interface of electrochemical hybrid cells, (iii) it manufactures a flexible tool with sturdy architecture, and (iv) it offers greater heat dissipation. On the other hand, electrocatalytic activities of graphene play a key role in improving the performance of electrochemical sun cells like dye-sensitized solar cells (DSSCs), where the liquid/ stable interface acts as a pathway for transferring electrons. but, the inert nature of the graphene basal aircraft often holds again CT on the graphene/liquid interface despite the excessive in plane price mobility, so enhancement in electrocatalytic activities takes place most effective the threshold-planes. subsequently, surface functionalization of graphene is required to improve in-aircraft CT and decorate utility for electrochemical solar cells[4].

Overview of Graphene Synthesis

The simple constructing blocks of all of the carbon nano structures are single graphitic layers, which might be covalently sp^2 bonded carbon atoms that exist in a hexagonal honey comb lattice, which forms 3-D bulk graphite, while the layers of single honeycomb graphitic lattices are stacked and bonded by a susceptible van der Waals force. The single graphite layer, while forms a sphere is known as zero dimensional fullerene, while rolled up with recognize to its axis bureaucracy a one-dimensional cylindrical shape, called the carbon nanotube, and while it famous a planar 2nd structure from one to few layers stacked to each different, known as graphene[3]. 2 One graphitic layer is known as single-layer graphene and correspondingly 2 and three graphitic layers are referred to as bilayer and trilayer graphene, respectively. greater than five layers up to ten layers graphene is commonly called as few-layer graphene and 20 to 30 layered graphene is characterized as multilayer graphene or thick graphene or nanocrystalline skinny graphite. This section overviews the primary and maximum famous graphene synthesis system, which includes exfoliation, chemical synthesis, thermal chemical vapor deposition (CVD), and epitaxial boom collectively with a quick dialogue in their feasibility for programs in sun electricity devices[4].

Thermal CVD process

Graphene may be synthesized on Ni and Cu the use of the CVD of hydrocarbon gases at high temperature in decreased atmospheric circumstance. on this method, Cu and Ni foils are used as substrates, wherein graphene deposition takes place on the floor of these transition metals because of the catalysis procedure. numerous different metals which includes Pt, Pd, Ru, Ir, Co and Fe also are used as substrates for the deposition of graphene by using CVD process[3,5]. The manner temperature turned into stored at $>1000 \text{ }^\circ\text{C}$ (although numerous lower or better temperature techniques were said as nicely) below lowering atmosphere (H_2 surroundings) to decompose methane (CH_4) and shape graphene as in keeping with the subsequent Eq. (1):



The procedure is flexible and scalable because the catalyzing manner does now not range with the substrate size. even though huge-scale graphene can be obtained via the CVD procedure, but, achieving massive-scale





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homogeneous layer of graphene remains under challenge. moreover, formation of grain barriers and ripples in graphene throughout CVD tactics causes illness formation in graphene. hence, those defects create a chief fee scattering and become to agraphene's electrical, thermal, and optical properties[6].

Pyrolysis of Graphene Synthesis

Solvo thermal approach become used as a chemical synthesis of graphene in bottom up system. on this thermal reaction the molar ratio of sodium and ethanol become 1:1 in closed vessel[7]. Graphene sheets could be easily indifferent with the aid of polymerization of sodium ethoxide the usage of sonication. This produced graphene sheets with dimensions of up to 10 lm. The crystalline structure, extraordinary layers, graphitic nature, band structure have been inveterate by means of SAED, TEM and Raman spectroscopy. Raman spectroscopy of the consequent sheet showed a broad D-band, G-band, and the depth ratio of IG/identification ~1.16, consultant of defective graphene[24]. The benefits of this system had been low-fee and without difficulty fabricated of excessive-purity, functionalized graphene in low temperature[8]. but, the exceptional of graphene became still not appropriate because it comprised a massive number of defects[9].

Chemical Exfoliation

In chemical exfoliation process, alkali metal ions were used to intercalate the bulk graphite structure to separate out graphene layers followed by the dispersion in a solution. The main reasons for using alkali metals for intercalation reactions are as follows: (i) alkali steel ions can without problems react with graphite and shape intercalated systems, (ii) additionally they produce a sequence of intercalated compounds with special stoichiometric ratios of graphite to alkali metals, and (iii) alkali metals have their atomic radius smaller than the graphite interlayer distance and as a result without difficulty match within the interlayer spacing during the intercalation reaction[9,10,11]. The main kinds of alkali steel ions are Li, k, Na, Cs, and Na-K2 alloy, which might be normally used to intercalate graphite for the chemical exfoliation process. Furthermore, the byproduct of exfoliation reaction, KC_8 undergoes an exothermic reaction whilst reacting with the aqueous solution of ethanol (CH_3CH_2OH) as per Eq. (2):



Further, chemical exfoliation of graphene additionally proven using the simple sonication system observed by using the dispersion in organic solvents. Hernandez et al. reported the exfoliation of pure graphite in N-methylpyrrolidone using a sincere sonication method, which yields high quality unoxidized monolayer graphene[12].

Application of graphene on different types of solar cells

Graphene -silicone solar cells

Numerous allotropes of carbon have been carried out into sun cells to lessen the value, permitting them to be extra broadly used. other allotropes of carbon, have no longer been a success due to the incapacity to track the electronic homes and the thickness of the layers. Graphene based totally movies for sun cells may be produced with a predetermined thickness and whole insurance[13,14,15,16]. It also allows the residences to be tuned, established upon the doping mixture used. Graphene has now been carried out into diverse junctions in graphene-silicon sun cells, inclusive of p-kind heterojunctions, n-type hetero junctions and Schottky junctions. Graphene-silicon sun cells are being researched but pure silicon cells overall performance is still superior[22,23]. The tune ability of graphene is promising for hybrid sun cells. while it is not on the identical stage yet, improvements are being made and it's miles only a rely of time till their efficiency surpasses natural silicon cells. to this point, n-type heterojunctions can generate a 0.55-0.57 internal voltage to help facilitate electron-hole separation. Schottky junctions have best confirmed an electricity conversion efficiency (PCE) of 1.5 %, however the fill thing at gift has handiest reached 56%, so theoretically, the performance can be hugely progressed upon. Doping the graphene layers with gold particles has determined to growth the efficiency by means of up to 40%[16].

Dye Sensitized Solar Cells

DSSC's are exclusive when in comparison to different types of sun cells. They contain a semi-undertaking material (e.g. TiO_2) with an image-sensitive dye because the anode coupled with a natural metallic cathode (e.g. Platinum)



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and an electrolyte answer [17]. Graphene has many beneficial homes that could increase the loading performance of the dye molecules, growth the interfacial region and enhance the conductivity of the electrons to compete against the outcomes of fee recombination. Balancing the ratio of TiO₂ and graphene is essential to attaining an efficient machine. The valence electrons from graphene become excited into the TiO₂ conduction band thru the graphene-TiO₂ interface, which efficaciously separates the electrons and the holes[18]. So, sufficient graphene is needed (kind of 1%) to facilitate this separation, but the introduction of higher graphene concentrations into the matrix causes the transmittance to be reduced[19,20]. The incorporation of graphene into DSSC's improves the mild scattering on the photoanode, effectively disperses the dye molecules and affords an performance that is 39% extra than pure TiO₂ electrodes[20,21,22,23].

Quantum Dot Solar Cells

Both graphene and carbon nanotubes have been hybridized with quantum dots to make functioning solar cells. Of the two carbon allotropes, graphene hybridized quantum dots have proven the maximum capacity[24,25]. Produced by way of electrophoretic and chemical bath deposition on ITO, a layered structure of both graphene layers and CdS quantum dots can be produced[26, 27]. The superior layering shape encompass 8 repeating graphene-CdS bilayers. This graphene-CdS configuration can produce an efficiency of as much as sixteen%, which out performs carbon nanotubes-CdS by 7%, and 11% for different carbon allotropes[28]. that is attributed to graphene producing a higher scaffold to include the quantum dots, the layered shape offers a fast electron transfer from the QD to the graphene while suppressing the recombination of prices[29, 30,31].

CONCLUSION

Currently graphene the noble material has added a innovative alternate within the area of nanoelectronics. Its outstanding contribution isn't always handiest restrained in nanoelectronics however additionally increasing in scientific technology, nanorobotics, commercial manufacturing of graphene synthesized merchandise and so on. Its particular mechanical, physical electric and optical properties makes it an critical industrially and economically material in the coming years. studies have shown that doped graphene can alternate one absorbed photon of a few electrons, which in exercise method an growth in performance of sun panels. further, graphene has a low coefficient of moderate absorption 2.3% which shows this is an almost really transparent cloth. In fact, it method that solar cells based on graphene can substantially extend the absorbed spectrum wavelengths of electromagnetic radiation. Graphene moreover is a cloth with a very immoderate tensile strength so it may be efficiently used at the silicon, bendy and organic substrates as nicely.

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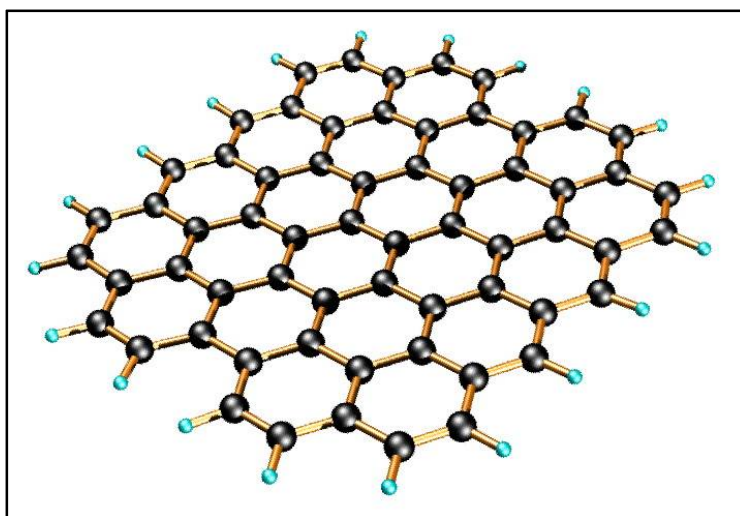


Fig. 1. Molecular structure of 2D Graphene layer





Recent Perspectives in Ocular Drug Delivery

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ABSTRACT

The major challenge faced by today's pharmacologist and formulation scientist is ocular drug delivery. Topical eye drop is the most convenient and patient compliant route of drug administration, especially for the treatment of anterior segment diseases. Delivery of drugs to the targeted ocular tissues is restricted by various precorneal, dynamic and static ocular barriers. Also, therapeutic drug levels are not maintained for longer duration in target tissues. In the past two decades, ocular drug delivery research acceleratedly advanced towards developing a novel, safe and patient compliant formulation and drug delivery devices/techniques, which may surpass these barriers and maintain drug levels in tissues. Anterior segment drug delivery advances are witnessed by modulation of conventional topical solutions with permeation and viscosity enhancers. Also, it includes development of conventional topical formulations such as suspensions, emulsions and ointments. Various nanoformulations have also been introduced for anterior segment ocular drug delivery. On the other hand, for posterior ocular delivery, research has been immensely focused towards development of drug releasing devices and nanoformulations for treating chronic vitreoretinal diseases. These novel devices and/or formulations may help to surpass ocular barriers and associated side effects with conventional topical drops. Also, these novel devices and/or formulations are easy to formulate, no/negligibly irritating, possess high precorneal residence time, sustain the drug release, and enhance ocular bioavailability of therapeutics. An update of current research advancement in ocular drug delivery necessitates and helps drug delivery scientists to modulate their think process and develop novel and safe drug delivery strategies. Current review intends to summarize the existing conventional formulations for ocular delivery and their advancements followed by current nanotechnology based formulation developments. Also, recent developments with other ocular drug delivery strategies employing in situ gels, implants, contact lens and microneedles have been discussed.



**Snehanjana Biswal et al.,****Keywords:** Ocular Drug delivery, Good health, Nano particles, Industry, Drug.

INTRODUCTION

Drug delivery belongs to the most exciting and difficult activities that formulators are facing. Every drug has some pharmacological properties which produce biological effects on the human body. These effects can give rise to the interaction between the drug and specific receptor at the site of action [1-2]. Primarily some ways are developed by humans to insert the drug into the human body. Some formulas are chewing the leaves and roots of medicinal herbs, inhalation of burning medicinal materials, and some basic juices from plants and animals [3]. In 1953, Nobel prize in chemistry was given to Hermann Staudinger for explaining the about "Makromoleküle" macromolecules which made easy for the elaboration of polymer chemistry. Jatzkewitz started the preparation of first polymer conjugate in 1955. A conjugate which contained a dipeptide spacer between the drug and polymer is considered as the first therapeutic nanoparticle is named as polyvinylpyrrolidone-mescaline conjugate [4]. Lipid vesicles were invented and known as the first nanotechnology-based drug delivery system and after that it named as liposomes [5-6]. Polymer drug conjugates and liposomes are two types of nanocarriers and together these are used in many types of marketed drug products and the investigations are continuing extensively [7].

At the same time Alejandro Zaffaroni founded the ALZA corporation and the history of drug delivery system is reportedly changed in 1968. And the ALZA corporation was unique because they not created new drugs and at the same time, they are used to develop the invented drug for better effects i.e., targeted, and controlled release [8]. Patrick Couvreur made the first rapidly biodegradable acrylic NPs made of poly (methyl cyanoacrylate) and poly (ethyl cyanoacrylate) [9-10]. Thus, the effective ophthalmic drug delivery has been a challenge for the researchers till date. Due to the different anatomy and physiology of eyes, some active molecules live Ocular in the eyes permanently and causes some tissue damages. So, to overcome these types of conditions, some systematic eye drug delivery system should be designed by technologist. Some important physiological barriers such as nasolacrimal drainage, tear dilution, and tear turnover of the eye are responsible for poor ocular bioavailability of conventional eye formula [11-12].

The eye is a unique organ, both anatomically and physiologically containing some complex structures with independent physiological functions. The complexity of eye provides top challenges to the drug delivery strategies. One of the major barriers of ocular medication is to maintain a therapeutic level at the site of administration for a long period of time [13-14]. The bioavailability of traditional ocular drug delivery systems such as eye drop is very poor because eyes is protected by a series of complex defense mechanisms that make it difficult to achieve an effective drug concentration because the burning of the eye starts after the eye drop inserted in the eyes and the tears are coming out, and the tear contains some amount of drug substances from the eye drop. Many approaches have been developed to solve the problem in recent decades. Drainage of an administered drug dose by the nasolacrimal system can occur when the volume of fluid in the eye exceeds the normal lacrimal volume about 7-10 μ l [11-12].

Anatomy of eye

In human body, eye is the most complex organ. It is divided into three layers. The outer region contains cornea and sclera. Cornea helps in refraction and transmission of light to lens and the sclera creates a protection layer in the eye against infection and structural damage to the deeper part of the eye. It also protects the eye against internal and external forces by creating a connective tissue in the eye. A transparent mucus membrane covers the visible part of sclera, called conjunctiva. The middle layer of the eye contains iris, ciliary body and choroid. Iris converts the size of pupil according to the amount of light reaching to the retina, ciliary body monitors the power and shape of the lens and it helps the eye in the production of aqueous fluid and choroid gives oxygen and nutrients to the outer retinal layer. The inner layer of the eye contains retina. Retina has a very complex structure that. And its neuron has a layered structure that capture and process light. There are three complex structure covers the ocular layer i.e. aqueous, vitreous, and lens.





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Novel ocular drug delivery system

Nanotechnology based ocular drug delivery

Many techniques have been utilized for treatment of ocular diseases for last few decades. Nanotechnology based ophthalmic preparation is one of them. And now a days this technique is applied for both anterior and posterior segment drug delivery. In this drug delivery system, the particle size is specially designed to ensure low irritation, absolute bioavailability, and compatibility of ocular tissue. There are so many nano carriers (nanoparticles, nanosuspensions, liposomes, nano micelles, dendrimers) are designed for ocular drug delivery and many are shown very effective results and absolute bioavailability.

Nano micelles: These are rapidly used carrier systems to formulate therapeutic agent into a pure aqueous suspension. Nano micelles are made with amphiphilic molecules which are either surfactant or polymeric in nature. Cholkar has reviewed about ocular barriers and application of nano micelles-based technology in ocular drug delivery [15]

Nanoparticles: These are colloidal carriers with a size range of 10 to 1000 nm. Nanoparticles contain lipids, proteins, natural or synthetic polymers such as albumin, sodium alginate, chitosan, PLGA, PLA and polycaprolactone which are suitable for ophthalmic products. Nanoparticles and nanospheres are mainly considered as drug loaded nanoparticles. In nano capsules drug loaded inside the polymeric shell where in nanosphere, the drug is uniformly distributed all over the polymeric matrix. For last some decades, many nanoparticles are designed for ocular drug delivery and scientists are trying to develop drug loaded nanoparticle for both anterior and posterior tissues of eye [16-25].

Nanosuspension: Nanosuspension is a colloidal dispersion of submicron drug particles which is stabilized by either polymer or surfactant. It has the best strategy of delivering of hydrophobic drugs. It has so many merits such as ease of eye drop formulation, sterilization, increases precorneal residence time and enhancement in ocular bioavailability of some drugs which are not soluble in tear fluid [26].

Liposomes: It is a spherical sac of phospholipid molecules which is closed with water droplet, it designed artificially to carry drugs or excipients into the tissue. Its size generally ranges from 0.08 to 10µm and it completely depend upon the size and phospholipid bilayer. Liposome is classified into three types such as small unilamellar vesicles (10-100nm), large unilamellar vesicles (100-300nm), and multilamellar vesicles (contains one or more bilayer) [27].

Dendrimers: Dendrimers are nanosized, high ordered, branched polymeric compounds, typically forming spherical macromolecules. These are available in various weights with terminal end amine, hydroxyl or carboxyl functional groups which helps to conjugate targeting moieties [28]. Dendrimers act as the carrier system of in drug delivery. Variation in molecular weight, size, surface charge, molecular geometry and functional group may create various problems in the delivery of drugs. In dendrimer, incorporation of wide range of drug occurs. This branched polymeric system shows so many good results in ocular drug delivery system [29-31].

Conventional ocular drug delivery systems

Drug input in the lower precorneal pocket is widely accepted and recommended route of drug administration. So many ocular drug liquids are lost due to eye blinking and only 20% is absorbed in the eye [32]. There are so many ophthalmic products are available in the market out of them 70% are eye drops. The reason behind this is safety, quality, stability, cost effectiveness and easy to use [33].

Topical liquid/solution eye drops: These are safe, effective, patient compliant and non-tending mode of ocular drug administration. To increase the bioavailability of the eyedrops many additives are added such as viscosity enhancer, permeation enhancer and cyclodextrins. This viscosity enhancer improves the precorneal residence time and bioavailability in topical drop administration by increasing viscosity of the formulation. Some examples of viscosity





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enhancers are hydroxy methyl cellulose, hydroxy ethyl cellulose, sodium carboxy methyl cellulose and polyalcohol [34-36].

Emulsions: Emulsion is a type of formulation which having some advantages to improve both solubility and bioavailability of the drug product. There are mainly two type of emulsion which are used as an excipient in drug product formulation i.e. oil in water (O/W) emulsion, water in oil (W/O) emulsion. For ophthalmic drug delivery, generally we used O/W type emulsion for excipient. [37]

Ointments: Normally ophthalmic ointments are a class of carrier systems which are develop to treat eye diseases. It consists of semi solid and solid hydrocarbon which has a melting point of 34°C (physiological ocular temperature). choice of hydrocarbon mainly depends on biocompatibility. It helps in sustain release of drug formulation. [27]

CONCLUSION

Drug delivery to targeted ocular tissues has been a major challenge to ocular scientist, for decades. Administration of drug solutions as topical drop with conventional formulations was associated with certain drawbacks which initiated the introduction of different carrier systems for ocular delivery. Tremendous efforts are being put into ocular research toward the development of safe and patient compliant novel drug delivery strategies. Currently, researchers are thriving hard to improve in vivo performance of conventional formulations. On the other hand, advent of nanotechnology, new techniques, devices and their applications in drug delivery is developing immense interest to ocular scientists. Drug molecules are being encapsulated into nanosized carrier systems or devices and are being delivered by invasive/non-invasive or minimally invasive mode of drug administration. Several nanotechnology based carrier systems are being developed and studied at large such as nanoparticles, liposomes, nanomicelles, nanosuspensions and dendrimers. Few of these are commercially manufactured at large scale and are applied clinically. Nanotechnology is benefiting the patient body by minimizing the drug induced toxicities and vision loss. Also, these nanocarriers/devices sustain drug release; improve specificity, when targeting moieties are used, and help to reduce the dosing frequency. However, there is still need of developing a carrier system which could reach targeted ocular tissue, including back of the eye tissues, post non-invasive mode of drug administration. With the current pace of ocular research and efforts being made and put in, it is expected to result in a topical drop formulation that retains high precorneal residence time, avoids non-specific drug tissue accumulation and deliver therapeutic drug levels into targeted ocular tissue (both anterior and posterior). In near future, this delivery system may replace invasive mode of drug administration to back of the eye such as periocular and intravitreal injection.

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CONFLICTS OF INTEREST

The authors of the article have no conflicts of interest to declare.

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A Role of Microbiota Gut-Brain Axis: Associated with Stress Induced Depression

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ABSTRACT

The human gut is a harbour of 100 trillion of bugs reflecting over ten time's unique species and contributing 150 times more genes. Gut microbiota has coevolved to play a fundamental role in normal human health, maintain homeostasis and disease. Gut microflora also plays a vital role in Gut-brain axis that contains a signalling pathway between the gut and brain. Any stress stimuli to the brain might activate Hypothalamo-pituitary axis that secretes cortisol that causes an alteration in gut microbiota mediate via gut-brain axis. Recent studies showed that the microbiota has the capability to the synthesis of different neuroactive substance including serotonin, dopamine, gamma-aminobutyric acid inside the lumen which act on Gut-brain axis via the vagus nerve and neuroendocrine system which may alter mood and cognition. it has been shown that alteration of gut microbiota (dysbiosis) may pathophysiological consequences of some diseases. Now a day probiotic therapy is greatly expanded for the treatment of depression and anxiety and irritable bowel syndrome. Here in this review, we present the latest literature explaining the effects of the gut microbiota on depression via Gut-brain axis.

Keywords: Stress; microbiota; probiotics; gut-brain axis

INTRODUCTION

Depression is a common and repetitive serious mood disorder causing disability in most cases associated with dejection and social burden worldwide [1]. Globally, greater than 300 million people subjected to depression. Depression really more common in women than in men. At worst, depression can contribute to suicide. In the recent survey says that Depression and anxiety leading to a worldwide financial drop of US\$ 1 trillion per year. In India, it is estimated that there are approximately 57 million people affected by depression which is the grand total of 18% of

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the global estimate. Treatment usually involves talking therapy and antidepressant drug including selective serotonin reuptake inhibitors (SSRIs) and tricyclic antidepressants (TCAs) or both. According to the sign and symptoms, depression can be categorised as mild, moderate, or severe [2]. Major Depressive Disorder (MDD) is a most severe form of depression. Depressive behavior is distinguished by loss of interest in normal daily activities along with sadness, anxious mood, hopelessness, difficulty concentrating, remembering, decreased energy, fatigue, sexual dysfunction [3]. The causes of depression are not understood or unknown etiology but some factor influencing cause such as genetic and environment. Recently it has been shown that gut flora also influences the source of depression. It has been proved that change in physiological system such as dysregulation of neuroendocrine, neuroimmune, metabolic and neurotransmitter systems may have significant impact on the cause of depression [4]. It also has been proven that depression is caused due to change of microbiota in gastrointestinal tract which may be a potential therapy for antidepressant activity as well as probiotic medication helps in reversed the symptoms of depression. Animal studies have demonstrated that depression is associated with reduces brain-derived neurotrophic factor (BDNF) level and this reduction can be prevented by treatment with antidepressant drugs. It has been shown that reduce the concentration of neurotransmitter like serotonin in the brain may lead to cause depression [5]. This review is highlighted that pathophysiological implementation of gut-brain axis in stress-induced depression and the vital role of microbiota in the modulation of stress-induced depressive behavioural, psychological and clinical status.

ABOUT GUT MICROBIOTA

Last several decades, scientists have started to really dig into how microbiome impact on our health. There are trillions of microbes reside in our body mostly in the gut. This entire section is called as gut microbiota or gut flora which are a big part of our digestive system. Gut microbiota (GM) is consist of trillions of microorganisms, including no less than 1000 diverse species and moreover 7000 strains of microbes creating the 10^{13} - 10^{14} microorganisms such as bacteria, virus, and fungi. The human body has ten times more microbial cells than human cells. We are in symbiotic relationship with many of our microbes. Gut microorganisms have an estimated weight of 1–2 kg, equivalence to the same weight of the human brain. Following techniques are apply for observing the relation of the gut flora and the brain taking into consideration of gut-brain axis: these techniques include germfree (GF) studies in animals, antibiotic and probiotic studies, preclinical and clinical fecal matter transplantation studies. Bacteria reside in the lumen of the gut and interplay some physiological role with human cells. Due to development of modern lifestyle, hygiene environment, diet, and antimicrobial treatment vaccinations, intensive use of disinfecting greatly influence the structure of gut flora that causes allergic diseases and autism in developed country. Bacteria also have the ability to help in synthesis various types of neurochemicals [6]. For example, gamma-aminobutyric acid (GABA) produced by *Lactobacillus* and *Bifidobacterium*, norepinephrine (NE) Produced by *Escherichia*, *Bacillus* and *Saccharomyces*, serotonin (5HT) produced by *Candida*, *Streptococcus*, *Escherichia* and *Enterococcus*; dopamine (DA) produced by *Bacillus*, *Serratia*, and acetylcholine (ACH) produced by *Lactobacillus*. Gut microbiota is playing a crucial role in Gut-brain-axis which is a bidirectional signalling highway between intestine and brain. they specially influence development of hypothalamic-pituitary-adrenal (HPA) axis, affects the stimulation of the immune response, modulates the construction of the blood-brain barrier, synthesis of neurochemicals in the gut and brain site, affects generation of neurones, the development and operates of neuralgia and brain. Gut bacteria are essential for host health and well-being. Gut microbiota participates in many of the metabolic, nutritional, physiological and immunological processes to maintaining homeostasis of the human host. The metabolic function including bile acids, choline, short-chain fatty acids (SCFAs), vitamins and amino acids [7]. Along with carbohydrates metabolism occurs inside gut by the help of gut microorganisms and produces neuroactive substance like SCFAs. Additionally, gut microbiota plays a crucial role in the mucosal immune system by resistance pathogens colonization and production of antimicrobial compounds. Besides this, they are involved in the development, maturation, and maintenance of the GI sensory and motoric functions.²¹ Many current studies demonstrated that dys bacteria is contributes to the pathology of neurological disorders including depression, anxiety, sclerosis, Alzheimer's disease. and Parkinson's disease. Furthermore, gut bacteria may influence the CNS expression by a release of some protein including brain-derived neurotrophic factor (BDNF) which is neurotrophin that affects cognition in brain and periphery. Gut





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microbes also influence synthesis of 5-hydroxytryptamine, melatonin, and the kynurenine metabolites maintain normal body homeostasis.

WHAT IS MICROBIOTA GUT-BRAIN-AXIS (GBA)

The microbiota-gut-brain-axis (GBA) is now emerging field. The microbiota GBA consist the central nervous system (CNS), the neuroendocrine and immune systems, the autonomic nervous system (ANS), the enteric nervous system (ENS) and most importantly the gut flora itself. Additionally, this bidirectional communication pathway also constitutes by both brain, spinal cord and the hypothalamic pituitary adrenal (HPA) axis, which plays a fundamental role in normal physiological processes of the body. ENS is concomitantly associated with CNS through a massive web spread of neurons as like CNS. So, it also called the second brain vagus nerve which is basically connected between gut and brain and relaying messages from the CNS to the viscera through activating the parasympathetic nervous system and sympathetic nervous system. The vagus is activated by Hormones and neurotransmitters include cholecystokinin, leptin, ghrelin, adrenalin, glutamate, and serotonin which facilitates control of the HPA axis with stress responses responsible for depressive symptoms. The some researcher found that microbiota makes contact with BGA through interaction with mucosal epithelial endocrine cells, through immune cells and finally through neural endings. Evidence suggested that gut microflora control the gut-brain axis and maintains normal gut function. stress induces changes in neurochemicals and proinflammatory cytokine may affect in the constitute gut flora. Both clinical and preclinical evidence also has been revealed the microbiota has an important impact on GBA influencing anxiety and depressive-like mood disorder. Recent surveys suggested that dysbiosis may be led to the disruption of GBA and finally associated with mood and behavioural disorders[8].

HOW MICROBIOTA INFLUENCE GUT BRAIN AXIS AND ASSOCIATED WITH DEPRESSION

In the last decade's an increasing amount of research have been carried out to explore the causation of depression that is associated with gut flora. Dysfunction of microbiota gut-brain axis leads to cause depression. Normal gut microbial balance is the favourable option for treatment and cure of depression. Researchers have tried to give more attention to found out the exact co-relation of the brain-gut axis and the depression since 2009[9]. The gut microbiome has been played an important role in stress regulation by stimulating hypothalamic pituitary adrenal (HPA) axis which is an important stress regulation mechanism. In the preclinical study, it has been shown that Germ-free mice exhibit an overreaction of HPA to stress show an imbalance hormone secretion. In depressive patient HPA axis is activated by both psychological and physiological stress and simultaneously release of corticotrophin-releasing factor (CRF) and arginine vasopressin (AVP) from the hypothalamus. These hormones encourage the anterior pituitary gland to increase adrenocorticotrophic hormone (ACTH) release, that amplifies the release glucocorticoid (GC) in circulation. Increase level of GC in the circulation making a negative feedback mechanism that inhibits the secretion of CRF and AVP by the hypothalamus. but, in depressive patient dysfunction of negative feedback of the HPA axis leads to a chronic increase GC and ACTH in circulation cause of hypercortisolaemia. The excessive circulatory GC is diminished the expression of Glucocorticoid Receptor, while antidepressant therapies increase the GR expression, enhance the GR function, and improve the negative feedback mediated by GR. Dysregulation HPA axis reduce the level of the brain-derived neurotrophic factor (BDNF), inhibits synthesis neurotransmitter such as 5-HT.

Nowadays Antibiotics treatment destroys the gut microbial balance that increases the prevalence of depression. Although antibiotics are used to counteract the infection by killing pathogens but also destroy gut microbiota[10]. This leads to elevating the occurrence of various mental disorders. Accumulating clinical studies suggested that the frequent use of antibiotics therapy significantly increase the prevalence of depression. However antibiotic use is dose-dependent and time-dependent effects to cause risk. Previous studies suggested that. One-year-old Infants in antibiotic treatment might have come into contact with behavioural problems and depression, and the effects were obvious at the age of three [11]. Bacteria reside in the lumen of the gut and interplay some physiological role with human cells. it has been shown to play a critical role in the immune system. Gut microbiota modulate the synthesis of several proinflammatory cytokines and chemokines including interleukin (IL)-8, IL-1, IL-6, IL-10 and transforming growth factor β (TGF- β) by interaction occurs via toll-like receptor (TLR)[12]. These receptors are involve in the



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primary initiation pathway for production cytokine and in neuronal expression. These inflammatory cytokines such as interferon-alpha (IFN- α), IFN- γ affect the metabolism of serotonin (5HT) and also depletion of tryptophan in periphery induces depression. These cytokines are blocked by antidepressants. The excessive pro inflammatory cytokines resemble to dysregulation of negative feedback mechanism of the HPA axis, not only alters tryptophan metabolism but also glutamatergic systems that cause depression. Some researchers found that intestinal permeability, or leaky gut, is also responsible for the causative factor for depression. Increased systemic pro-inflammatory cytokines like lipopolysaccharide (LPS) which are circulating bacteria derived product that causes Inflammation. Inflammation is a key role for causation of depression. Faecal microbiota transplantation (FMT) is the process of transfer of faecal microorganism from a healthy individual to the disease patient in order to recuperate the impaired gut flora. Zheng et al. observed a mice induced with depression that showed additional depressive manifestation along with dissimilar microbiota composition from the healthy recipients[13]. These dissimilarities were the same as the differences between their respective human donors, which specifying some microbiota phenotypes can influence metabolism alteration, result from the depressive sign. Kelly et al. Studied a model, in which the transfer of the faecal microbiota of depressed patients to rats which were microbiota-depleted via antibiotic cocktail treatment. It was shown that the recipient rats are suffered from mood disturbance behaviour including anxiety and depressive with alteration of tryptophan metabolism. It has been reported that faecal samples of MDD patients contains above presentation of bacteroidal species with lower presentation of Lachnospiraceae report. The study further described a significant correlation that existed between depression and one species in each of the genera *Oscillibacter* and *alisticipes*. Bacteria that are relates with prevalence of MDD were also correlates with an excessive level of isovaleric acid. valeric acid is acts an inverse agonist of adenosine A₁ receptor, affect the release of various neurotransmitters in CNS and cause MDD. A magnesium deficient diet in humans and rodents may cause of anxiety and depressive-like symptoms. Winther et al. they have been explained that magnesium deficiency diet may resolve the consequences by an impair gut microbiota and cause depression-like behavior in mice. they noticed that magnesium deficient group of mice have more immobility behavior than control mice for 6 weeks of forced swim test (FST)[14]. The gut microbiota resides in the digestive tract and helps to produce hormone and another biologically therapeutic compound. Gut microbiota may have a transition of neurochemicals substances such as serotonin (5HT), noradrenaline (NA), dopamine (DA) are excitatory neurotransmitters acts on post-synaptic neuron and except gamma-aminobutyric acid (GABA), glutamate is an inhibitory neurotransmitter contribute 'balance' process for brain neuronal activity. Accumulating evidence suggested that decreased levels of serotonin, noradrenalin and dopamine deregulation of the glutamate-GABA systems are ultimately linked with depression. Modern medical antidepressant has been either increased or decreased levels of these neurotransmitters artificially in the brain and treats depressive symptoms therefore, gut microbiota may have great contribution to maintain levels of neurotransmitters both in central and peripheral region of the body, and play an important role to treat mood disorder. Serotonin is a precursor of tryptophan, affect by gut microbiota[15]. In preclinical study suggested that animal treatment with *Bifidobacteriainfantis* greatly modulates serotonin metabolism in the CNS. Serotonin and its receptors play a greatly influence in MDD has long been accepted, and gut microbiota alter the tryptophan level and cause to the development of MDD. O'Mahony et al. detailed that there a significant variation in faecal microbiome composition when the adult rats exposed to maternal separation was contrasted with that of non-separated controls[16].

USES OF PROBIOTIC IN DEPRESSION

Over the past several decades uses of probiotics and prebiotics treatment has interestingly expanded. Initially probiotic therapy was started in the year of 1910 in order to treat depression. Logan and Katzman recommended that probiotics are used as an adjuvant drug for major depression in 2005. Probiotics are live microorganisms that have health benefit when administered in enough quantity that has the health benefit. The supplement of prebiotic facilitates the growth or survival of a specific gut microorganism. Estimated annual economy of probiotic used in is one billion USD in United states. Probiotic having mental health benefits (psychobiotic) reported to be present in gram positive LAB (lactic acid bacteria) such as lactobacillus and bifido bacterium strains. Probiotics have probe of inhibiting oxidation process (i.e. as antioxidant) and hence protect from free radical damage, enhance synthesis of



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gamma-aminobutyric acid (GABA), and enhance absorption of certain nutrients in the intestine. These properties of probiotics have been administered in the causation of depression [17].

CONCLUSION

In the current scenario, Depression is a common and repetitive serious mood disorder causing disability in most cases associated with dejection and social burden worldwide. Several antidepressant drugs have shown low rates of efficacy, less therapeutic activity, and unwanted side effects. Stress is the important factor for the pathology of depression. Stress causes over activation of HPA axis, immune response along with dysfunction of microbiota-gut-brain axis, thus increase level of proinflammatory cytokines and cortisol in the circulation ultimately progress depression like behaviour. Gut microbiota play a great importance for maintaining homeostasis of the body and it has been suggested that gut microbiota influence mood by producing various neurotransmitters including serotonin, GABA that act on GABA. Considering this concept, gut microbiota, and gut-brain axis may be the potential target for the treatment of several mental disorders. Probiotics are used to regulate and modify the extent of gut flora. It has been believed that using diet, probiotics, and FMT may have greatly helps to cure depression.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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The N-Terminal Domain of FAT1 is Critical for Interaction with TNF-A

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ABSTRACT

Fat family members (FAT1, FAT2, FAT3, and FAT4) are human homologs of *Drosophila* Fat and are implicated in tumour suppression and planar cell polarity. Cellular homeostasis is largely maintained at the cellular level via transcription regulation, which can vary in response to physiological alterations. One of the most commonly altered genes in human cancer is FAT atypical cadherin 1 (FAT1), which encodes a protocadherin. FAT1 is thought to play a vital role in the maintenance of organ and cellular homeostasis, as well as activating a number of signalling pathways via protein-protein interactions, such as the Wnt/catenin, Hippo, and MAPK/ERK signaling pathways. Unregulated FAT1 expression can cause cancer and have a negative impact on prognosis. In this study, we focused on the structural and functional aspects of various domains and motifs of FAT1. Global bioinformatic databases resulted in streamlining a list of putative protein associates of FAT1. Since FAT1-mediated structural and functional alterations, as well as variations in FAT1 expression, contribute to disturbances in cellular homeostasis and result in patho-physiological disorders including cancer, we essentially focused on cancer-related genes functionally related to the FAT1. FAT1 is a huge protein composed of 4588 amino acid residues. By mutational analysis and further protein-protein docking studies using multiple bioinformatic tools it was confirmed that the N-terminus 1-100 amino acid residues are critical for interaction -with cancer-related genes including *Tumor necrosis factor*. Interestingly, it was found that the small peptides corresponding to the N-terminus domain 1-100 of FAT1 effectively interact with tumor-suppressor genes. These evidences widens up the possibility of administering potential peptides when the FAT1 expression is inhibited. Our preliminary results will pave way forward in improving the prognosis and treatment of patients with cancer.



**Ipsita Sahoo et al.****Keywords:** FAT genes, tumor, patho-physiology, homeostasis, mutation, oncogene

INTRODUCTION

FAT1, FAT2, FAT3, and FAT4 are the genes that make up the human FAT family (Schreiner *et al.*, 2006; Sun and Irvine, 2011). It was found in *Drosophila* in the 1920s as a result of a deadly mutation. Ft and Ft2, two FAT cadherin members found in *Drosophila*, are thought to be tumour suppressors. "The Ft gene results in an epithelial overgrowth phenotype in *Drosophila* larvae, with mutational modifications affecting the wings, eye antenna, legs, glands, and genital imaging disc" (Peng *et al.*, 2021). The fact that localises and expresses levels of the Hippo signalling pathway transcription factors like Yorkie (Yki), Warts (Wts), and another FAT cadherin member in *Drosophila* is connected with the expansion of the phenotype found in Ft inactivation in humans. Fat2 is necessary for the formation and stability of ectodermal tubular structures. Any Fat2 mutation causes aberrant development of renal tubular structures in humans, including the absence of the trachea, gastric glands, and salivary glands. The complete coding sequence of FAT1, FAT2 and partial coding sequence of FAT3 was published (Mariot *et al.*, 2015; Perugorria *et al.*, 2019; Schwartz *et al.*, 2003). The complete coding sequence of FAT3 and FAT4 was reported (Camargo *et al.*, 2007). The most similar to FAT3 is FAT1. Big proteins with extracellular cadherin repeats, EGF-like domains, and laminin G-like domains are encoded by both human and *Drosophila* FAT family genes. Codons 275-352 of FAT2 are identical to the 3rd cadherin repeat of FAT1. However, this region of FAT2 was not anticipated to represent the cadherin repeats using NCBI's conserved domain search (CDS) algorithms. Because cadherin repeats and EGF-like domains are defined loosely in CDS algorithms, it is still unclear whether areas remotely linked to cadherin repeats and EGF-like domains are functional or not. From *Drosophila* to vertebrates, the FAT cadherin family has grown from 2-4 members, but its structure and function have remained consistent. Invertebrates of the FAT family have distinct configurations in which the amount of laminin motifs and EGF-like motifs leads to the unique function. FAT1 and FAT4 have extracellular domain cadherin repeats, whereas FAT2 and FAT3 contain 32 and 33 repeats, respectively. "The condition of constant internal, physical, and chemical circumstances that biological systems maintain is known as homeostasis" (Mariot *et al.*, 2015). All organisms' metabolic processes can only take place in highly precise physical and chemical conditions. The circumstances vary depending on the organism, and the chemical reaction occurs within the cell or in the interstitial fluid that surrounds the cells. "The best-known homeostatic systems in humans and other animals are regulators that keep the extracellular fluid composition constant" (Peng *et al.*, 2021). The alternative homeostatic system, on the other hand, encompasses many components of human physiological controls and other entities in the body. Hyper and hypo conditions, such as hypothermia, hypotension, and hypertension, are usually preceded when the amount of variables is larger or lower than what is necessary by the process of homeostasis. From the previous reviews found that there are three domains that is helical, cytoplasmic and extracellular in FAT1 gene. The helical domain is very less contained than cytoplasmic and extracellular topology in case of FAT1 cascade. The role of different domains is different in fat1 protein. The helical domain of FAT1 describes the mutational studies discovered in HNSCC which associated with research of two researchers and from the cancer genomics. The therapeutic studies pave the way to the result of activation of HNSCC by Notch signaling pathway. This domain also acts as a cadherin molecule to binds with the protein of fatty acid binding protein, contains high chain longevity and high affinity. New data from in vitro and whole animal research suggests that fatty acid transmembrane transport is mediated by proteins. FABPs appear to have a role in the cell's extranuclear compartments by transporting their ligands into the cytosol, where they interact with particular proteins. The extracellular domain plays major role that to consider as cadherin gene super family. From the reviews we found the function of a mammalian FAT cadherin. This domain, which overlaps with dynamic actin structure, shoes the specific structures of FAT1 at filopodial tips, lamellipodial edges, and cell-cell borders. Disorganization of cell junction related f- actin and f other actin fibers/cables, disruption of cell-cell contacts, and suppression of cell polarity development at wound borders were all seen when FAT1 was knocked down via RNA interference. Ena/vasodilator – activated phosphor proteins were identified as a possible downstream effector of FAT1. This suggests that FAT1 modulates cell contacts and polarity through regulating actin cytoskeletal structure at cell peripheries. The current study emphasizes the importance of FAT1 and TNF-A in maintaining cellular homeostasis



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and thus aligns with one of the objectives on United Nations formulated Sustainable Development Goals (SDGs); SDG3 which ensures healthy lives and promotes well-being for all at all stages. In this study, we focused on the structural and functional aspects of various domains and motifs of FAT1, primarily involved in interaction with Tumor necrosis factor-A (TNF-A).

METHODOLOGY

Determination of protein sequences and putative protein partners

Freely accessible database of protein sequence and functional information is found from Uniprot. It contains a large amount of information about the biological function of proteins derived from the research literature. It is also a database which comprises many other databases such as Uniprot knowledgebase (UniportKB), the Uniprot reference clusters (UniRef) and the Uniprot Archive (UniParc). The Uniprot consortium collaborated with the European Bioinformatics Institute (EBI), the Swiss Institute of Bioinformatics (SIB) and the Protein Information Resources (PIR). EBI developed large resources of bioinformatics databases and services. SIB is the founding centre of the swissport group and maintains the EXPASY (Expert Protein Analysis System) server a central resource for proteomics databases and tools. Likewise PIR is the oldest sequence which to be considered as analysis and sequences the structure of protein. Also classifies the protein sequences in this tool. It is the database finds out from uniprot shows that how one protein interacts with more than one protein. It is the functional protein association networks which also opened in NCBI by the server <https://string.db.org/>. Protein sequences and putative protein partners of FAT1 and TNF-A were retrieved from UniportKB and STRING.

Determination of three dimensional configurations of proteins

Protein Data Bank (PDB) was used for retrieving the protein structures. Swiss model is the part of Swiss-ProtKB is used as a structural bioinformatics web server dedicated for homology modeling of 3D protein structure. Homology modeling is currently the most accurate methods to generate reliable 3D protein models and is routinely used in many practical applications. Homology modeling method makes use of experimental protein templates to build models for evolutionary related targets. Three dimensional configurations of proteins of FAT1 and TNF-A were obtained from Swiss-Prot. It is accessed in the web server <https://swissmodel.expasy.org/>.

Visualization of three dimensional protein structures

The three dimensional structures of native proteins and interaction of proteins were primarily visualized by PyMOL. PyMOL is an open source but proprietary molecular visualization system created by Warren Lyford DeLano. The private software company by DeLano scientific LLC dedicated to creating useful tools that become universally accessible to scientific and educational communities. Currently it is commercialized by Schrodinger, inc.as original software license was a permissive license they were able to remove it, new versions are no longer released under the python license, but under a custom license and some of the source code is no longer to released. PyMOL can produce high quality 3D images of small molecules and biological macromolecules such as proteins. According to original author by 2009, almost a quarter of all published images of 3D protein structures in the scientific literature were made using PyMOL. It is one of the few mostly open source model visualization tools available for use in structural biology. It uses OpenGL Extension wrangler library (GLEW) and free GLUT and can solve poisson Boltzmann equation using adaptive poisson Boltzmann solver. Anyone can either compile an executable from the python licensed source code or pay for a subscription to support service to obtain access to precompile executable.

Protein-protein interactions

Protein- protein and protein-DNA/RNA interactions play a fundamental role in a variety of biological processes. Determining the complex structures of these interactions is valuable in which molecular docking has played a important role. HDock is the novel web module of our hybrid docking algorithm of template based modelling and free docking in which cases with misleading templates can be rescued by the free docking protocol. We retrieved our datas of protein- protein interaction by using the server <https://hdock.phys.hut.edu.in/>.





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RESULTS AND DISCUSSION

The protein domain organization, three dimensional configuration and putative protein interactors of FAT1

In order to reveal the important function domains of FAT1, UniProtKB database was considered which primarily provided significant information related to the protein of interest. FAT1, which is associated in various signalling events comprises of 4588 amino acid residues (Figure 1A, 1B). The three dimensional structures of the FAT1 and TNF-A proteins were generated using Swiss model. The proteins contain α -helices and β -sheets configured structures (Figure 1C, 2B). The putative protein interactors of FAT1 were retrieved from the STRING module, which highlighted ten numbers of proteins (Figure 1D). Since, TNF-A is involved in cell-cycle regulation and plays an significant role in maintaining cellular homeostasis, we opted to find out the functional domains of FAT1 involved in interaction with TNF-A.

The protein-protein interaction of Wild-type FAT1, mutants with TNF-A

Using the H-DOCK module, the docking scores for protein-protein interactions were predicted. The Wild-type and domain mutants of FAT1 were included for this study (Figure 2). It was observed that the docking score for Wild-type FAT1-TNF-A was -285.10. The docking score for FAT1 (Δ 1-100)-TNF-A was -253.92. The docking score for FAT1 (Δ 101-200)-TNF-A was -265.32. The docking score for FAT1 (Δ 201-300)-TNF-A was -264.72. The docking score for FAT1 (Δ 301-400)-TNF-A was -287.29. The docking score for FAT1 (Δ 401-500)-TNF-A was -263.42 (Table 1; Figures 3-8). The N-terminal 100 amino acids of FAT1 are vital for interaction with TNF-A since the deletion of initial amino acid residues resulted in weak interaction between FAT1 (Δ 1-100)- and TNF-A with respect to wild-type FAT1-TNF-A interaction. However, it was observed that the docking score for FAT1 (Δ 301-400)-TNF-A interaction was slightly elevated to -287.29 suggesting that the amino acid residues spreading from 301-400 residues did not affected the strength of interaction between two proteins rather it is quite relevant that this domain might regulate the interaction of FAT1 with TNF-A.

CONCLUSION

Using the H-DOCK module, the docking scores for protein-protein interactions were predicted. It was observed that the docking score for Wild-type FAT1-TNF-A was -285.10. The docking score for FAT1 (Δ 1-100)-TNF-A was -253.92. The docking score for FAT1 (Δ 101-200)-TNF-A was -265.32. The docking score for FAT1 (Δ 201-300)-TNF-A was -264.72. The docking score for FAT1 (Δ 301-400)-TNF-A was -287.29. The docking score for FAT1 (Δ 401-500)-TNF-A was -263.42. The N-terminal 100 amino acids of FAT1 are vital for interaction with TNF-A since the deletion of initial amino acid residues resulted in weak interaction between FAT1 (Δ 1-100) and TNF-A with respect to wild-type FAT1-TNF-A interaction. However, it was observed that the docking score for FAT1 (Δ 301-400)-TNF-A interaction was slightly elevated to -287.29 suggesting that the amino acid residues spreading from 301-400 residues did not affected the strength of interaction between two proteins rather it is quite relevant that this domain might regulate the interaction of FAT1 with TNF-A. Our results highlight the importance of various functional domains of FAT1 including the N-terminus 1-100 amino acid residues for interaction TNF-A. Interestingly, it was found that the small peptides corresponding to the N-terminus domain 1-100 of FAT1 effectively interact with tumor-suppressor genes. These evidences widens up the possibility of administering potential peptides when the FAT1 expression is inhibited. Our results steps way forward in improving our understanding on the functional aspects of critical protein factors such as FAT1 and TNF-A.

Statements and Declarations

Competing Interests

The authors declare that they have no conflict of interest.



**Ipsita Sahoo et al.****Ethical Approval and consent to participate**

No ethics approval is required.

Consent to publish

Not applicable.

Human and animal rights

No animals were used in the study.

Availability of data and materials

Not applicable.

Credit authorship contribution statement

All the authors have substantial contribution for the preparation of the manuscript. Gagan Kumar Panigrahi conceived the idea. Data curation and writing: Ipsita Sahoo, Santosh Kumar Sahoo, Annapurna Sahoo, Jyotishree Acharya and Gagan Kumar Panigrahi. All the authors have read and approved the final manuscript before submission.

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Table 1: Docking score of protein-protein interactions of wild-type and mutants of FAT1 with TNF-A

SL. NO.	INTERACTION OF FAT1 AND TNF-A	DOCKING SCORE
1.	WT FAT1 and TNF-A	-285.10
2.	FAT1(Δ 1-100) and TNF-A	-253.92
3.	FAT1(Δ 101-200) and TNF-A	-265.32
4.	FAT1(Δ 201-300) and TNF-A	-264.72
5.	FAT1(Δ 301-400) and TNF-A	-287.29
6.	FAT1(Δ 401-500) and TNF-A	-263.42





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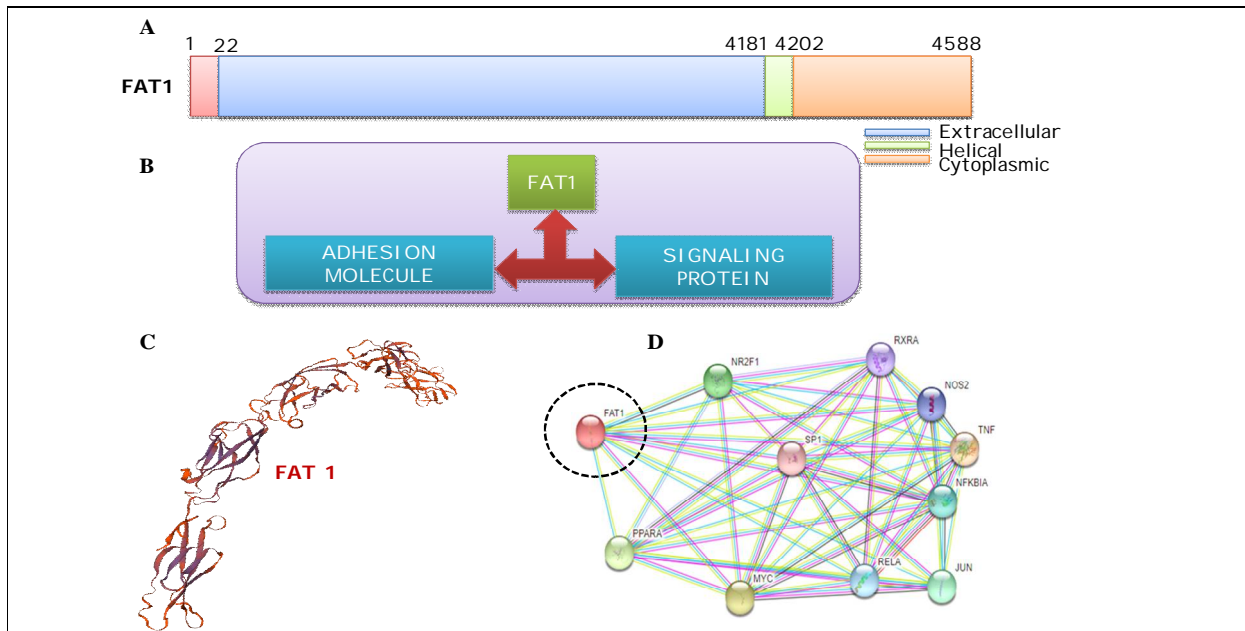


Figure 1: The domain organization of FAT1 (A); Major functional role of FAT1 in cellular physiology (B); 3-d structural configuration of FAT1 (C); Putative protein partners of FAT1 (D).

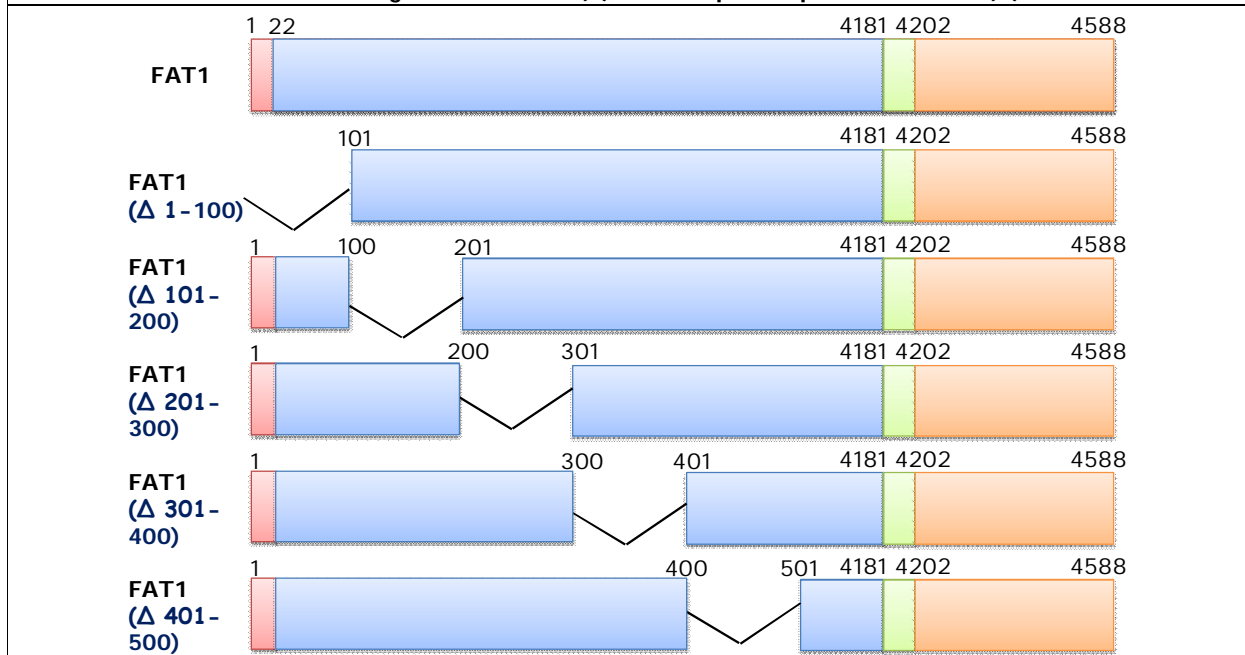


Figure 2: Wild-type and domain mutants of FAT1 used in this study for seeing their interaction with TNF-A.





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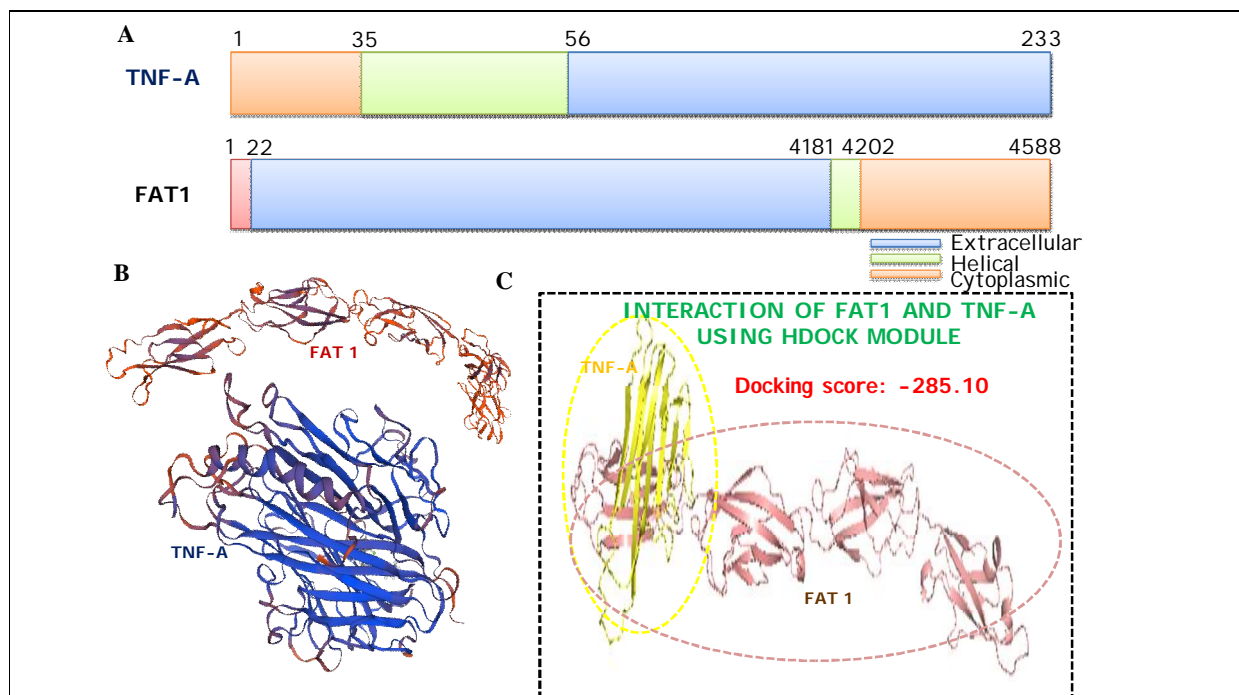


Figure 3: The domain organization of FAT1 and TNF-A (A); 3-d structural configuration of FAT1 and TNF-A (B); Interaction of FAT1-TNF-A (C).

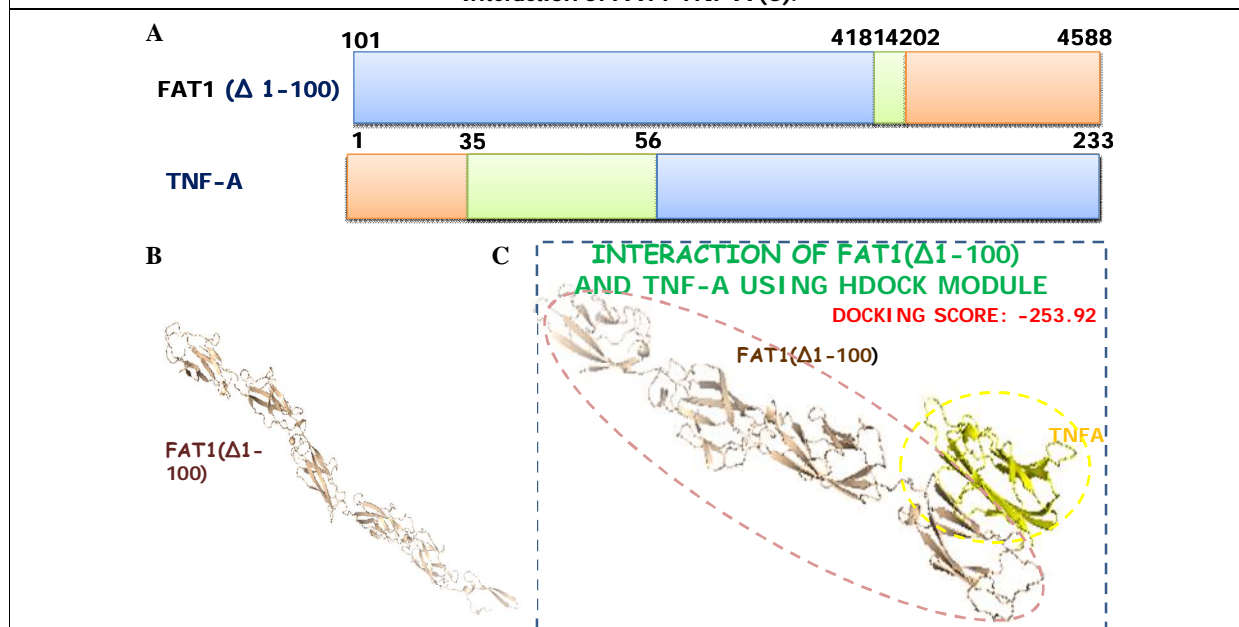


Figure 4: The domain organization of FAT1 (Δ 1-100) and TNF-A (A); 3-d structural configuration of FAT1 (Δ 1-100) (B); Interaction of FAT1 (Δ 1-100) -TNF-A (C).





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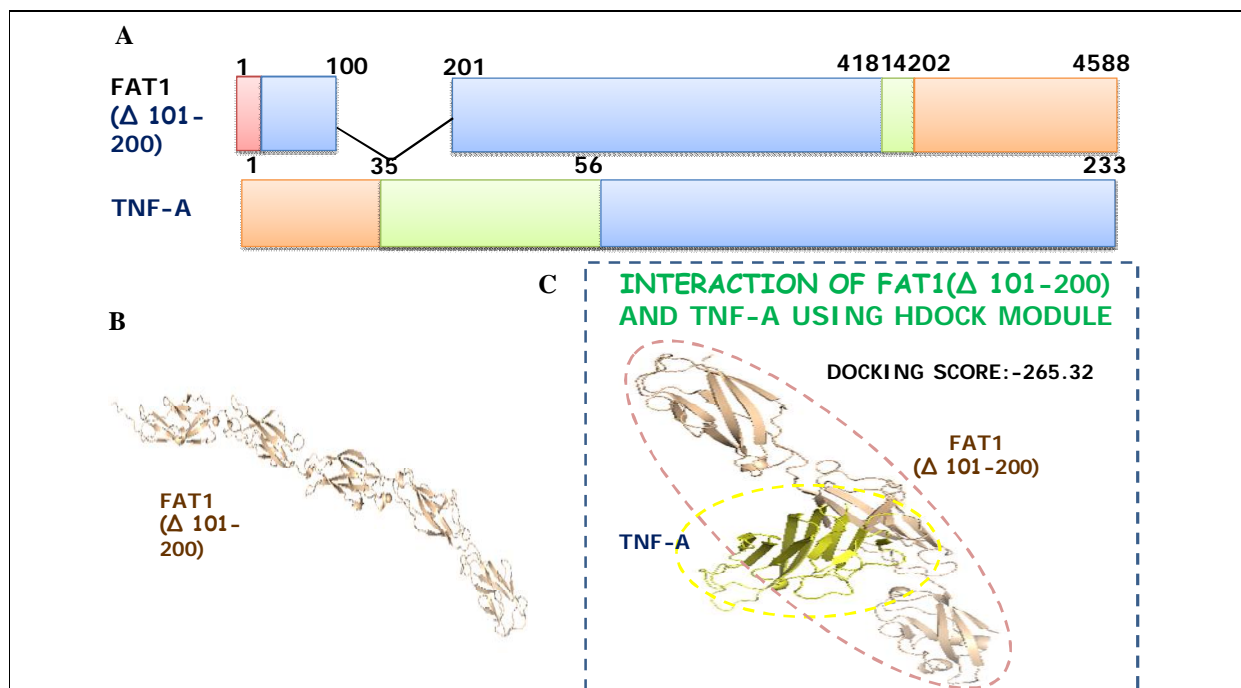


Figure 5: The domain organization of FAT1 (Δ101-200) and TNF-A (A); 3-d structural configuration of FAT1 (Δ101-200) (B); Interaction of FAT1 (Δ101-200) -TNF-A (C).

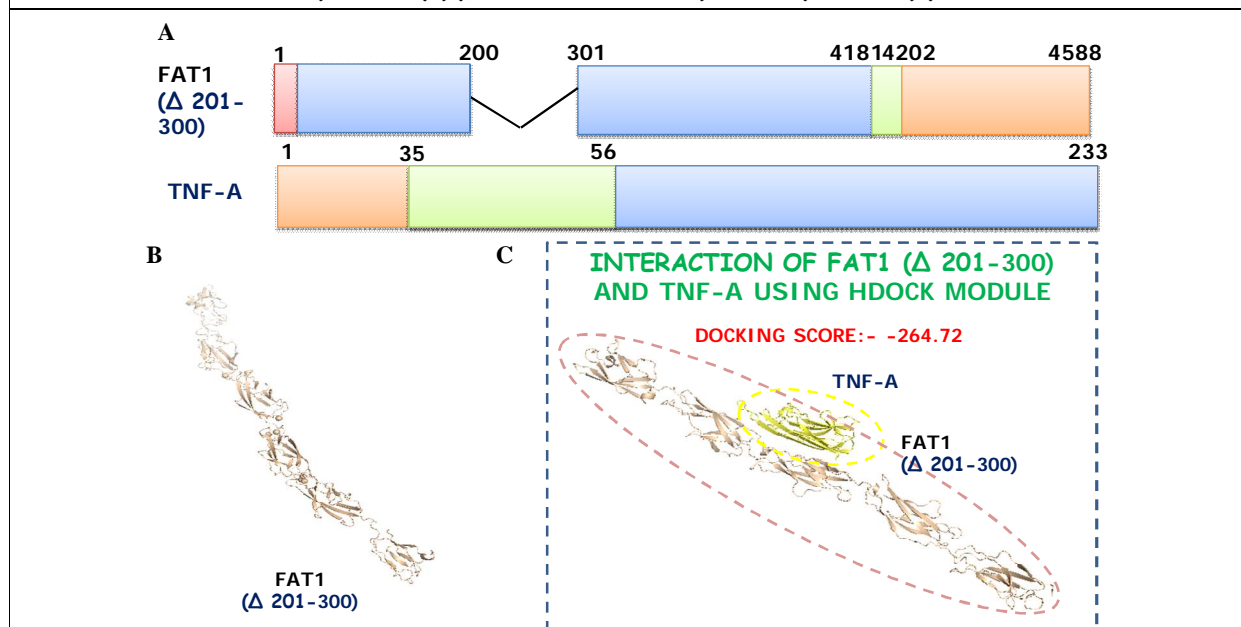


Figure 6: The domain organization of FAT1 (Δ200-301) and TNF-A (A); 3-d structural configuration of FAT1 (Δ200-301) (B); Interaction of FAT1 (Δ200-301) -TNF-A (C).





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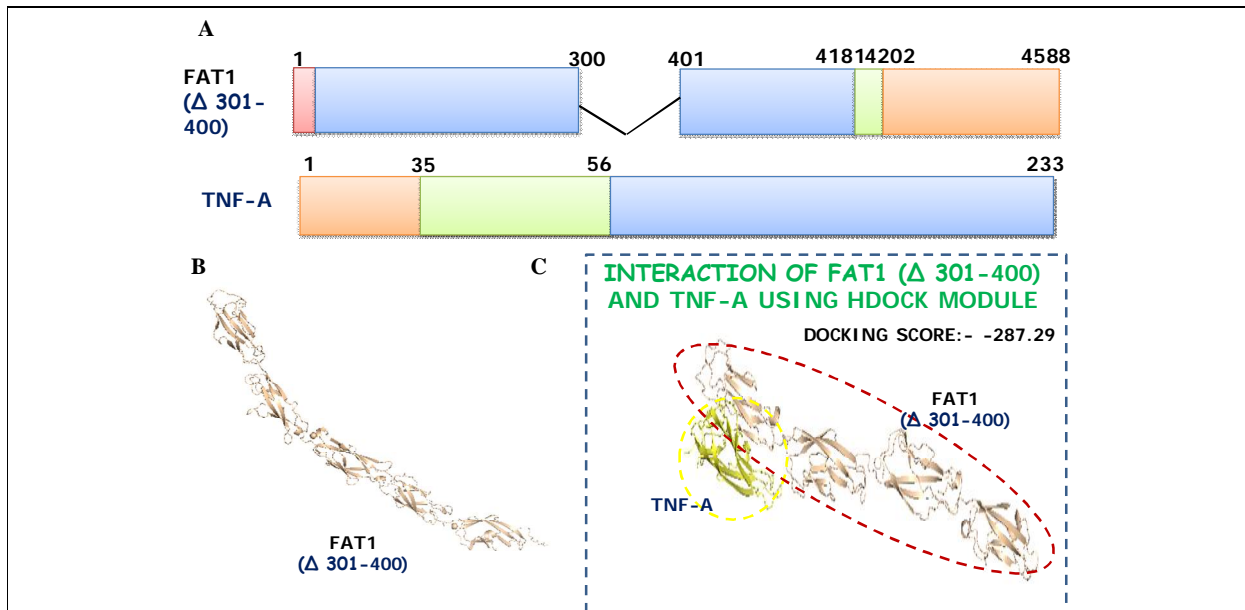


Figure 7: The domain organization of FAT1 (Δ301-400) and TNF-A (A); 3-d structural configuration of FAT1 (Δ301-400) (B); Interaction of FAT1 (Δ301-400) -TNF-A (C).

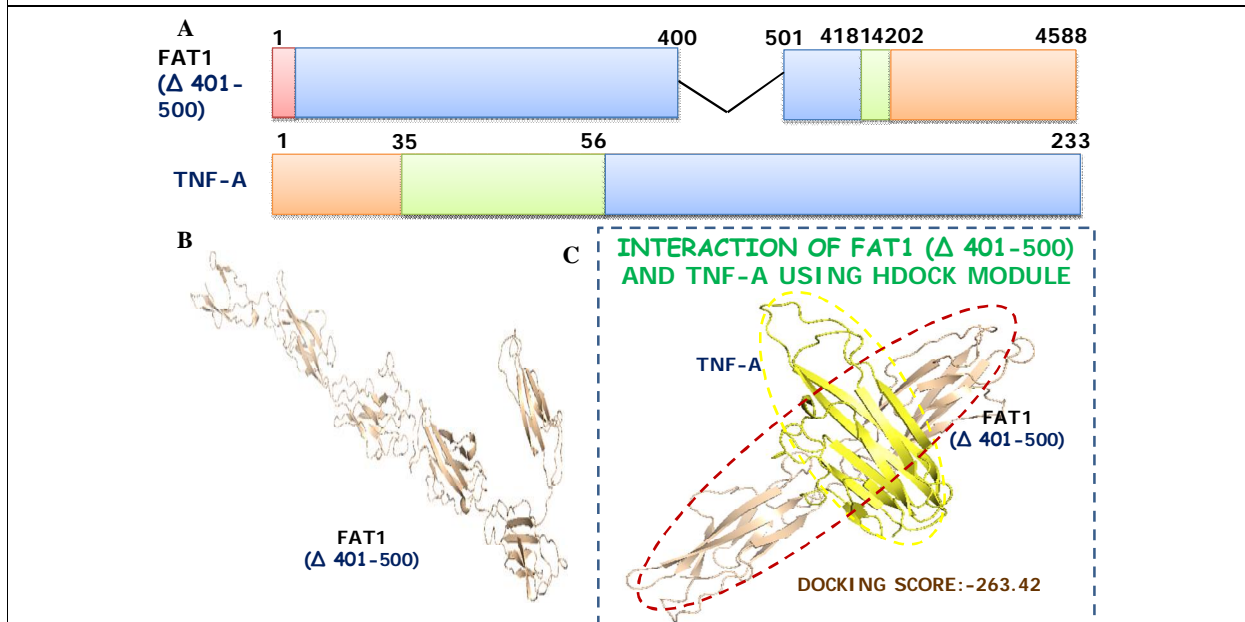


Figure 8: The domain organization of FAT1 (Δ401-500) and TNF-A (A); 3-d structural configuration of FAT1 (Δ401-500) (B); Interaction of FAT1 (Δ401-500) -TNF-A (C).





Bio-Electronic Medicine

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ABSTRACT

Innovation in technology is required to change the world. Bioelectronic medicine is the consolidation of molecular medicine, neuroscience, engineering, and computing to develop a device to diagnose and treat diseases. The mechanisms of Bioelectronic medicine for neural control of a biological process that underlie disease and the development of devices to modulate these specific neural circuits as therapy using electrons instead of drugs. Bioelectronic medicine has emerged at a convergent epicenter in health care, technology, and science. Bioelectronic medicine is a new way to treat disease. Today patients are treated by either drug, which can lead to a side effect or drive up costs, which can mask pain signals but they usually can't mask the central cause of disease. With the rapid rise in technology for the precision detection & modulation of electrical signalling patterns in the nervous system is a new class of treatment known as bioelectronic medicines. Specifically, the peripheral nervous system will be at the center of this advance, as the functions it controls in chronic disease are extensive. The vision for bio electronic medicine is one of the tiny, implantable devices that can be attached to individual peripheral nerves. Such devices will be able to decipher & modulate neural signalling patterns, achieving therapeutic effects that are targeted at signal function of a specific organ. This new field was exploring the potential to treat Paralysis, Diabetes, Rheumatoid arthritis, chronic disease, Hypertension, blind diseases etc.

Keywords: Bioelectronic medicine, Targeted delivery, Neuromodulation, Simulation, Health.

INTRODUCTION

Bioelectronics was defined as 'the use of biological materials and biological architectures for information processing systems and new devices'. Bioelectronics, specifically bio-molecular electronics, were described as 'the research and development of bio-inspired (i.e. self-assembly) inorganic and organic materials and of bio-inspired (i.e. massive parallelism) hardware architectures for the implementation of new information processing systems, sensors and



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actuators, and for molecular manufacturing down to the atomic scale'. This field brings together material science, biochemistry, biophysics, molecular medicine, neuroscience, immunology, bioengineering, electrical engineering, mechanical engineering, computer science, mathematics, artificial intelligence, and other basic and clinical disciplines. Bioelectronic Medicine promises to bring new insights into the diagnosis and treatment of diseases and conditions as varied as cancer, rheumatoid arthritis, inflammatory bowel disease, obesity, diabetes, asthma, paralysis, blindness, bleeding, ischemia, organ transplantation, cardiovascular disease, neurodegenerative diseases, and others. Bioelectronic Medicine focuses on electrical signalling in the nervous system. Insights into the regulatory functions of the nervous system and technologies that record, stimulate, or block neural signalling to affect specific molecular mechanisms are the primary focus.

Bioelectronic approaches for monitoring and controlling biological processes, for providing insights into host and pathogen physiology and disease pathogenesis, and for restoring musculoskeletal function and mobility and treating paralysis, and many other conditions. In addition, developments in prostheses, robotics, and other relevant areas will be featured. Innovative preclinical research and development as well as clinical trials assessing new diagnostic and treatment advances will be well represented. *Bioelectronic Medicine* also welcomes related topics including ethics, community impact, regulatory and legal implications, reimbursement, and patient feedback in order to embrace multidisciplinary input across fields of science, technology, and healthcare.[1]

Concept of mechanism of smart bio-electronics

Given that practically all of the body's organs and functions are regulated through neural circuits communicating via electrical impulses, it should theoretically be possible to interpret the electrical language of diseases. By extension, it could be possible to stimulate or inhibit the malfunctioning pathways with tiny electrodes in order to correct the defect. This micro-manipulation of the nervous system - targeting impulses (action potentials) to specific cells within neural circuits - could conceivably be exploited to manipulate a broad range of bodily functions, such as controlling appetite or blood pressure or stimulating the release of insulin in response to rising blood sugar. Strategy to isolate the nerve bundles sending efferent signals involved in specific diseases from the peripheral nervous system to the brain, and blocking them will likely involve an invasive procedure. The strategy of blocking the afferent signal from being released in the brain will have a broader impact.

Some following important area:

- Understanding molecule/cell-electronics interfaces;
- Understanding cellular responses—and their variabilities—to stimulation (electrical, mechanical, chemical, thermal, and the like);
- Ability to collect and analyse essential data on the state of biomolecules and cells (chemical, physical, structural, functional);
- Ability to monitor, in real-time, the biochemistry of a single cell or a population of cells, which requires comprehension of interaction between molecules;
- Ability to deliver appropriate therapeutic materials and stimuli in real-time; and
- Ability to detect, identify, and quantify thousands of different biomarkers simultaneously. [1]

Current researches in bioelectronic medicine:

Bioelectronic in Hypertension: Antihypertensive drug therapy is successful only to a point, leaving a significant percentage of patients nationwide with blood pressure measurements above guidelines despite being treated with at least three agents at maximally tolerated doses, consistent with a diagnosis of resistant hypertension. The sympathetic nervous system is an effective homeostatic mechanism for modulating hemodynamic in times of stress and illness. Bioelectronic in Rheumatoid Arthritis: Rheumatoid arthritis (RA) is a chronic autoimmune disease, which is characterized by pain, swelling, and stiffness of joints, due to synovial inflammation. During active disease, the joints are the persistence of synovial inflammation leads to the development of bone erosions and finally joint deformities. Bioelectronic medicine is increasingly becoming applied in clinical trials. Patients suffering from



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rheumatoid arthritis that were implanted with a vagus nerve stimulator to activate the inflammatory reflex showed significant improvement of clinical signs and symptoms also in patients with previously therapy-resistant disease. Signals through the vagus are transduced through the nerve and trigger. Activation of inflammatory cells is reduced. This is reduced production of systemic inflammation mediators.

Bioelectronic in CNS Disease: VNS (vagus nerve stimulation) therapy has been approved as a treatment for epilepsy in Europe in 1994, and in the US in 1997, in the US, VNS has also been approved for the treatment of depression. VNS can be performed after neurosurgical implantation of a vagus nerve stimulator; in 2012, 100,000 vagus nerve stimulators had been implanted. The device consists of two parts: a pulse generator and a lead with electrodes. The pulse generator contains the battery and the stimulation system and is positioned subcutaneously below the left clavicle on the pectoral muscle. It is connected to the left vagus nerve in the neck via the lead, with three helices at the end: one positive electrode, one negative electrode, and an anchor tether. The three helices are placed around the vagus nerve to deliver the electrical pulse of the pulse generator. During surgery, the vagus nerve is electrically stimulated to test the impedance and functionality of the device, which can be accompanied by bradycardia and short-lasting systole. After implantation, VNS therapy can be initiated starting at a low dosage of stimulation with an output current of 0.25 mA^{85, 86}. Dosage is increased slowly with steps of 0.25 mA to a maximum output current of 3.5 mA⁸⁷ because toleration to the stimulation is built up with the use of the VNS device. Implantation of the three helices around on the left vagus nerve containing a positive electrode, a negative electrode, and an anchor tether. The electrodes are connected to the lead, which is attached to the pulse generator.

Bioelectronic in Spinal Cord: Regaining motor function is of high priority to patients with spinal cord injury (SCI). A variety of electronic devices that interface with the brain or spinal cord, which have applications in neural prosthetics and neurorehabilitation are in development. Brain machine interfaces that decode motor intentions from cortical signals are enabling patient-driven control of assistive devices such as computers and robotic prostheses⁹⁵, whereas electrical stimulation of the spinal cord and muscles can aid in retraining of motor circuits and improve residual capabilities in patients with SCI. Next-generation interfaces that combine recording and stimulating capabilities in so-called closed-loop devices like BMI (Brain-Machine Interference). Will further extend the potential for neuroelectronic augmentation of injured motor circuits. Emerging evidence suggests that integration of closed-loop interfaces into intentional motor behaviours has therapeutic benefits that outlast the use of these devices as prostheses. Brain-machine Interference: Brain-machine interfaces (BMIs) that record and decode signals from the brain enable volitional control of assistive devices and modify patterns of cortical activity through the process of neurofeedback. The translation of invasive BMIs from animal studies to patients suggests that these technologies could control functional electrical stimulation for the restoration of movement to paralyzed limbs. Functional limb movements involving the coordinated activity of multiple muscles and the activation of spinal circuitry in combination with volitional intent could have therapeutic benefits.

Bioelectronics in Blind Disease: For the treating retinal disease, bioelectronic medicine play critical role. Bioelectronic medicine it's a device that is implanted in the retinadiscussed progress in the new field of bioelectronic medicine, and underlying neurophysiological and other mechanisms make it possible to target specific circuits to treat disease and improve affected organ functions. So, indeed bioelectronics is a career of the future, and it promises a lot to the general public, too, as electronics are very economical when they go into mass production. That prospect certainly promises a significant leap forward in both treatment safety and efficacy, by replacing electrons on the place of drugs.

Futures Prospective

- Venture fund should be dedicated to bioelectronics with the aim of developing —the first medicine that speaks the electrical language of the body|| by the end of this decade.
- The applications of this approach are intuitive for central nervous system (CNS) diseases, but could be even more widespread in light of research which suggests stimulation of certain nerve fibres can boost the immune response.



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Harnessing that potential could bring cancer and potentially even infectious diseases into the electroceutical spectrum.

Multifunctional Endoscope

Conventional endoscopes lack the spatial resolution necessary to detect and treat small cancers and other abnormalities. They are equipped with a flexible tube fitted with a camera, lens and light delivery system, providing both manoeuvrability and direct visualization of the gastrointestinal tract. However, despite the proven utility of current surgical endoscopes, on board sensors coupled with treatments are unavailable because of the macro-scale size of the conventional system, preventing diagnosis and therapy of micro-scale tumours. Multifunctional endoscope systems have the potential to reduce the procedure time and improve the efficiency of minimally invasive surgical procedures for colon cancer treatment. Furthermore, efficient therapy can contribute to the excellent oncologic and economic yield for various gastrointestinal cancers or precancerous lesions in the future.

Bio-Electronic Band-Aids

A team of researchers from Tufts, Perdue, Harvard, and Women's Hospital, supported by the National Science Foundation is, working on a new kind of bioelectronic smart bandage. The team introduced a bandage that uses sensors, biomaterials, and microsystems tech to monitor and treat wounds that require longer-term care, such as diabetic ulcers and burns. Pre-emptive care in bandaging one team out of UC Berkeley, also supported by the NSF, is working on a bandage that detects tissue damage before it even becomes visible. Intended for pressure ulcers, otherwise known as bedsores, the bandage monitors the electrical changes caused by cell death. It is essentially a printed array of tiny electrodes on a thin flexible film. Bedsores can be anything but minor: Christopher Reeve died of an infection that started with a bedsore.[7]

Flexible Bioelectronics

Flexible electronics is an emerging field which encompasses design and fabrication of electronic devices and circuits on flexible polymeric substrates. Flexible bioelectronics is the application of flexible electronics into biomedical and life sciences applications for monitoring, sensing and neuroprosthetics. The new devices, known collectively as flexible bioelectronics, will do much more than deliver medicine. They will be able to monitor all the vital signs of the healing process, such as oxygen levels and temperature, and make adjustments when needed, as well as communicate the information to health professionals who are off-site. To fulfil the critical need for the devices to be flexible, the team is testing new materials, such as a hydrogel that would cover a wound with just the right amount of stretch to be comfortable.

Mouth Guard

Within a circuit board about the size of a penny, the device contains a screen-printed sensor that incorporates silver, Prussian blue ink and an enzyme known as uricase. When the uricase is exposed to uric acid in the user's saliva, it reacts by forming hydrogen peroxide, which subsequently reacts with the ink. This in turn produces an electrical signal, which is digitized and then wirelessly transmitted to a smartphone or tablet for analysis. So far the mouth guard has proven accurate at detecting high uric acid levels in saliva samples from a patient with hyperuricemia, a condition which produces excessive uric acid in the bloodstream. It was also able to detect that those levels had gone down, when the test subject took uric acid-lowering medication. Previously, the only way of monitoring those levels would have been through the drawing of multiple blood samples, and the patient would need to wait for symptoms to develop before knowing that they needed to take the medication. In the lab tests, however, the saliva samples were simply spread on the sensor – the electronics need to be further miniaturized before the mouth guard can comfortably be worn continuously in a person's mouth. It is hoped that a wearable version should be complete within a year.[9]



**Debaprasad Routray et al.****3D-printed programmable release capsules**

An increasing number of 3D-printing appearing in nanotechnology applications (see for instance these recent Nano work Spotlights: 3D-printed graphene for electronic and biomedical applications; 3D-printed 'smart glue' leverages DNA assembly at the macroscale; or fully 3D-printed quantum dot LEDs), researchers are expanding this fabrication technique to more and more areas. A recent example is the introduction of a novel 3D-printing based method to produce highly monodisperse core/shell capsules that can be loaded with biomolecules such as therapeutic drugs. "Our method provides us with robust control over particle properties, passive release kinetics, and particle distributions throughout a 3D matrix,". The researchers expect that this platform of 3D printed programmable release capsules will be useful in applications such as dynamic tissue engineering, 3D printed drug delivery systems, synthetic/artificial tissues, programmable matter, and bionic Nano systems. Beyond this, another important application area could be combinatorial screening of biomolecular gradients – drugs, toxins, pollutants, etc. – against cell types. A particularly far-reaching example would be to imagine having a collection of stem cells, which could be triggered using a red laser into a heart, or with a green laser into a liver.[10]

Advancements and challenges

Much progress has been made in the fields of neural decoding and bioelectronic medicine, but there are many limitations that still must be addressed. To tap into the intricate and complex network of neural pathways, rich with information, improvements in current neural interface technology will be required. Cortical implants provide higher spatial and temporal resolution than fMRI; however, they cannot cover the entire brain and also do not match its neuronal density. Continued development of microfabrication and surgical methods will be required to improve coverage area and spatial density. Furthermore, implementing neural decoding in the central or peripheral nervous system will require an increased number of signals. Sensing multiple signals from neural pathways such as nerve fibres is a difficult challenge and requires small implantable neural interfaces, which are under development today. Furthermore, an interface of this nature can fail to provide quality signals over time due to biomechanical issues such as migration, encapsulation and scarring. Understanding how information is encoded in the nervous system is another important area that needs further development to advance the field of bioelectronic medicine. Neural signals can be recorded in high resolution with improved neural interfaces, but corresponding biological measurements must be made simultaneously to learn the relationship between the two. This process of association is precisely how we learn any new language, but requires accurate real-time biological sensing. Some real-time sensor technologies exist, such as glucose and blood pressure sensors, but others such as cytokine sensors to track the inflammation process need to be developed and allow us to learn the neural language and how information is encoded into the electrical pulses that travel throughout our neural networks.[4]

Summary

In the field of bioelectronic medicine, it will be critically important that we focus on how information is encoded and how various neural networks are connected. Continued efforts in neural decoding (learning the language of human nervous system) and mapping functional connectivity will be required. We also have to consider that as we develop closed-loop methods and devices we will be adding a control system to an already present control system, the human nervous system, which is vast and complex. This will lead to many exciting challenges and opportunities as we grow this new field. The application of electronics technology to biology and medicine is not new. Examples include pacemakers and virtually the entire medical imaging industry. Research that enabled these applications grew out of many disciplines of science and engineering; however, recently, the term —bioelectronics‖ is being used more widely to describe this multidisciplinary field.

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**Debaprasad Routray et al.****Conflicts of interest**

The authors of the article have no conflicts of interest to declare.

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Identification of Real-time Maglev System using Cat Swarm Optimization based FLANN

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ABSTRACT

In the recent past identification of nonlinear plant is a significant work has done by many researcher and it is found to be an emerging area for further research due to its wide application. In this article, the characteristics and behavior of a real time maglev plant has been identified using an efficient Artificial Neural Network (ANN) based on functional expansion technique i.e. functional link artificial neural network (FLANN). The weights of FLANN has been iteratively updated by a heuristic optimization algorithm i.e. Cat Swarm Optimization (CSO). So that the error needs to minimized, which is considered as a cost function. To demonstrate the robust identification performance of the Maglev plant Mean square error (MSE) and CPU time is considered for analysis. The simulation results justify the proposed model robustly identifies the characteristics and parameters of non-linear dynamic maglev plant.

Keywords: Non-linear System; System Identification; FLANN; Maglev plant; Chebyshev Expansion; CSO

INTRODUCTION

The principle of identification is to formulate a mathematical modeling of plant by taking its input-output data. A mathematical modeling of a system can be determined by using laws of nature or through the experimentation. Out of many techniques to find out the mathematical modelling (using parameter estimation) of the system, direct modeling and inverse modeling, have most attractive features [1], [2]. As maximum plants are non-linear and dynamic in nature, their identification is a thought provoking. Accurate and fast identification of above system is still a nightmare. Identification of non-linear plants finds application in the area of control system, power system, communication, instrumentation and many other fields. This technique helps to design an identification technology for wide range of nonlinear system for sustainable development.



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To perform the above task in highly non-linear environment, an ANN is the best solution for it. As ANN can take the non-linear decision based on the objective. Pao et al. have proposed FLANN to overcome the above issue [3], [4], [5]. The FLANN is one of its kind and it holds the advantages of both single layer and multi-layer network. Mainly the FLANN is popular for its simple structure and less computation complexity due to absence of the hidden layer. The input of the FLANN gets functional expanded and combined to a linear combiner. The functional expansion of inputs gets by different expansion method like power series expansion, trigonometric expansion and Chebyshev expansion [6]. In this article, the Chebyshev expansion has been used to functionally expand the input. The FLANN model has been trained by using the Cat Swarm Optimization (CSO) technique. This is a random search algorithm, which is based on the achieving the best arrangement to avoid failure to get optimal solution. Using this steps the cost function is minimized. Here, the error is considered as the cost function. The performance of the proposed identification technique has been studied in terms of error, MSE and the CPU time. This paper layout having, Section 2 presents the model of maglev plant. In Section 3 deals with the principle of system identification. Section 4 explain the basics of CSO. The proposed CSO based FLANN structure is discussed in section 5. The simulation result is discussed in section 6. Finally, the concluding remarks of the paper is outlined in section 7.

The Magnetic Levitation System

Magnetic levitation (Maglev) has been extensively accepted due to its contactless, low noise and low friction behavior and has application in many engineering field [7], [8]. Basically, Maglev plant is a highly non-linear plant and their control and identification is still a problem. The Maglev setup consist of two parts i.e. a physical Maglev plant and a computer interface. The Maglev plant is consist of electromagnet, IR sensor, amplifier and control objects. The electromagnet helps to control the steel ball in moving up and down from the equilibrium position. When current flows in the electromagnet, then their induces an emf, which controls the position of the steel ball. The steel ball is balanced by electromagnet force and gravitational force to keep it in the desired position. The IR sensor helps to measure the position of the ball and send a signal to input. The amplifier used to improve the level of the input voltage. The Maglev laboratory setup used for experimentation is manufactured by Feedback Instrument Ltd. and it works with MATLAB environment.

where, m is the mass of the ball, $y(t)$ is the distance between ball electromagnet, g is the acceleration constant, F indicates electromagnetic force, $i(t)$ is the current through the coil. The physical parameters of Maglev plant is given in Table 1.

System Identification Overview

System identification is a technique that helps to estimate a mathematical modeling for any system from its input-output data. The proposed ANN based FLANN model is a single layer network with absence of hidden layer and the weights are updated by a nature-inspired algorithm CSO [9], [10], [11]. Here, $u(k)$ represents the input, $y(k)$ is output, $\hat{y}(k)$ indicates the estimated output and $e(k)$ is the error. The cost function is taken as error for the identification of Maglev plant. The cost function need to minimize to get an efficient identified model whose response efficiently track the real-time Maglev plant response. This technique helps to design an identification technology for wide range of nonlinear system for sustainable development.

The Cat Swarm Optimization (CSO) Algorithm

In 2007, Chu and Tsai was introduced the Cat Swarm Optimization (CSO) optimization technique [12]. This technique is based on the behavior of a cat searching its prey and it is used for optimization problem. In CSO, the behavior of cat during searching of its prey are divided into two modes, i.e., the seeking mode and the tracing mode. In the seeking mode, cats targets its prey and changes its position. Similarly, in the tracing mode, cats tries to trace/track it's desired target. In this process, if the cat finds the desired prey, then they immediately their behavior into the tracing mode. The seeking mode always provides the global search procedure, whereas the tracing phase resembles a local search procedure. The positions of the cats are always a solution sets in the CSO algorithm. The cost function of all candidate points are evaluated and assigned with a probability to identical fitness function of the cats.





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The probability of each candidate point is calculated by using equation (1). In this mode, only the best, maximum and minimum fitness values are to be calculated and this can be further utilized in the tracing mode. In the tracing mode, the velocity and the position is to be initiated. The fitness values of all cats are to be calculated and out of that, the best fitness values are to be kept for computer memory. The iteration is continued until cost function finds an optimal solution otherwise again, the process of CSO algorithm repeats.

Seeking Mode:

$$P_k = \frac{\text{Probability: } FS_k - FS_b}{FS_{max} - FS_{min}} \quad (1)$$

Tracing Mode:

$$\text{velocity: } V_{k,d} = \beta \times V_{k,d} + c \times r_1 \times (x_{best,d} - x_{k,d}) \quad (2)$$

where dimension: $d = 1, 2, \dots, M$.

$$\text{position: } x_{k,d} = x_{k,d} + V_{k,d} \quad (3)$$

where, FS , P_i are the fitness value and the probability of each candidate, β is the inertia weight, c is the acceleration constant and r_1 is any random values between 0 and 1, $x_{best,d}$, and $x_{k,d}$ are the global and present positions respectively.

Algorithm for Cat Swarm Optimization

Step 1: In M dimensional space Random position of cats is initialized, i.e., $x_{k,d}$.

Step 2: Cat velocity is initialized as $V_{k,d}$.

Step 3: According to mixture ratio, the Cats are randomly chosen from the population. The cats are assigned for seeking mode and tracing mode.

Step 4: The fitness and local position of each cat is to be calculated $x_{l,d}$ and global position $x_{best,d}$ of cat will be assigned.

Step 5: The previous global best and current global best position are compared according to the fitness function and the best one is saved.

Step 6: The Cat's position and velocity will be updated using equation (2) and (3) for a new population.

Step 7: Check the termination condition, if satisfied, terminate the program otherwise repeat the Steps from 4 to 6.

Proposed CSO based FLANN Network

Pao et al. has proposed a single layer ANN i.e. functional link artificial neural network (FLANN), in which the inputs are expanded functionally. It generates the decision boundaries, which is capable of taking complex decision. Mainly the FLANN improves the learning rate with less computational complexity for identification problem. The proposed FLANN model with input signal $x(k)$ is functionally expanded to a number of non-linear components which is given as input to a linear combiner with weights are associated with it as shown in Figure 3. The functional expansion of inputs gets by different expansion method like power series expansion, trigonometric expansion and Chebyshev expansion. In this article, the Chebyshev expansion has been used to functionally expand the input.

Mathematically, Chebyshev expansion can be written as,

$$\begin{aligned} T_0(x_k) &= 1 \quad \text{for } k = 0 \\ T_1(x_k) &= x_k \quad \text{for } k = 1 \\ T_2(x_k) &= 2x_k^2 - 1 \quad \text{for } k = 2 \\ T_{k+1}(x_k) &= 2x_k T_k(x_k) - T_{k-1}(x_k) \quad \text{for } k > 2 \end{aligned} \quad (4)$$





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where, $x(k)$ is the input and $w(k)$ is the weights of the model. The output of the proposed model is given as

$$\hat{y}(k) = \sum_{m=1}^{Q-1} s_m(k)w_m(k) \quad (5)$$

The weights of the proposed FLANN model are updated by CSO algorithm for identification of Maglev plant.

RESULT AND DISCUSSION

The proposed method is simulated and test by using acer Aspire V, 8 GB RAM, intel CORE i5 processor, 1.80GHZ with Windows 10. For identification of real time Maglev plant 5000 no. of samples have been taken, out of that in 8:2 proportion is taken for training and testing with 10 no. of iteration. The performance of the proposed FLANN network updated by CSO algorithm is analysed in terms of error, MSE and CPU time. Here, the error is 0.0029, MSE is 0.0213 and CPU time is 28.043 sec. From Figure 6, it shows that the high convergence rate of MSE curve.

CONCLUSIONS

In this paper, the proposed model successfully identified the real time Maglev system based on the input-output data. Here, Cat Swarm Optimization (CSO) technique has play the important role to updated the weights of the FLANN model. A simulation study is carried to check the effectiveness of proposed CSO based FLANN network. The efficacy of proposed model found from the closed fitting of identified model response and actual model response, which exhibit that the proposed model using CSO is more suitable for identification of highly nonlinear Maglev plant. The research work in this area includes efficient neural network structure optimized by efficient nature inspired algorithm for further development to enhance its robustness and efficiency. This technique helps to design an identification technology for wide range of nonlinear system for sustainable development.

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Table 1. The physical parameter of MAGLEV plant

Sl. no.	Parameters	Value
1	m—Steel ball mass	0.02kg
2	g—Acceleration Constant	9.81m/s ²
3	i ₀ — Current value at equilibrium	0.8 A
4	x ₀ —Equilibrium position	0.009m
5	Control input (u)	±5 v
6	output voltage (xv)	+1.25v to -3.75 v

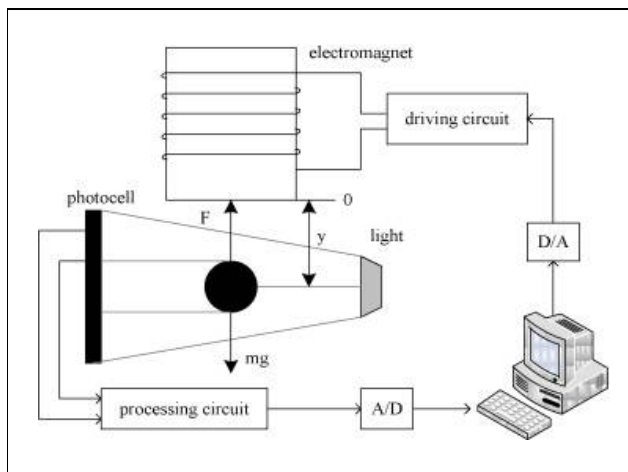


Figure 1. Block diagram of the MAGLEV system

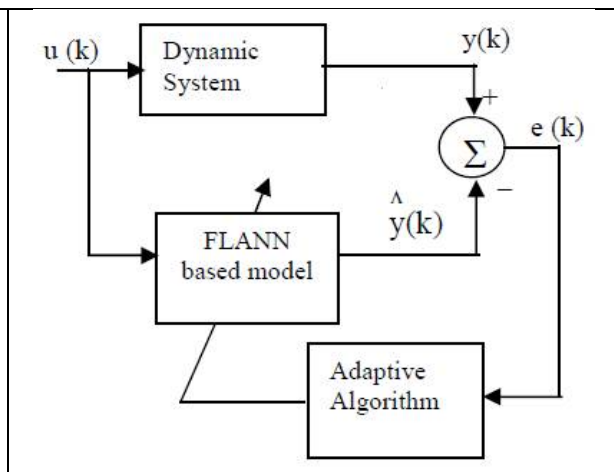


Figure 2. Schematic diagram of Maglev plant identification





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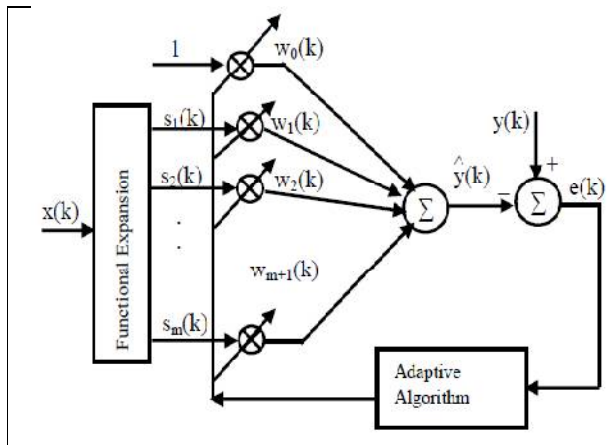


Figure 3. Structure of FLANN Model

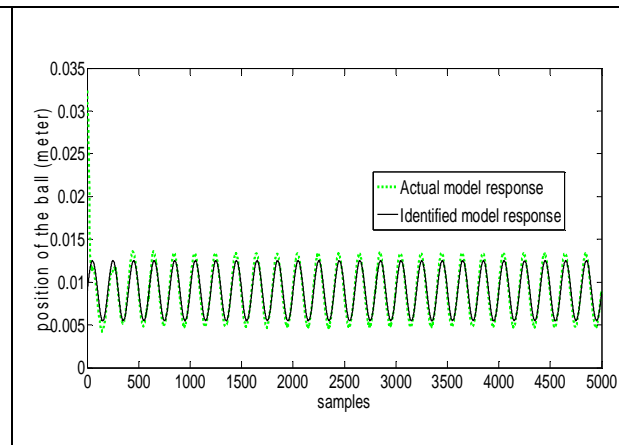


Figure 4. Actual and Identified model response (position of the ball)

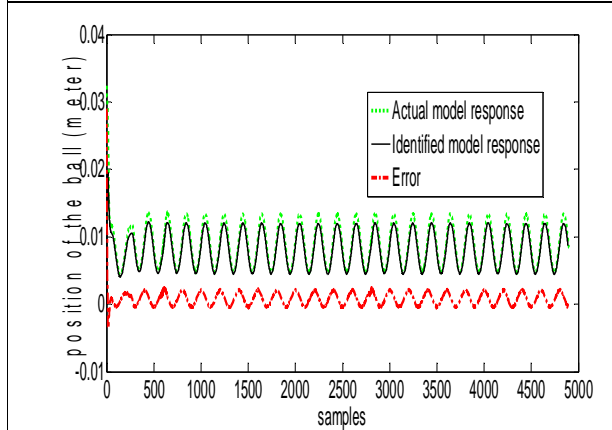


Figure 5. Identified model response generated by FLANN-CSO

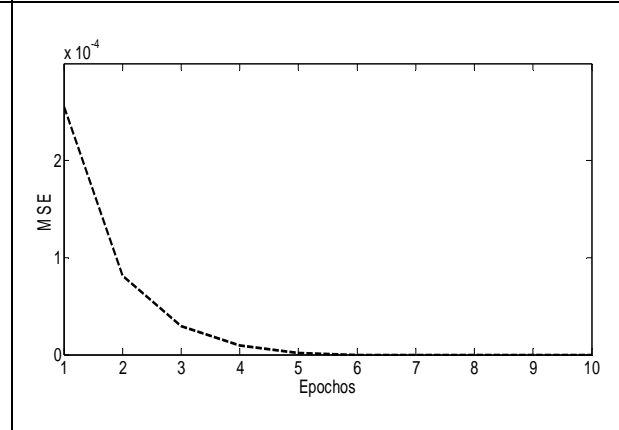


Figure 6. MSE plot of FLANN-CSO





Mutational Analyses of Human Interleukin-33 and their Interaction with MYD88

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ABSTRACT

Immune cells that are both innate and adaptive, along with cells and tissues that aren't immune interact through interleukins and associated cytokines. Both of them are crucial for the progression, advancement, and management of tumors. Interleukins can promote cancer growth and are also required for a successful tumor-directed immune response. Features of interleukins' could also be used for making immunotherapy more effective, increasing their efficiency while reducing side effects. The main goal of this research is to gain insights on the functional role of several interleukins (ILs) involved in accelerating pro-tumoural effects. IL-33 favours tumor development that is accompanied by immune suppression, which leads to treatment resistance. IL-33 can generate a tumorigenic microenvironment that self-amplifies and promotes the growth of a nascent tumour. In order to develop any potential therapeutic strategy, the structural and functional domain organization of IL33 was accessed by using widely acceptable bioinformatic tools, whereby the putative protein interacting partners of IL-33 were also enlisted. The major objective of this study was to design such mutants of IL-33 which would lead to preclinical neutralization resulting in alleviation of protumor effects. It is known that the tumorigenic niche mediated by the IL-33 secretion from tumor-initiating cells aggravates the suppression of cytotoxic T lymphocytes (CTLs) resulting in cancer immune evasion. Based on this established fact, putative protein partners of IL-33 were screened. It was found that IL-33 interacts with Myeloid differentiation main response protein (MyD88) is an adapter protein associated in the innate immune response's Toll-like receptor and IL-1 receptor signalling pathways after conforming from protein-protein docking studies. Then, strategically IL33 domain mutants were constructed and tested for interaction with MyD88 and it was revealed that the IL-33 (163-270) amino acid residues are vital in providing the surface for interaction with MyD88. Further studies resulting in deciphering minimal amino acid residues may



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enable to design possible strategy to deactivate the physical interaction of IL-33 and MyD88, will allow having a better understanding of some of these complex connections.

Keywords: Interleukins, tumor, cytokines, cancer, immunotherapy

INTRODUCTION

The strong interaction amid the immune system and both normal as well as cancerous cells has been revealed by advances in cancer biology over the last century. These discoveries laid the groundwork for the idea of immune-surveillance, or even the immune system's ability to detect and remove abnormal cells. Immuno-editing, on the other hand, narrates the immune system and cancer cells interact and shape each other, which finally leads to cancer development and progression [1,2]. Two important characteristics of cancer are immunological resistance and the occurrence of pro-tumoural inflammation [3]. The immune system contexture at the site of cancer at the time of presentation can determine the prognosis of colorectal cancer patients, which highlights its importance [4,5]. In the tumour microenvironment, immune cells and non-immune cells interact in the presence of cytokines. The Tumour microenvironment in lung adeno carcinoma, for example, has recently been shown to allow malignancy cells and immune responses will co-evolve [6]. Numerous interleukins are extremely significant in the genesis and tumor progression among the cytokines. The pleiotropic effect of interleukins in cancer is defined by a variety of biological sources, receptors, and signalling pathways, as well as potency. Interleukin intervention could be unique to each cell and extends initiation, progression, and control of tumor cells [7]. The discovery of the precise regulation of tumor immune mechanisms and escape opened the way for the development of novel, more drugs. In recent years, both fundamental and therapeutic cancer research has become fascinated in the therapeutic benefits of interleukins. The increasing number of clinical and preclinical researches demonstrates their promise as a medicinal agent and a goal. The growing number of preclinical and clinical studies demonstrates their promise as a target and a medicinal agent. Attempts to use cytokines have already been in medicinal studies as single therapeutic substances with modest performance, but are currently seeing resurgence in combination with the help of synthetic biology, genetics, and cell therapy [8]. The majority of the time, cytokine classification is based on homology in structure or receptors, as well as gene proximity, rather than their biological contributions to cancer, which is the focus of this study [9]. Interleukins will be considered in this review rather than their family ties, in terms of their biological importance in cancer. In this section, you'll find more information regarding cytokine classification. The turning points of the most recent interleukin-related findings pathways in tumor, and their utilization in medical care, will be covered in this review. We present an up-to-date review of trials in the clinic, recently licensed medicinal medicines, and preclinical breakthroughs. Mainly the focus of this review is on cancerous cells, but most of the exact concepts are applied to many diseases, as a result, it might be handy to all the readers in a wide range of subjects. Swelling that persists is recognized as a factor for the development of several cancers, including lung, cutaneous, esophageal, gastric, colorectal, and pancreatic cancers, as well as hepatocellular cancer [4]. The equilibrium state of a tissue is maintained by interleukins that cause the cells that are not immune to signal. Interleukin signalling in cancer cells, on the other hand, can develop into a pathogenic development of tumor's mechanism, metastatic dissemination, and the progression of cancer after an oncogenic event. Interleukin 1 is found to be related to inflammation-persuaded malignancy [10,11]. Toll-like receptors require inflammasome stimulation when caspase 1 cleaves them into their active state [13]. The canonical inflammasome forms filaments of procaspase 1 and activates caspase 1, which subsequently inactivates pro-IL-1 Beta and pro-IL-18 to produce their active forms [14]. Tumor-initiating cell releases IL-33, that increases tumor-associated macrophage infiltration and enhances transforming growth factor- β (TGF Beta) signalling, resulting in tumorigenic niche formation [15,16]. IL-1 alpha and beta can enhance the formation of tumorigenic mediators like nitric oxide and reactive oxygen species in the case of chronic inflammation [12,17]. IL1 is regulated by the phosphorylation of nuclear factor κ B (NF κ B), thereby activating the cytokine inhibitor 3 (SOCS3) signal and enhancing the phosphorylation [18]. IL1 signaling in T cells triggers protoplasmic retention of IL17 and IL22 [19]. This investigation is in line with previously reported protozoal effects on IL23 production by myeloid cells and the subsequent response of T helper 17 (T_H17) cells to microbial products [20]. The current study emphasizes the



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importance of IL-33 and MyD88 in maintaining cellular homeostasis and thus aligns with one of the objectives on United Nations formulated Sustainable Development Goals (SDGs); SDG3 which ensures healthy lives and promotes well-being for all at all stages.

METHODOLOGY**Determination of protein sequences and putative protein partners**

Freely accessible database of protein sequence and functional information is found from Uniprot. It contains a large amount of information about the biological function of proteins derived from the research literature. It is also a database which comprises many other databases such as Uniprot knowledgebase (UniportKB), the Uniprot reference clusters (UniRef) and the Uniprot Archive (UniParc). The Uniprot consortium collaborated with the European Bioinformatics Institute (EBI), the Swiss Institute of Bioinformatics (SIB) and the Protein Information Resources (PIR). EBI developed large resources of bioinformatics databases and services. SIB is the founding centre of the swissport group and maintains the EXPASY (Expert Protein Analysis System) server a central resource for proteomics databases and tools. Likewise PIR is the oldest sequence which to be considered as analysis and sequences the structure of protein. Also classifies the protein sequences in this tool. It is the database finds out from uniprot shows that how one protein interacts with more than one protein. It is the functional protein association networks which also opened in NCBI by the server <https://string.db.org/>. Protein sequences and putative protein partners of IL-33 and MyD88 were retrieved from UniportKB and STRING.

Determination of three-dimensional configurations of proteins

Protein Data Bank (PDB) was used for retrieving the protein structures. Swiss model is the part of Swiss-ProtKB is used as a structural bioinformatics web server dedicated for homology modeling of 3D protein structure. Homology modeling is currently the most accurate methods to generate reliable 3D protein models and is routinely used in many practical applications. Homology modeling method makes use of experimental protein templates to build models for evolutionary related targets. Three dimensional configurations of proteins of IL-33 and MyD88 were obtained from Swiss-Prot. It is accessed in the web server <https://swissmodel.expasy.org/>.

Visualization of three dimensional protein structures

The three dimensional structures of native proteins and interaction of proteins were primarily visualized by PyMOL. PyMOL is an open source but proprietary molecular visualization system created by Warren Lyford DeLano. The private software company by DeLano scientific LLC dedicated to creating useful tools that become universally accessible to scientific and educational communities. Currently it is commercialized by Schrodinger, inc.as original software license was a permissive license they were able to remove it, new versions are no longer released under the python license, but under a custom license and some of the source code is no longer to released. PyMOL can produce high quality 3D images of small molecules and biological macromolecules such as proteins. According to original author by 2009, almost a quarter of all published images of 3D protein structures in the scientific literature were made using PyMOL. It is one of the few mostly open source model visualization tools available for use in structural biology. It uses OpenGL Extension wrangler library (GLEW) and free GLUT and can solve poisson Boltzmann equation using adaptive poisson Boltzmann solver. Anyone can either compile an executable from the python licensed source code or pay for a subscription to support service to obtain access to precompile executable.

Protein-protein interactions

The HDock server is a highly integrated suite of homology search, template-based modeling, structure prediction, macromolecular docking, biological information incorporation and job management for robust and fast protein-protein docking. We used for protein-protein docking by using the server <https://hdock.phys.hut.edu.in/>.



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RESULTS AND DISCUSSION

The protein domain organization, three dimensional configuration and putative protein interactors of IL33

In order to reveal the important function domains of IL33, UniProtKB database was considered which primarily provided significant information related to the protein of interest. IL33, which is associated in various signalling events comprises of 270 amino acid residues (Figure 1). The three dimensional structures of the IL33 and MYD88 proteins were generated using Swiss model. The putative protein interactors of IL33 were retrieved from the STRING module, which highlighted ten numbers of proteins. Since, MYD88 is involved in cell-cycle regulation and plays a significant role in maintaining cellular homeostasis; we opted to find out the functional domains of IL33 involved in interaction with MYD88.

The protein-protein interaction of Wild-type IL33, mutants with MYD88

Using the H-DOCK module, the docking scores for protein-protein interactions were predicted. The Wild-type and domain mutants of IL33 were included for this study (Figure 2). It was observed that the docking score for Wild-type IL33-MYD88 was -218.91. The docking score for IL33 (Δ 1-54)-MYD88 was -218.91. The docking score for IL33 (Δ 55-108)-MYD88 was -218.91. The docking score for IL33 (Δ 109-162)-MYD88 was -218.17. The docking score for IL33 (Δ 163-216)-MYD88 was -243.93. The docking score for IL33 (Δ 217-270)-MYD88 was -251.31 (Table 1; Figures 3-8). The N-terminal 100 amino acids of IL33 are vital for interaction with MYD88 since the deletion of initial amino acid residues resulted in weak interaction between IL33 (Δ 109-162) and MYD88 with respect to wild-type IL33-MYD88 interaction. However, it was observed that the docking score for IL33 (Δ 217-270)-MYD88 interaction was slightly elevated to -251.31 suggesting that the amino acid residues spreading from 01-216 residues did not affected the strength of interaction between two proteins rather it is quite relevant that this domain might regulate the interaction of IL33 and MYD88.

CONCLUSION

Using the H-DOCK module, the docking scores for protein-protein interactions were predicted and it was found that the docking score for Wild-type IL33-MYD88 was -218.91. The docking score for IL33 (Δ 1-54)-MYD88 was -218.91. The docking score for IL33 (Δ 55-108)-MYD88 was -218.91. The docking score for IL33 (Δ 109-162)-MYD88 was -218.17. The docking score for IL33 (Δ 163-216)-MYD88 was -243.93. The docking score for IL33 (Δ 217-270)-MYD88 was -251.31. The N-terminal 100 amino acids of IL33 are vital for interaction with MYD88 since the deletion of initial amino acid residues resulted in weak interaction between IL33 (Δ 109-162) and MYD88 with respect to wild-type IL33-MYD88 interaction. However, it was observed that the docking score for IL33 (Δ 217-270)-MYD88 interaction was slightly elevated to -251.31 suggesting that the amino acid residues spreading from 01-216 residues did not affected the strength of interaction between two proteins rather it is quite relevant that this domain might regulate the interaction of IL33 and MYD88. Our results paves way forward in improving our understanding on the functional aspects of critical protein factors such as IL33 and MYD88.

Statements and Declarations

Competing Interests

The authors declare that they have no conflict of interest.

Ethical Approval and consent to participate

No ethics approval is required.

Consent to publish

Not applicable.



**Aseema Rath et al.****Human and animal rights**

No animals were used in the study.

Availability of data and materials

Not applicable.

Credit Authorship Contribution Statement

All the authors have substantial contribution for the preparation of the manuscript. Gagan Kumar Panigrahi conceived the idea. Data curation and writing: Aseema Rath, Adyasha Pradhan, Ved Prakash Prusty, Annapurna Sahoo and Gagan Kumar Panigrahi. All the authors have read and approved the final manuscript before submission.

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Table 1: Interaction of IL33 with MYD88

SERIAL NUMBER	POSITION OF INTERACTION	DOCKING SCORE
1	IL33(Δ 1-54)- MYD88	-218.91
2	IL33(Δ 55-108)- MYD88	-218.91
3	IL33(Δ 109-162)- MYD88	-218.17
4	IL33(Δ 163-216)- MYD88	-243.93
5	IL33(Δ 217-270)- MYD88	-251.31

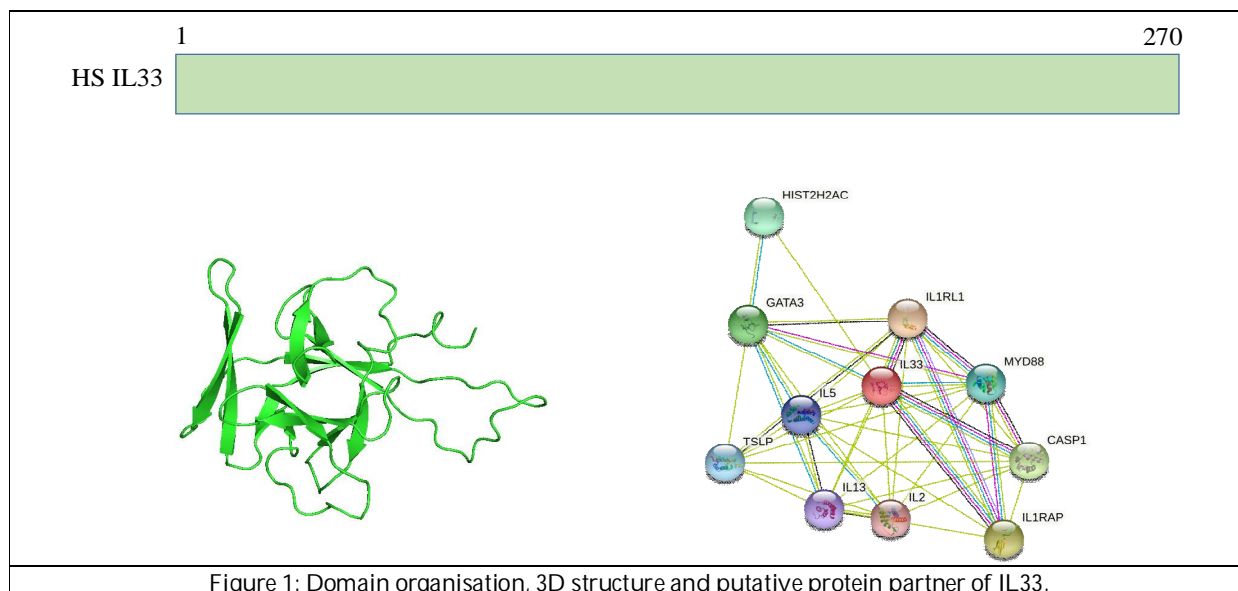


Figure 1: Domain organisation, 3D structure and putative protein partner of IL33.





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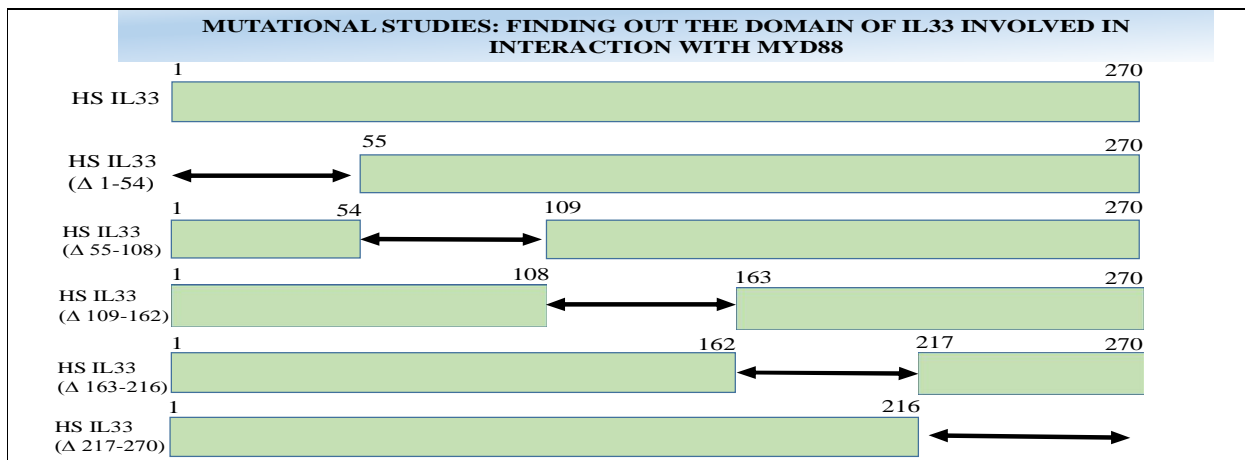


Figure 2: Domains of IL33 involved in interaction with MYD88.

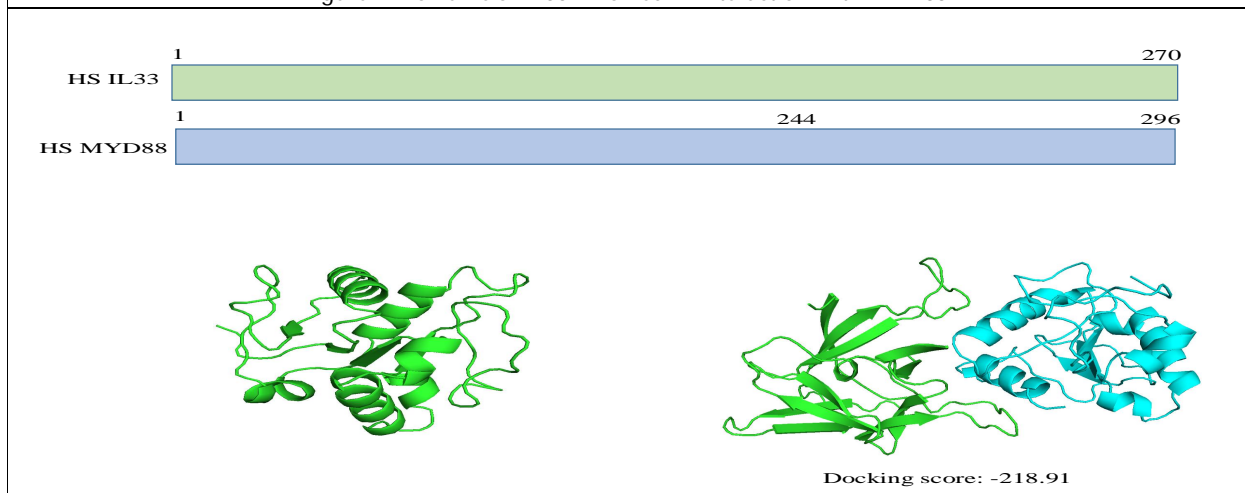


Figure 3: Domain organisation, 3D structure of MYD88 and HDOCK Module of IL33-MYD88.

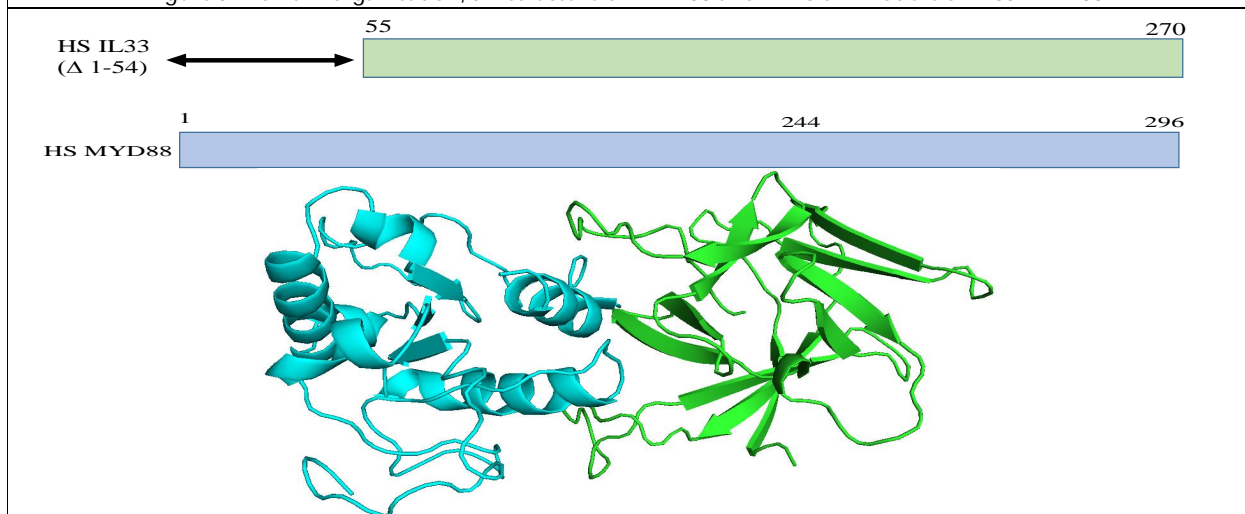


Figure 4: Interaction of IL33 (Δ 1-54) with MYD88.





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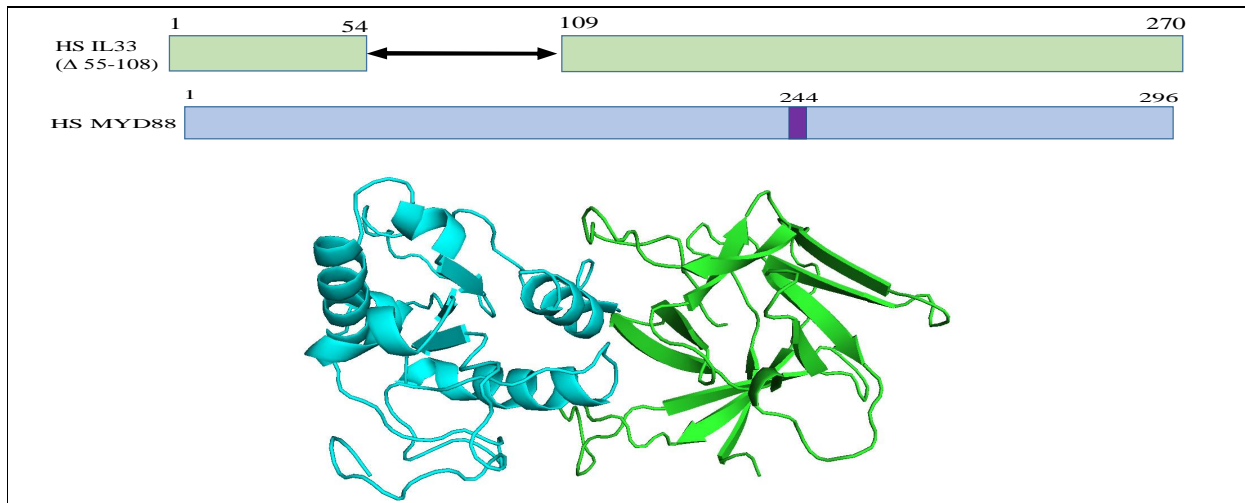


Figure 5: Interaction of IL33 (Δ55-108) with MYD88.

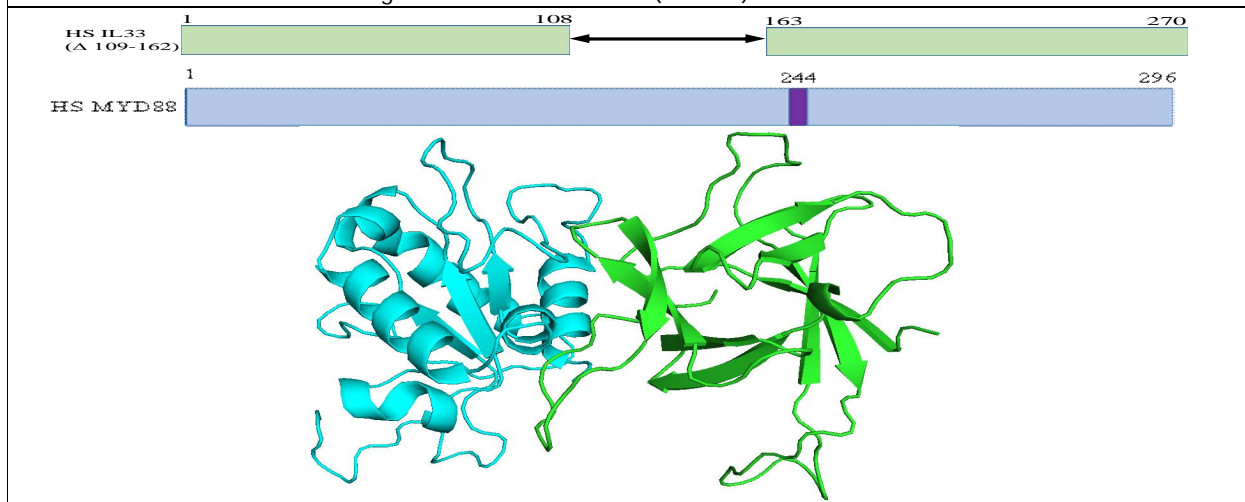


Figure 6: Interaction of IL33 (Δ109-162) with MYD88.

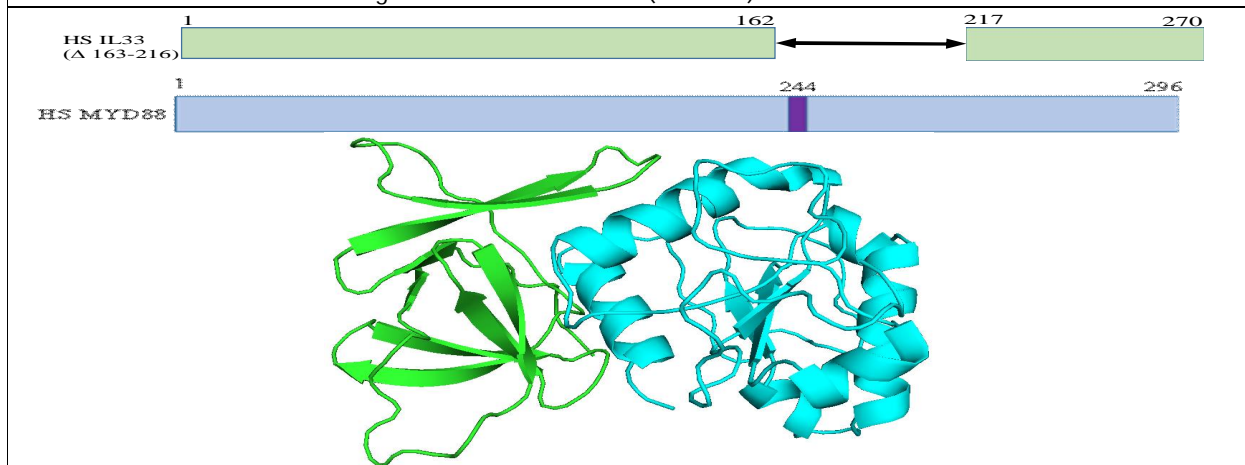
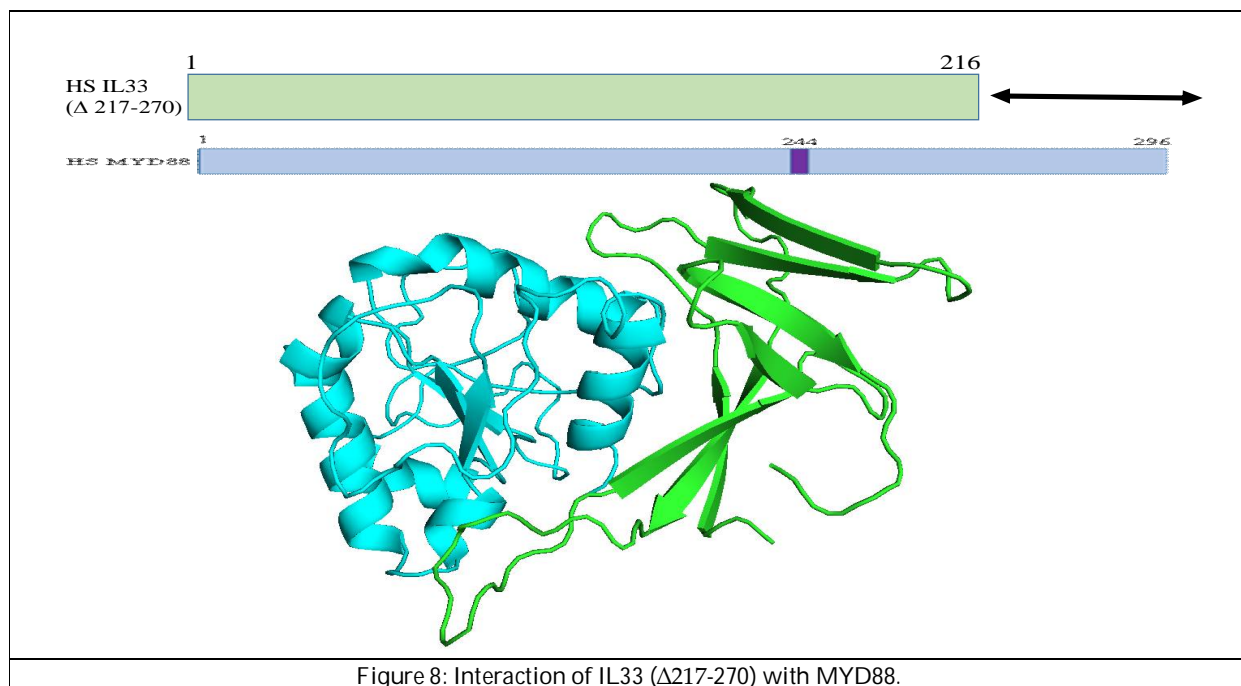


Figure 7: Interaction of IL33 (Δ163-216) with MYD88.





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Vesicular Stomatitis Virus Glycoprotein as a New Gene Carrier: NiosomalVirosome

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ABSTRACT

Virosomes as membranous vesicles with viral fusion protein in their membrane are versatile vehicles for cargo delivery. The vesicular stomatitis virus glycoprotein (VSV-G) is a common fusogenic protein used in virosome preparation. This glycoprotein has been used in liposomal systems so far, but in this study, we have tried to use the niosomal form instead of liposome for. Niosomes are vesicular systems composed of non-ionic surfactants. Niosomes were constructed by the thin-film hydration method. VSV-G gene in pMD2.G plasmid was expressed in the HEK293T cell line and then was reconstituted in the niosome bilayer. The formation of niosomalvirosomes was confirmed with different methods such as SDS-PAGE gel, western blotting, and transmission electron microscopy (TEM). The efficiency of niosomalvirosome was investigated with the pmCherry reporter gene. SDS-PAGE and western blotting proved the expression and successful insertion of protein into the bilayer. The TEM images showed the spike projection of VSV-G on the surface of niosomes. The transfection results showed high efficiency of niosomalvirosomes as a novel carrier. This report has verified that niosome could be used as an efficient bilayer instead of liposome to construct virosomes.

Keywords: Virosomes, Niosome, Cancer, Health, Social disease.

INTRODUCTION

Gene therapy has been approved to be effective for the treatment of certain hereditary diseases (e.g., congenital immunodeficiency due to adenosine deaminase deficiency), and it also can be applied to other genetic disorders such as malignant tumors. Gene therapy is completely dependent on the efficiency of gene delivery systems [1]. These systems could be categorized into viral and non-viral forms [2,3]. Non-viral vectors are attractive for researchers to be used as a promising alternative to viruses. These vectors have some considerable properties such as



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ease of pharmacologic production, low toxicity, lack of pathogenicity, and immunogenicity [4] which prove their potential as beneficial vectors. However, low levels of gene transfer by these vectors as compared to viruses restrict their application in gene delivery. There are a variety of non-viral vectors for gene delivery like polymers, peptides, mesoporous nanoparticles, organic-inorganic hybrids, and micro-vesicles such as liposomes and niosomes [5]. Among non-viral vectors, the niosome has attracted a lot of attention due to its remarkable properties. Niosomes are vesicular systems composed of non-ionic surfactants which have amphipathic characteristic and overall neutral charge [6,7]. These non-ionic surfactants are safe and inexpensive which could be used in biomedicine e.g. as drug carriers for both hydrophilic and hydrophobic drugs. Niosomes are highly stable and their leakage is only a little more than liposomes [8].

Besides, they could be easily prepared and the presence of non-ionic surfactants makes them less toxic than liposomes [9]. Therefore, the niosome is an interesting choice for cargo delivery. Several viruses have been considered to be used as foreign genetransducing vectors [10]. But the main problem with these vectors is that none of them could be used as risk-free or long-lasting treatments because of their potential for malignant alternations and cell destroying activity against the recipient cells [11,12]. Virosomes are the reconstruction of lipid membranes and viral spike proteins but without the viral genetic materials [13,14]. Liposomal virosomes have been constructed so far. Studies have proved that virosomes not only could carry different biologically active components like proteins, nucleic acid, peptides, and DNA [15-17] but also they could be used to carry therapeutic agents for drug delivery purposes [18]. Viral coated proteins are assumed to act independently of the other virion components; therefore they could be utilized in other non-viral gene transfer systems for the targeted selection of a certain organ or tissue [19]. These proteins have a key role in the entrance of viruses into the host cells and are different from one virus to another. As an instance, surface glycoproteins of influenza are hemagglutinin and neuraminidase [20] or G-protein is the glycoprotein of vesicular stomatitis virus (VSV) [21] and S-glycoprotein is the glycoprotein of coronavirus [9].

As mentioned, VSV-G is one of the proteins used in the construction of virosomes. It has been reported that VSV-G can restructure into the lipid bilayer spontaneously, however the controlled condition in which this protein could conserve its fusogenic activity in such lipids is necessary [22,23]. VSV-G is made up of 511 amino acids which could be in three conformations including a) prefusion conformation that is found in high pH ranges, b) the active form that has some interaction with the membrane of the host cell and c) the post-fusion conformation [24]. This glycoprotein has been inserted in liposomes or used solitary for gene delivery enhancement [25]. To the best of our knowledge, no research has been accomplished for the investigation of niosomalvirosomes instead of liposomes. Therefore, this study aims to evaluate the possibility of the preparation of niosomalvirosomes. For this purpose, the expression of VSV-G protein in the HEK293T cell line was carried out and the possibility of VSV-G entrance into the cell membrane was evaluated.

MATERIALS AND METHODS

Materials

Cell lines were purchased from the Pasteur Institute of Iran (Tehran, Iran). Maxi-prep plasmid extraction kit was purchased from YektaTajhizAzma, Iran. Hoechst dye, fetal bovine serum (FBS), trypsin, DMEM medium, and Opti-MEM medium were all provided from Thermo scientific (Carlsbad, CA). Cholesterol, Span 80, Span 60, Tween 80, Tween 60, and secondary antibody were obtained from Sigma (Steinheim, Germany). The primary antibody was purchased from Santa Cruz Company (USA). Valid commercial resources were used to provide other required reagents.

Niosome preparation

Niosomes were prepared by the thin-film hydration method as described previously [26]. In the end, the vesicles were extruded 15 times through the membrane (200 nm). The composition of different formulation of niosomes is presented in Table 1. Because VSV-G is a glycosylated protein, it was expressed in the HEK293T cell line. The HEK293T



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cells were purchased from the Pasteur Institute of Iran (Tehran, Iran). HEK293T cells were cultured in DMEM high glucose which was supplemented with 10% FBS and 1% (v/v) Penicillin/Streptomycin at 37 °C and appropriate atmospheric condition. For the deactivation of complement, FBS was incubated at 56°C for 30 min and was kept at 20 °C until use. For all transfection steps, instead of the conventional medium, the Opti-MEM medium was used as a serum-free condition medium.

VSV-G expression

pMD2.G plasmid transfection

pMD2.G plasmid was used for the expression of VSV-G. pMD2.G plasmid was inserted into DH5- α bacteria using the heat shock method. The pMD2.G containing colony was cultured in LB liquid medium containing ampicillin and the extraction of pMD2.G plasmid was performed using the GeneJET plasmid extraction kit (Fermentas, USA) according to the manufacturer's instruction.

VSV-G extraction and SDS-PAGE

After plasmid cloning, the plasmid was extracted and transfected into the eukaryotic cells (HEK293T) based on the CaPo4 transfection protocol. After three days, the medium was collected and centrifuged at 70000 g for 2 h. The supernatant was discarded and 500 mL of PBS buffer was added to the precipitate. The concentration of semi-purified protein was determined using the BCA assay kit. The semi-purified VSV-G protein was verified using Polyacrylamide gel electrophoresis. Considering the molecular weight of the protein which is about 70 KDa, the lower gel was chosen to be 12% and the upper gel was 7%.

Confirmation of expression and purification of VSV-G

Syncytium formation by VSV-G expression. Since VSV-G is categorized as a fusogenic protein, it could cause syncytium formation in HEK293T cells. These syncytia are presented as the big multinucleated cells which are the result of the fusogenic activity of VSV-G during transfection. These cells were investigated with an optical microscope after Hoechst and Wright-Giemsa staining.

SDS-PAGE and western blotting.

After protein extraction, this step was carried out using a polyclonal antibody against VSV-G (Cat. No. P5D4, Santa Cruz Biotechnology, Santa Cruz, CA). 100 mg of protein was loaded on SDS-PAGE gel and transferred onto the PVDF membrane according to the standard protocol. In the next step, the PVDF membrane was kept in a blocking buffer for 2 h. Next, the membrane was transferred into a solution of the primary antibody for 2 h. The membrane was then washed 3 times with TBS buffer containing Tween 20 (TBST). After that, the membrane was kept in a secondary buffer. Finally, the HRP substrate was added. The chemiluminescence substrates (Bio-Rad) were used to determine the HRP activity by exposure to X-ray film.

Niosomal virosome formation

Niosomesolubilization and vesicle reconstitution. Niosomesolubilization was performed according to our previous report [6]. Briefly, preformed and pre-sized niosome bilayer suspensions were mixed with increasing amounts of TritonX-100 (TR) solutions. After each aliquot reached a steady-state, the vesicles and detergent were left at room temperature (RT) for 1 h to equilibrate, and the solubilization process was monitored by the changes in turbidity. Differences were measured as absorbance at 540 nm by a Cary 500 UV-VIS-NIR spectrophotometer (Varian, Australia). TR was added to the 20 mg of niosomes several times and the absorption changes were monitored with the spectrophotometry method.

Solubilization parameters

Solubilization parameters including R_{sat} , R_{sol} , D_{sat} , D_{sol} , D_{sat} , and D_{sol} were characterized. The detergent-to-lipid ratio at the greatest saturation (R_{sat}) and total solubilization points (R_{sol}) was determined by the slopes of twophase boundary straight lines.



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When the absorption reached a certain point (R_{sat}), VSV-G protein which was solved in DDM detergent was added to the niosomes and the mixture was incubated and shaken for 15 min at refrigerator temperature.

Removal of Triton X-100 with Bio-Beads SM-2

After Beads SM-2 preparation, Bio-Bead resin was used for the collection of TR and DDM. Finally, the mixture was centrifuged (65000 xg for 1 h) and the free VSV-Gs were separated.

Confirmation of niosomalvirosome formation with SDS-PAGE

Preformed virosomes were dissolved in the sample buffer and applied to SDS-PAGE gels. Considering the molecular weight of the protein (~70 kDa), the lower gel was chosen to be 12%. The gel was then stained with Coomassie brilliant blue. Approval of niosomalvirosome formation with transmission electron microscopic (TEM). Morphology and size of the particles were investigated with TEM (Zeiss Leo 960 at 100 kV, Germany) after negative staining. A drop of the dispersion was directly placed onto a Formvar membrane-coated grid and stained by adding a drop of 2% (w/w) sodium phosphotungstate solution. Then to remove the excess solution filter paper was used, followed by through-air-drying.

Size distribution and net charge of virosomes

The size distribution and zeta potential of virosomes were determined with Dynamic Light Scattering (DLS) analysis using a Cordouan Technology VASCO-2® particle size analyzer (Pessac, France).

Investigation of niosomalvirosomeefficiency with a reporter gene**Extraction of pmCherry-N1**

The extraction was accomplished according to the manufacturer's instructions (YektaTajhizAzma, Iran). In brief, the cultured bacterial cells were centrifuged at 6000 xg for 10 min at 4°C and the supernatant was discarded. The precipitated bacteria were dissolved in the resuspension buffer. After that, lysis buffer was added and the mixture was left at room temperature for 10 min immediately after that 15 mL of neutralization buffer was added and the mixture was centrifuged at 5000 xg at 4°C for 20 min.

Encapsulation of plasmid in virosome

This step was carried out by freezing and thawing of the vesicles in the presence of plasmid several times. The freeze-thaw process was accomplished at 196°C and 40°C respectively.

Investigation of gene transfection with fluorescence microscopy and flow cytometry

5000 HEK293T cells were incubated in a 96-well plate for 24 h. After that, different amounts of virosomes were added to the cell culture. For the investigation of pmCherry expression in transfected cells, the fluorescence rate of protein was measured after 48 h with fluorescent microscope Olympus BX5. In addition, for quantifying the results of transfection, the fluorescent intensity of transfected cells was measured with a Becton Dickinson FACScalibur flow cytometer and the results were analyzed with Pro Quest Cell software. For this purpose, the samples were investigated using the non-transfected group and lipofectamine as negative and positive controls, respectively.

Statistical analysis

One-way ANOVA was used for the statistical analysis of various experiments. A Post-hoc Bonferroni t-test was performed to examine the ANOVA test. The p-values of <0.05 were considered significant and each value is reported as mean ± SD.

RESULTS**Niosome formation**

Light microscopic examination confirmed the formation of niosomes which was carried out successfully in both formulations by the thin-film hydration method. Saturated and unsaturated niosomes are presented in Fig. 1a and

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Fig. 1b. Due to the adequate formation of both saturated and unsaturated niosomes and considering the previous studies [8], unsaturated niosome was chosen for the next steps.

Niosome toxicity

For the investigation of niosome toxicity, HEK293T cells were cultured in a 96-well plate. As can be seen in Fig. 1c, the viability of cells was not significant compared to the control group in 1 and 0.5 mM concentration of niosomes. The cytotoxic effects of niosomes increased with higher concentrations, but it was not statistically significant.

VSV-G virosome production

Cloning, extraction, purification, and verification of VSV-G

The extracted plasmid was transfected into HEK293T cells with the calcium phosphate method. After the addition of calcium chloride to DMEM, a fine precipitate of CaPO₄ was formed, the nature of which depended on the concentration of calcium chloride. The cells were grown in Opti-MEM media without FBS. The efficiency of this transfection is presented in Fig. 1def by a reporter gene (pmCherry containing ref fluorescent protein). This result shows that the calcium phosphate method is an inexpensive and reliable method to transfect and express genes (the quantified transfection efficiency result is presented in Fig. 1gei). After setting up the transfection method, pmd2.G plasmid containing the VSV-G gene was transfected. The concentration of protein was 0.4 mg/mL which was determined by the BCA method. In order to confirm the protein expression, SDS-PAGE analysis was carried out. As can be seen in Fig. 2f, the VSV-G protein band with the molecular weight of 70 kDa is obvious. For the final validation, identification of the VSVG band was confirmed by western blot analysis with the specific VSV-G antibody. Fig. 2g shows the results of the expression and purification of the VSV-G protein.

Syncytium formation

The formation of cellular syncytium was investigated with Hoechst stain and Wright-Giemsa staining. These cells which are the result of the fusogenic activity of VSV-G could be observed as multinucleated cells and represented the successful expression of VSV-G protein. Fig. 2bed shows the results of Hoechst and WrightGiemsa staining. The number of syncytium cells was compared for transfected and un-transfected groups and the difference was significant ($P < 0.05$). As can be seen in Fig. 2e, the number of syncytium cells in transfected cells is about twofold more than the control group.

Niosomesolubilization and virosome preparation

As is obvious in Fig. 3, the protein outgrowth in reconstituted niosomes is completely distinctive from un-reconstituted niosomes. Spike-like projections in Fig. 3a shows the homogeneous distribution of glycoproteins in the membrane of virosomes while other vesicles in Fig. 3b lack spike proteins. The solubilizing parameters are given in Table 2 and the turbidity changes with the TR addition during the solubilization process are illustrated in Fig. 3d. The construction of the VSV-G virosome was accomplished as described in section 2.3.4 and subsequently, the presence of this protein in the membrane was evaluated with SDS-PAGE and TEM microscopy. As can be seen in Fig. 3c, niosomalvirosomes of VSV-G have shown sharp bands on the SDS-PAGE gel. VSV-G was reconstituted in niosomes at 1 to 600 and 1 to 400 protein to surfactant ratios. The final confirmation of the VSV-G entrance to the niosome bilayer was carried out with TEM.

Virosome physical characteristics

The results of DLS analysis show that the size distribution of virosomes is 112 ± 14 nm and their net charge is -7.5 ± 1.1 . This size distribution could affect the activity of virosomes according to a previous study [19] and some of the vesicle-cell activity could be attributed to the slightly negative charged virosomes. The size distribution and zeta potential of virosomes are presented in Fig. 4a and b. 3.3.5. Functional study the efficiency of niosomalvirosomes in gene delivery was investigated with the pmCherry-c1 reporter gene. For this purpose, pmCherry-c1 was placed in virosomes with the freeze-thaw method and virosomes were treated to the HEK293T cell line. The results show that niosomalvirosomes have transferred pmCherryc1 to the cells successfully. This high efficiency can be seen in the



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virosome transfected cell (Fig. 4c) compared to the positive control (Lipofectamine 2000) (Fig. fd). In Fig. 4e quantified data are presented. Transfection efficiency was higher in the virosome group as compared to Lipofectamine but the difference was not significant.

DISCUSSION

Due to the importance of VSV-G, some investigation about the expression and the different methods for its extraction and purification has been accomplished so far [27]. In this study, the expression and purification of VSV-G with different methods like the construction of cellular syncytium, and with a polyclonal antibody against VSV-G protein in HEK293T cells have been confirmed. There are also several studies about the development of VSV-G virosomes. There are two different methods for the preparation of virosomes. In the first method, the native virus is cultured and then solubilized with Triton [23]. In the second method, due to the special conditions for viral culture, envelope glycoproteins are expressed and purified using the appropriate cell lines [19]. To the best of our knowledge, the construction of virosomes with non-ionic surfactants has not been reported so far. Our results show that membrane proteins could be incorporated in the niosome membrane correctly. This has been confirmed with SDS-PAGE gel and TEM microscopy. TEM is a reliable method for the recognition and investigation of membrane proteins, which has been used before [28].

In the present study, we have confirmed that the VSV-G has not only been placed in the membrane of niosomes but also has a reasonable activity. There are different reports on the VSV-G protein which have investigated the fusogenic activity of the complete or truncated form of this protein. Kaikkonen et al. used 21 amino acids of G ectodomain with transmembrane domain (TM) and cytoplasm domain (CTP) and the results of the transfection were satisfactory [29]. Jeetendra et al. also used a truncated form of VSV-G which included 42 amino acids of G ectodomain with TM and CTP which had acceptable results for protein fusion [30]. In this study, we used the complete form of the VSV-G. Size distribution can affect the virosome activity. As an instance, Shoji et al. explained that the size distribution of 40e140 nm could be useful for the endocytosis-dependent gene-transfer activity of virosomes [19]. TEM images show that the size of the prepared virosomes in this study is in this range, and some of the virosomes' activity could be attributed to their size. Another factor that could affect the activity of virosomes is the surface charge. Puri et al. demonstrated that VSV and asilo-VSV had sufficient fusion with liposomes composed of neutral phospholipid but, after the construction of liposomes with a mixture of neutral and negatively charged phospholipids, only the asilo-VSV fused adequately [31].

Here, we have utilized neutral surfactants. Some studies have also used glycoprotein G as a non-viral vector. Akihiro et al. inserted VSV-G into liposomes and increased the efficiency of lipofection remarkably [27]. Okimoto et al. proved that gene transfection could be carried out by the conjugation of VSV-G to the plasmid DNA [32]. For the determination of transfection efficiency, the HEK293T cell line was used. Moreover, Zhou et al. have investigated the cell entrance mechanism of niosomes. They have reported that niosomes that had been made of Span80 could enter the cell by the endocytosis pathway [33]. Therefore, Span80 containing niosome is a reasonable choice for gene delivery into the cells and besides that, it has been reported that Span80 could have a role in the instability of the endosomal membrane which could lead to increases in the endosomal escape [34].

CONCLUSION

Although niosomes and liposomes are different in structure and composition, they have some essential characteristics in common. The results of this study have proved that due to the remarkable stability of niosomes compared to liposomes and the suitable compatibility of VSV-G in the niosome structure, niosomes are compatible alternatives for liposomes in the construction of virosomes. Moreover, considering the role of Span80 as a versatile assistant in gene delivery, this component is an adequate choice for niosome preparation in the presence of Tween80.



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Although the niosomal form of virosome has been prepared in this report, there is a need for more efforts in this area which could lead to the development of novel methods for gene and drug delivery.

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CONFLICTS OF INTEREST

The authors of the article have no conflicts of interest to declare.

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Table 1: The composition and molar ratio of different niosome formulations are evaluated to be used for the next steps of virosome preparation.

Components	Molar ratio
Span 80; Tween 80; CH	4.25; 4.25; 1.5
Span 60; Tween 60; CH	4.25; 4.25; 1.5





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Table2: Solubilization parameters of ST80CH bilayers by Triton X-100.

Niosome formulation	R_{e}^{sat}	R_{e}^{sol}	D_{w}^{sat} (mM)	D_{w}^{sol} (mM)	D_{i}^{sat} (mM)	D_{i}^{sol} (mM)
ST80CH	0.55	1.28	0.15	0.22	6.4	11.5

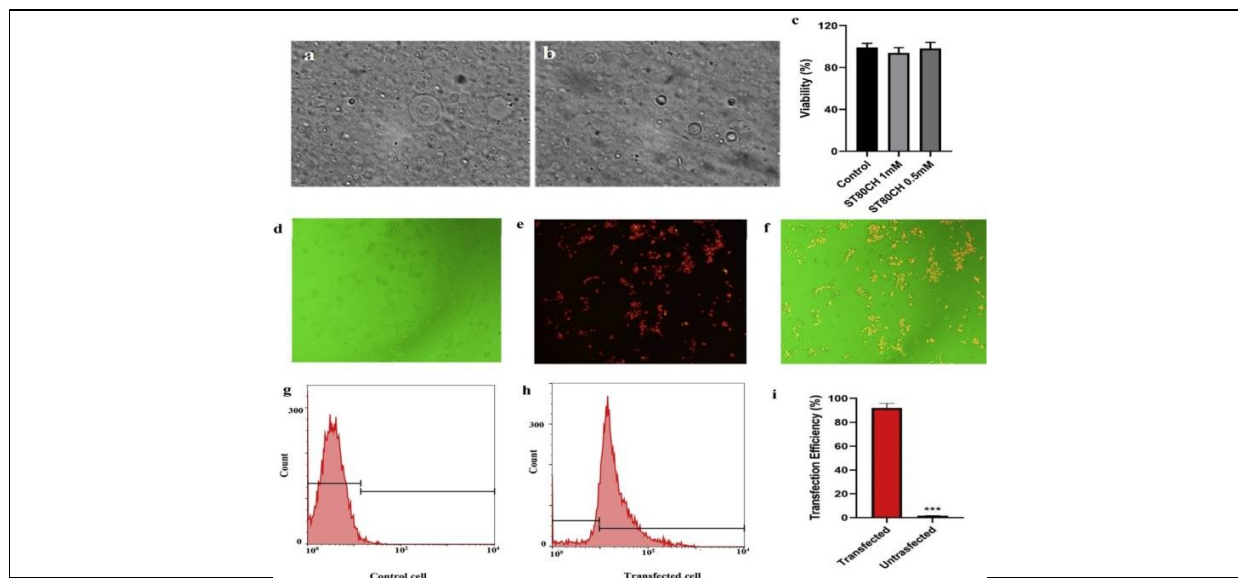


Fig.1. a) Saturated niosomes and b) Unsaturated niosomes under the optical microscope. c) Comparison of the cell viability of two concentrations of niosomes Span80/Tween80/ cholesterol (ST80CH). The viabilities for these two concentrations do not have a considerable variation compared to the control group. d, e, & f) Transfection efficiency of pmCherry plasmid on HEK293T cells under the optical microscope, fluorescent microscope and merged pic. g, h, & i) Transfection efficiency of pmCherry plasmid was quantified by flow cytometry in transfected and control group.

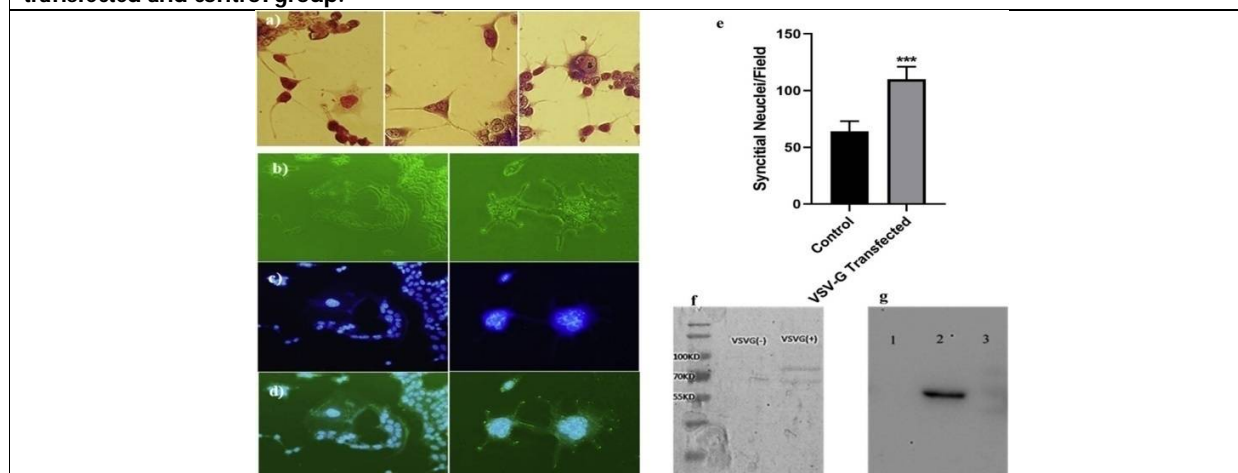


Fig. 2. Cellular syncytium construction after VSV-G expression with a) Wright-Giemsa and b, c, & d) Hoechst stain could be seen in 5 fields. The presence of multinucleated cells confirms the formation of the cellular syncytium. e) The counted number of multinucleated cells in 5 fields presents the significant difference between the VSV-G transfected and the control group of cells. f) SDS-PAGE gel of VSV-G expression and g) Western blotting image of expressed protein. Lane 1: non-transfected control, Lane 2: VSV-G transfected and purified protein, Lane 3: protein marker.





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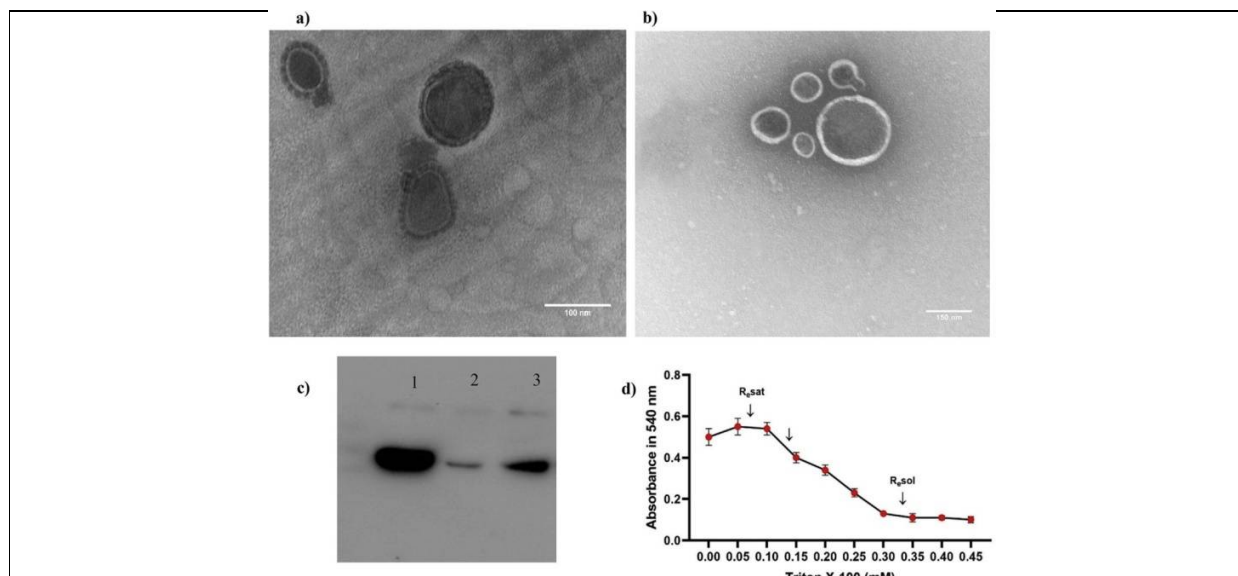


Fig.3. Electron microscopic study of the VSV G-virosome. a) Spherical particle with VSV-G spike projections can be seen. b) niosome particles without VSV-G insertion. c) The image of SDS-PAGE gel for niosomal virosome. Lane 1: VSV-G protein with out bilayer constitution, lane 2: VSV-G reconstituted in niosomes At 1 to 600 protein to lipid ratio, lane 3: VSV-G reconstituted in niosomes at 1 to 400 protein to lipid ratio. d) Destabilization of phospholipid vesicles with Triton X-100, monitored by turbidity. As a measure of turbidity, optical density at 540 nm is plotted versus detergent concentration. Niosome concentration was 1 mM. R_{sat} and R_{sol} refer to the detergent concentration where the membrane is saturated with detergent and fully solubilized, respectively. The middle arrow indicates the suggested point in the titration curve at which the niosome combined with the VSV-G to commence the reconstitution procedure.

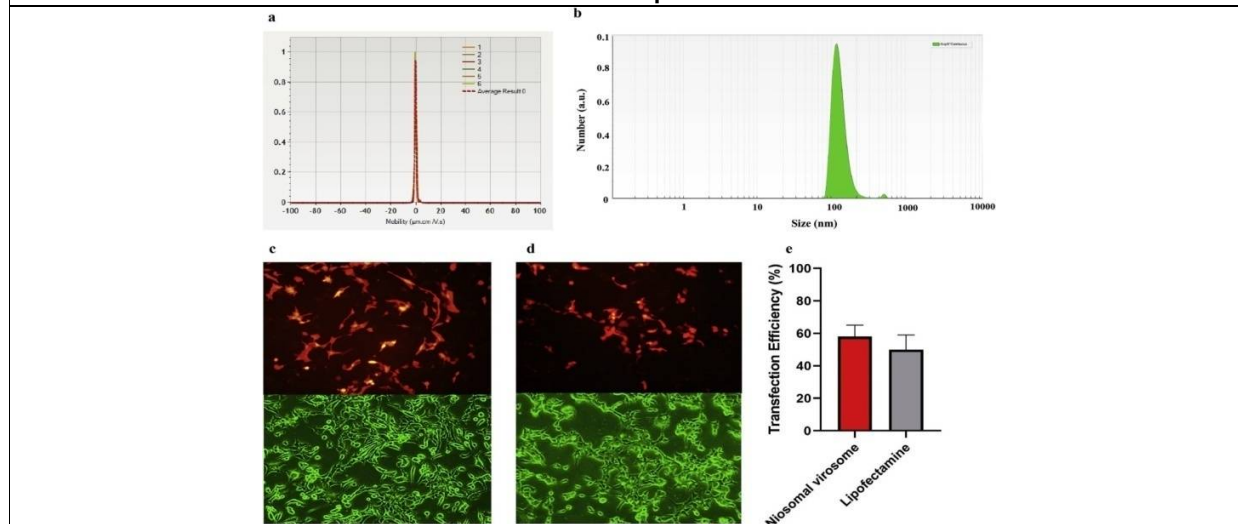


Fig 4. The results of DLS (a) and zeta potential (b) of the niosomal virosome. The results of reporter gene transfection to the HEK293T cells by c) niosomal virosome and d) Lipofectamine are presented. e) quantified transfection efficiency between groups showed superior transfection efficiency in niosomal virosome compared to Lipofectamine.





Effective Role of Computational Methods for Drug Discovery and Personalized Medication

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ABSTRACT

Advanced computational methods has received wide attention in recent years due to its several applications relating to healthcare for opening new directions in the area of diagnostics and drug discovery including vaccine for unforeseen viruses. The drug discovery involves identifying a ligand that can optimally fit to a definite cavity on a target protein. The drug discovery has speeded up its process with advanced computational methods effectively. An enhanced quality of software and computational tools enables to reduce the drug discovery cycle. The bioinformatics research has made available a significant amount of data sources like biological structures, ligand databases and various computational tools that can help in drug discovery. This paper gives an overview of computational methods and databases that helps in acceleration of drug discovery and personalized medication.

Keywords: Drug discovery, personalized medication, computational methods, Bioinformatics, molecular docking, deep learning.

INTRODUCTION

The complexity in drug discovery needs combined effort to design effective drugs. In drug design it is required to detect a ligand that can fit effectively to a specific cavity on a targeted protein [1]. The traditional drug discovery methods take long process cycle with considerable cost. Current methods that utilize computational methods in structure-based drug design has improved the speed in the process of drug discovery effectively. An enhanced quality of software and computational tools enables to reduce the drug discovery cycle thus making more cost-effective. The bioinformatics research has made available a significant amount of data sources like biological structures, ligand databases and various computational tools required in various phases of drug discovery and development pipeline. Some of the public databases that provide the biomolecular information are GenBank, PDB, SWISS-PROT, PIR, SCOP and CATH etc. The informatics practice tools like BLAST, FASTA and CLUSTALW perform sequence analysis using these databases. Further the molecular structures are visualized using software like

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Rasmol, PyMOL, UCSF Chimera etc. can help in understanding the complex phenomena of the molecules and hence useful for biomedical investigation in testing the clinical samples [2].

Computational drug discovery can help in recognizing effective ligand and targets to evaluate possible binding or active sites and allows to produce active drug molecules effectively by docking parameters [3]. High performance computing system and software can help to produce high quality data to discover a novel drug molecules [4]. The validation of drug target is needed to check failure in the clinical testing stages. Drug discovery also involves several segments of identification of target to preclinical progress [5]. Thus there is a need of effective analysis by computational techniques for high efficiency. "Rational Drug Design" (RDD) is tool for molecular modeling that helps to study the knowledge of 3D structure of the desired target proteins. The concept of RDD has enabled drug target identification and validation to be more specific. In addition, several novel technologies and approaches have been introducing genomics, proteomics and other omics areas such as 3D QSAR, pharmacophore modeling and other, which playing a promising role in accelerating the pace of drug discovery process [6]. Since the in-silico drug design methods are cost effective, hence a number of software is currently used in drug design. In-silico drug designing can be performed by homology modeling, molecular dynamic, energy minimization, docking and QSAR etc. and found to have great importance in target identification and novel drugs prediction [7].

Many bioinformatics technologies are growing importance fields to understand and predict the potential drug because it focuses on Data Management and Data Analysis [8]. Drug discovery practice involves a series of events that include target drug identification and validation, pre-clinical pharmacology and toxicology. "Computer-aided drug discovery" (CADD) tools are potentially used to automate and speed up this process and to reduce the cost. Hence CADD has become an essential tool in drug development. The bioinformatics and CADD approaches play a critical role in addressing different challenges in drug design. [9-10]. This paper gives an overview of computational methods databases that helps in acceleration of drug discovery and personalized medication.

Computational Methods for Drug Discovery

The growth in biomacromolecule and micromolecule data can be analysed by computational tools for aspects of the drug discovery process and its validation. The commonly used computational drug discovery approaches are structure-based drug design (SBDD), ligand-based drug design (LBDD) and sequence-based approaches(SBDD) methods including quantitative structure-activity relationship (QSAR) [11]. The various stages involved in computational drug design includes homology modelling, active binding site prediction, molecular graphic system, Virtual screening and molecular docking.

The computational informatics tools are used for performing various tasks such as molecular modeling, visualization, molecular docking and molecular dynamics. The nanomedicine for targeted drug delivery is a growing field of research with application to several biomedical problems. The information revolution with biomolecular data mining and advanced machine learning has been applied to drug delivery. Docking allows predicting protein-ligand interactions in the drug discovery process by detecting the low-energy binding modes ligand within the active site of a macromolecule. The degree of interaction or binding of ligand with receptor related with a disease may inhibit its function and thus act as a drug[12]. There are large numbers of tools available for researchers as shown in table 1 for helping in drug discovery. Artificial Intelligence (AI), in particular ANN like deep neural networks perform a crucial role in drug discovery. AI drives the novel active molecules towards preferred properties [13]. Neural networks (NNs) find rules for drug discovery according to training molecules. With deep learning, variants of ANNs are now able to use different kinds of inputs, that help researchers with variation in the analysis for drug discovery. The integration of AI-aided drug discovery and and precision medicine-aided drug application, patient management will transform the arena of medicine. The authors in [14] initiated the base of AI and precision medicine revolutions in drug discovery and patient management.



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Support vector machines (SVM), Particle Swarm Optimization (PSO) and Genetic algorithm are widely applied in drug progress for huge data used in drug research studies. Deep neural network learning has achieved significant achievement in drug discovery. Deep learning in pharmaceutical research has helped in addressing diverse problems in drug discovery with bioactivity prediction, molecular design, synthesis prediction and bioimage analysis [15]. DeepScreening constructed a deep learning model and generate the libraries and used for virtual screening against diverse chemical libraries in stock. The deep learning-based web server will assist for drug discovery [16]. The authors in [17] provide outline of the applications of NNs in drug discovery including *de novo* drug design, ligand-based and receptor-based drug design and allows molecules can be inputs of NN-based models and achieve suitable results.

Personalized Medication

The developments in computational skill are gradually altering the mode that explain disease, improve drugs and advise treatments. Personalized medication also recognized as precision medicine is an evolving arena of medicine that can identify specific biological markers, based on genotype and phenotype to help assess suitable treatments for each patient and determine the right treatment for the person at right dose in right time. It is centered on the patient's distinctive individualities which is comparatively innovative in medical community. The genetic makeup varies from patient to patient and risk of side effects may be observed for specific drugs and accordingly need a different dose than normally prescribed. Personalized medication and genetic categorization of severe diseases can provide way to the development of new drugs. Genetic testing is progressively acting as vital portion of clinical decision-making towards actual treatment of disease [18]. Genetic characteristics and other factors such as age, genus, eating habit play a role for specific use of various medicines [19]. Advanced statistical and machine learning tools are required to mine complex gene polymorphisms data gathered by pharmacogenetics researchers for analyzing during drug discovery. Computational methods such as ANN and GA are used for Genome-wide studies [20].

The aim is to optimally use obtainable data and patients' physiognomies for research. This also holds good for the transformation of research outcomes into clinical practice. New technologies have the potential to enhance the use of genetic evidence in clinical decision-making, its prevention, surveillance, and safer drug therapies for patients. Thus there is a need of this analysis more effectively by computational intelligence techniques to deliver better treatment for patients, deliver benefits development of new medicines of healthcare systems and society and more efficient.

CONCLUSIONS

The wide variety of computational tools has been developed by the scientific community to address the drug discovery process. The drug discovery has been reformed with innovations of fresh methods in bioinformatics tools. Computational drug discovery can help in recognizing effective ligand and targets to evaluate possible active sites and allows to produce active drug molecules effectively using computer added tools like molecular docking and molecular dynamics simulation. The Artificial Intelligence and deep learning techniques have the potential to play vital role in drug discovery for effective novel drugs prediction and more emphasis on personalized medication in future.

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Table 1. Computational Drug Discovery Tools

Computational Methods	Software Tools
Molecular Visualization	Raswin, Raster3D, Chemlab, Jmol, PyMOL, VMD, Webmol etc.
Active Site prediction	LIGSITE, POOL, Pocket-Finder, 3DLigandSite, FINDSITE etc.
Molecular Docking	MOE, PyRx, Autodock Vina, Biovia material studio, Schrodinger, Libdock
Molecular dynamic simulation	LAMMPS, Gromacs, YASARA, Amber, CHARM, Gromos, NWChem
Homology modelling	Sybyl, ICM, MODELLER, MOE, SWISS-MODEL, Phyre etc.





A Systematic Review on Evolution of Vaccine against the Zika Virus

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ABSTRACT

The virus named Zika is a newly discovered source of infection that poses a significant threat to human health. Even though majority of these cases are symptomless or have minor, identity symptoms, and a small proportion of patients develop health problems, such as congenital anomalies in infected pregnant women's developing foetuses and neurological dysfunction. There are currently no vaccines, antiviral medication, or other treatments. The goal is to create an immunogenic, nanoparticle-encapsulated peptide-based vaccination that is simple to make, stable, does not require a cold chain, and is safe for pregnant women and immunocompromised people to administer. The present efforts for the improvement of Zika virus vaccines, as well as gaps in research in the progress of candidate vaccines, are examined in this review.

Keywords: Zika virus, vaccines, nanoparticles, health, immunogenic

INTRODUCTION

The Zika virus's ancestor first originated in the early 1900s, most probably in Uganda, and went unnoticed for decades. Researchers at the Uganda Virology Station were looking for yellow fever virus when they discovered the Zika virus in 1947 [1,2]. This Zika virus is mainly related to the Family Flaviviridae, that contains breakbone fever. Also it includes West Nile fever, and jaundice. The positive-sense single-stranded RNA genome encodes structural and non-structural viral proteins (capsid, precursor membrane [prM] and envelope [E]). The genetic code is translated into a single polypeptide, which is after that intersected to specific proteins using proteolytic enzymes. In terms of sequence, the prM, E, and nonstructural proteins are the most different from those of other flaviviruses. Polynesia and South America infections were very similar, while Western Hemisphere infections were about 89 percent similar to African genotypes [3]. After being separated from rhesus monkeys, the virus was found in



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mosquito vectors (including *Aedes aegypti* and *Anopheles* species). Virus spread is facilitated by the large number and diversity of animal hosts, which can lead to exposure of recombinant varieties. The current study emphasizes the importance of vital strategies resulting in cellular homeostasis and thus aligns with one of the objectives on United Nations formulated Sustainable Development Goals (SDGs); SDG3 which ensures healthy lives and promotes well-being for all at all stages.

Zika Virus Infection

The Zika virus is spread by *Aedes aegypti* mosquitoes, which has quickly become a public health concern. The virus has unfurl far away its historical range. Mostly found in equatorial Africa and Asia, as well as the Federated States of Micronesia. The virus is transmitted to the Caribbean, South America, and Central America in 2015, resulting in epidemics [4]. 22.7 million of people in the United States live in areas where active mosquito populations make Zika virus transmission possible throughout the year. *Aedes aegypti* and *Aedes albopictus*, the mosquitoes that transmit the Zika virus, are found in more than 30 states and territories across the United States [5]. Furthermore, because of the topographical spread of *Aedes* species mosquitoes, 60 percent of people of the U.S. stays on the region where the Zika virus could be transmitted seasonally [6]. The Zika virus causes a mild form of dengue fever, rash occurs on skin, muscle aches, eye infections, nausea, migraine, oedema of the legs and fingers [6]. The incubation period for Zika virus is usually 3-12 days, and symptoms usually last 2-7 days. The Zika virus genome has been found in body fluids for weeks after infection. RNA present on this virus can be detected in semen at least 62 days after an individual is infected [7]. The existence of Zika virus in semen increases the risk of sexual transmission. T-cells and Phagocytic cells in the testis have the ability to trigger an immune response [8,9].

Responses of the Immune System to the Zika Virus

Entry receptors could be found in a variety of biological proteins [10]. The stimulation of toll-like receptor III, retinoic acid inducible gene-I, and melanoma differentiation associated gene 5, as well as type 1 and 2 interferon release and elevation of interferon-stimulated genes that drive antiviral actions, are all characteristics of Zika virus cellular infections [11]. Glycosaminoglycans helps in the attachment and penetration of the virus into the body [12]. Most neutralizing antibodies target region 3 or region 2 determinants in flaviviruses (including Zika virus). Several monoclonal antibodies targeting viral E proteins have been developed, and these antibodies provide varying degrees of protection in lethal infection models in mice following passive transmission [13-16]. These results highlight the importance of humoral responses in protective immunity [17]. In infection models in mice and rhesus monkey PrM and E protein act as immunogens, that is provided by a single dose of pure and inactivated vaccine derived from virus and plasmid DNA [18]. In addition, a single dose of vaccine against rhesus adenovirus (serotype 52) provided complete protection in rhesus monkeys [19]. This DNA vaccine also induces protective immunity in animals whose CD4-positive or CD8-positive T cells were depleted prior to viral challenge, suggesting that humoral immunity is sufficient. for clinical protection [1].

Vaccine Efforts

With several candidate vaccines in different stages of development. the evolution of a secure and successful Zika virus vaccine is a realistic possibility, given the potency and effectiveness of the joudince fever vaccine, as well as the trending success of a dengue virus vaccine. There were 18 known virus vaccines in progression at the time, according to a WHO report from March 2016, but none had progressed beyond early preclinical development. Zika virus that has been immobilised, Zika virus strains that have been weakened, and live or inactivated viral recombinants that generate Zika virus proteins [20].

Whole Virus Inactivated Vaccines

Higher antibody titres and better protection were obtained when this vaccine was administered intramuscularly rather than subcutaneously. Nonhuman primates were also used to test the vaccination [19]. After being exposed to live Zika virus, Rhesus macaques given the inactivated vaccination developed humoral as well as cellular immunity, and no virus was found in their blood, urine, CSF, or other bodily fluid. High dosages of pure IgG from vaccinated animals were adopted and shift to animals, providing full challenge defence.



**Amalendu Samantray and Gagan Kumar Panigrahi****Nucleic Acid Vaccines**

Vaccinated mice have also been shown to be protected by a plasmid DNA vaccine [18]. A single subcutaneous or intramuscular dose of the plasmid vaccine. Immunised mouse displayed a strong mitigating immune response, as well as identifiable virus-specific CD4-positive and CD8-positive T-cell responses, and were resistant to live virus infection. The prM antigen-free plasmid was significantly less antigenic and elicited significantly lower neutralising antibody titres than the prM antigen-containing plasmid.

Vectored Vaccines

The vector vaccine rhesus adenovirus was tested in nonhuman primates. If the animals exposed to the virus, a single dose of vaccine elicited strong immune response and provided hundred percent defence. One more research on C57BL/6 mouse looked at 2 other vaccines: recombinant & adenoviral vector vaccines, both of which contained the Zika virus E protein fused to the trimerization region of the T4 fibritin fold (the subunit vaccine). Regardless of the fact that both vaccines generated neutralising antibodies, the indices of the subunit vaccine were four to sixteen times less than those of adenoviral vector vaccines [21].

Additional Vaccines

Protein and peptide vaccines are being studied by several groups. In order to determine the peptide-based vaccine, the Mayo Clinic Vaccine Research Group is performing preliminary testing to determine the Zika virus HLA class I and II epitopes. This project is a partnership between the Nano Vaccine Initiative and Iowa State University. The goal is to develop an immunogenic vaccine based on peptides encapsulated in nanoparticles, which is easy to manufacture, stable, does not require cryopreservation, and can be used in pregnant women and in immune-compromised patients with reduced immunity [1].

CONCLUSION

In order to protect the life of human being, particularly women of childbearing age, Antibiotic drugs and vaccines to prevent Zika virus infection must be inexpensive, widely available, and extremely effective. Antiviral drugs alone would not be sufficient to prevent asymptomatic infection from causing foetal difficulties or aberrations in pregnant women. As a result, it's critical to develop safe and effective Zika virus vaccines that provide long-term immunity. The probability of the Zika virus transforming in a way that makes it more disease-prone, particularly in pregnant women and the youngsters, the adults, and the people with compromised immune systems, is a cause for concern. Clinical trials to demonstrate pathogen potency can be relatively simple, but using effectiveness requirements for health problems like congenital Zika virus syndrome and other birth defects, as well as Guillain-Barré syndrome, may necessitate a large number of supporters to gain predictive significance. These outbreaks are still considered exceptional by the international health community, which ignores the need for a coordinated and global response strategy. Final development of a Zika virus vaccine will be considered too little, too late if these efforts are not made.

Statements and Declarations**Competing Interests**

The authors declare that they have no conflict of interest.

Ethical Approval and consent to participate

It is a review article. No ethics approval is required.

Consent to publish

Not applicable.

Human and animal rights

It is a review article. No animals were used in the study.



**Amalendu Samantray and Gagan Kumar Panigrahi****Availability of data and materials**

Not applicable.

Credit authorship contribution statement

All the authors have substantial contribution for the preparation of the manuscript. Gagan Kumar Panigrahi and Amalendu Samantray conceived the idea. Data curation and writing: Amalendu Samantray. All the authors have read and approved the final manuscript before submission.

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A Comprehensive Review on Proton Pump Inhibitors: Understanding the Benefits, Complications and Risks

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ABSTRACT

Since their introduction in the late 1980s, proton pump inhibitors have demonstrated gastric acid suppression superior to that of histamine H₂-receptor blockers. Proton pump inhibitors have enabled improved treatment of various acid-peptic disorders, including gastro esophageal reflux disease, peptic ulcer disease, and non-steroidal anti-inflammatory drug-induced gastropathy. There are several types of medications that can reduce the amount of acid in the stomach, including histamine 2-receptor antagonist (H₂RA) and proton pump inhibitors (PPI). PPIs work by irreversibly blocking the proton pumps that release acid into the stomach. They are generally well tolerated but adverse outcomes have been associated with long-term use of PPIs.

Keywords: Proton-pump inhibitor (PPI), Omeprazole, Esomeprazole, Pantoprazole, Lansoprazole, Rabeprazole, Helicobacter pylori, Health.

INTRODUCTION

When activated by stimuli such as histamine and acetylcholine, the parietal cell undergoes dramatic morphologic changes from the resting status to the stimulated state. The gastric H⁺, K⁺ ATPase, which pumps gastric acid, appears to be in cytoplasmic tubular membranes in the resting state and then in the microvilli expanded secretory canaliculus in the stimulated state of the parietal cell.[1] It is important for health professionals to know the accepted indication and the correct doses for the use of these drugs. On the market there are different types of PPI. Omeprazole, Pantoprazole, Lansoprazole, Rabeprazole and Esomeprazole. Omeprazole is the oldest and most used PPI, being also cheapest. Although there are no important differences between PPIs incurring disease. Esomeprazole,

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a new generation PPI, has proven to be more effective in eradicating H. Pylori infection. In recent years the use of generic drugs has spread, these drugs have same bioavailability than the original drugs. In case of PPIs, the few comparative studies available in the literature between original and generic drugs have shown no significant difference in clinical efficacy [2]

Proton-pump inhibitor

Histamine binds to the H₂ receptor, leading to elevation of intracellular cyclic AMP concentrations and activation of protein kinase A (PKA). One effect of PKA activation is the phosphorylation of cytoskeleton proteins involved in the transport of the gastric H⁺, K⁺-ATPase from cytoplasm to the plasma membrane, i.e., from the vesicular and/or tubular vesicular membrane to the canaliculus. In the canaliculus, the gastric H⁺, K⁺-ATPase can access KCl of the extracellular region and exchange the intracellular proton with the extracellular K ion, which represents the gastric acid secretion. The H₂ receptor is crucial in making the acid secreting morphology of the parietal cell, while the gastric H⁺, K⁺-ATPase is the final functional work on the acid secretion [3]. The consumption of food stimulates acid secretion and acid secretion activates PPIs. Then activated PPI is converted to a sulfonamide in the acidic secretory canaliculi of the parietal cell. The sulfonamide interacts covalently with sulfhydryl groups in the proton pump and make complex, thereby irreversibly inhibiting its activity.[4] The pathway of acid impairment by proton-pump inhibitors (PPIs) is illustrated (dotted lines indicate putative pathways). Hypochlorhydria interferes with antral D and G cells, resulting in increased gastrin and chromogranin that activates a hyperplastic reaction in enterochromaffin-like (ECL) cells and parietal cells.

Metabolism of the Proton Pump Inhibitor

The PPIs are inactive in their native form and are rapidly metabolized by the liver. Since PPI is an acid-activated prodrug, it is important to keep the PPI plasma level high until the gastric acid secretes. Maintaining high plasma level of the drug is significantly affected by the character of the metabolism. Metabolism of PPIs is dependent on the cytochrome P450 system. CYP2C19 and CYP3A4 polymorphism are major components for this. Omeprazole is converted to hydroxyl and 5-O-demethyl metabolites by CYP2C19 and to the sulfone by CYP3A4. According to the metabolic rate of omeprazole, individuals are classified as homozygous extensive metabolizer (homoEM), heterozygous extensive metabolizer (heteroEM) and poor metabolizer (PM). PMs exhibit a 3 to 10 folds higher area under the plasma concentration curve (AUC) than homoEM, while heteroEMs exhibit a 2 to 3 folds higher AUC. The CYP2C19 genotype greatly influenced this difference. The most extensively described variant alleles for PMs are CYP2C19*2 and CYP2C19*3, which encode for nonfunctional proteins. Omeprazole is a racemic mixture of 2 enantiomers, R-omeprazole and S-omeprazole. Each enantiomer showed different affinity to the CYP enzyme. R-omeprazole was more sensitive to CYP2C19 while S-omeprazole was less sensitive. Therefore, S-omeprazole provided better plasma level of the drug. Like omeprazole, lansoprazole also was extensively metabolized by CYP2C19 and CYP3A4. Major metabolites of lansoprazole are 5-hydroxy lansoprazole and the sulfone. Similar patterns of metabolism were observed in pantoprazole and rabeprazole [4,5].

Pharmacokinetic

The rate of PPI absorption is decreased by concomitant food intake. The elimination of half-life of PPIs ranges from 0.5 to 2.0 hr, but the effect of single dose on acid secretion usually persists up to three days. Since an acidic pH in the parietal cell acid canaliculi is required for drug activation, and since food stimulate acid production, these drugs ideally should be given about 30 minutes before meals. Chronic renal failure does not lead to drug accumulation with once-a-day dosing of the proton pump inhibitors. Hepatic disease substantially reduces the clearance of esomeprazole and lansoprazole [5].

Adverse Effect

Short term- The common adverse effect include: nausea, diarrhea, abdominal pain, fatigue, and dizziness. Because the body uses the gastric acid to release vitB12 from food particles, decrease vitB12 absorption may occurs with long-term use of PPIs, and may lead to vitB12 deficiency [5,6]. Long-term- In the specific but common case of the use of PPIs as long-term treatment for managing GERD. PPIs may cause deficiency by increase gastric symptoms if they are



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disconnected. However, 12-week PPI therapy had no impact on calcium, vitamin D or bone metabolism in healthy young males. Long-term PPI therapy also interferes with zinc absorption and zinc body stores [6].

Therapeutic uses

Proton pump inhibitors are used principally to promote healing of gastric and duodenal ulcers and to treat gastroesophageal reflux disease (GERD). Lansoprazole is FDA approved for treatment and prevention of recurrence of nonsteroidal anti-inflammatory drug (NSAID) associated gastric ulcers in patients who continue NSAID use [6]. In children, Omeprazole is safe and effective for treatment of erosive esophagitis and younger patients generally have increased metabolic capacity, which may explain the need for higher dosages of omeprazole per kilogram in children compare to adults [6].

Medicinal Uses

Dyspepsia

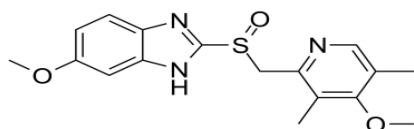
Peptic ulcer disease

Gastro esophageal reflux disease

Laryngopharyngeal reflux

Stress gastritis prevention

Zollinger-Ellison syndrome (often 2-3x the regular dose is required as compare to the other indication)

Omeprazole

Omeprazole is indicated for the short-term treatment of peptic ulcer disease in adults where most patients heal within four weeks. Patients with duodenal ulcer disease and *H. pylori* infection disease that is active for up to one year may benefit from combination therapy that includes omeprazole with a macrolide antibiotic. Studies show a reduction in recurrence of duodenal ulcers with *H. pylori* treatment and a reduced rate of clarithromycin resistance with triple therapy. Clinicians should expect antimicrobial resistance and susceptibility testing performed if patients fail treatment, and treatment adjusted accordingly.[7] Omeprazole indications also include gastric ulcers in adults, and gastroesophageal reflux disease in adults and pediatric populations. Studies have shown the efficacy of omeprazole for short term treatment in erosive esophagitis. Omeprazole is also indicated for healing erosive esophagitis in both adults and children. Conditions prone to hypersecretion such as Zollinger-Ellison syndrome, multiple endocrine adenomas, and systemic macrocytosis also respond to management with omeprazole treatment in adults [8].

Mechanism of Action

Omeprazole is a proton pump inhibitor. It inhibits the parietal cell H^+ / K^+ ATP pump, the final step of acid production. In turn, omeprazole suppresses gastric basal and stimulated acid secretion. The inhibitory effects of omeprazole occur rapidly within 1 hour of administration, with the maximum effect occurring in 2 hours. The inhibitory effects last for approximately 72 hours after administration, followed by a return to baseline activity in 3 to 5 days. With daily use of the medication, the effects will plateau at four days. Omeprazole metabolism occurs via the hepatic cytochrome P450 enzyme system; the two primary CYP isozymes involved are CYP2C19 and CYP3A4. Urinary excretion is a primary route of excretion of omeprazole metabolites. Omeprazole has a short half-life of a half-hour to an hour in healthy subjects and about three hours for patients with hepatic impairment, but its pharmacological effect lasts much longer since it preferentially concentrates in parietal cells where it forms a covalent linkage with H^+/K^+ ATPase, which it irreversibly inhibits.[9]



**Rajesh Ranjan Pradhan et al.****Administration**

The method of delivery for omeprazole is heavily dependent on the diagnosis. For *H. pylori* infection, the recommended adult oral regimen is 20 mg plus clarithromycin 500 mg plus amoxicillin 1000 mg, each given twice daily for ten days. If an ulcer is present on initial diagnosis, then it is recommended to provide an additional 18 days of omeprazole 20 mg once daily. The recommended oral adult dose for the treatment of symptomatic GERD absent esophageal lesions is 20 mg daily for up to 4 weeks. However, if erosive lesions are present, therapy may extend to 8 weeks. The recommendation for patients with hypersecretory diseases is to start at 60 mg once daily, followed by the individualization of dosage based on the patient's need and clinical response. If the daily dose is higher than 80 mg, they should divide the dosage throughout the day. Long term treatment with omeprazole is not recommended, and eventually, switching to an H2-inhibitor is preferred.[10]

For pediatric patients between the ages of 1 and 16, the dosage is dependent on the weight of the child.

Weight: 5 less than 10 kg, dose:5 mg Weight between 10 and 20 kg, dose:10 mg Weight: over 20 kg, dose: 20 mg

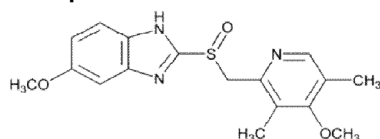
Omeprazole should be ingested 30 to 60 minutes before meals. It may be taken with antacids. When taken twice daily, the first dose should be before breakfast and the second dose before dinner. The capsule and tablet should be swallowed whole, not crushed or chewed. However, it is permissible to open the capsule and mix the contents with one tablespoon of applesauce, soft enough to be swallowed without chewing. The suspension should be left to thicken for two to three minutes, following reconstitution and administered within 30 minutes. Drink with a glass of cool water to ensure complete swallowing of the pellets.[11] Omeprazole therapy should be at the lowest dose possible for the shortest duration; physicians have looked into deprescribing proton pump inhibitors if patients are on long term use. One group recommends deprescribing PPIs, meaning to reduce the dose, stop completely, or use "on-demand" dosing in adults who have completed a minimum of 4 weeks of PPI treatment for heartburn or mild to moderate gastroesophageal reflux disease or esophagitis, and who have achieved symptomatic resolution. The patient should follow up for monitoring of symptoms at weeks 4 and 12 and again at 6 to 12 months. But these recommendations do not apply to those who have or have had Barrett's esophagus, severe esophagitis grade C or D, or documented history of bleeding gastrointestinal ulcers.[10]

Adverse Effects

Omeprazole is considered a benign drug; however, the primary adverse effects of omeprazole include headache, abdominal pain, nausea, diarrhea, vomiting, and flatulence in adults. The major adverse effects in the pediatric population are similar to adults; the most frequent events were reportedly fever and respiratory. Proton pump inhibitors (PPI) therapy may correlate with an increased risk of *Clostridium difficile* (*C. diff*) associated diarrhea. Long-term and multiple daily dose PPI treatment may have connections with an increased risk for osteoporosis-related fractures of the hip, wrist or spine but newer studies show long-term PPI use does not correlate with any changes in bone mineral density or bone strength that would predispose to an increased risk of fracture suggesting this relationship is not casual. Some evidence has shown a diminished antiplatelet activity of clopidogrel due to impaired CYP2C19 function when used in conjunction with 80 mg omeprazole. There are rare reports of hypomagnesemia with prolonged treatment with PPIs. Avoid concomitant use of omeprazole with St John's wort or rifampin and other CYP450 inducers due to the potential reduction in omeprazole concentration [11,12].

Toxicity

There have not been a significant number of omeprazole overdoses that have led to serious medical consequences. There is no specific antidote for an event such as this.

Esomeprazole

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Esomeprazole is used to treat symptoms of gastroesophageal reflux disease (GERD) and other conditions involving excessive stomach acid such as Zollinger-Ellison syndrome. Esomeprazole is also used to promote healing of erosive esophagitis (damage to your oesophagus caused by stomach acid). Esomeprazole may also be given to prevent gastric ulcer caused by infection with *Helicobacter pylori* (*H. pylori*), or by the use of nonsteroidal anti-inflammatory drugs (NSAIDs). It can also be found in quadruple regimens for the treatment of *H. pylori* infections along with other antibiotics including Amoxicillin, Clarithromycin, and Metronidazole, for example. Its efficacy is considered similar to other medications within the PPI class including Omeprazole, Pantoprazole, Lansoprazole, Dexlansoprazole, and Rabeprazole. Esomeprazole is the *s*-isomer of Omeprazole, which is a racemate of the *S*- and *R*-enantiomer.

Mechanism Of Action

Esomeprazole exerts its stomach acid-suppressing effects by preventing the final step in gastric acid production by covalently binding to sulfhydryl groups of cysteines found on the (H⁺, K⁺)-ATPase enzyme at the secretory surface of gastric parietal cells. This effect leads to inhibition of both basal and stimulated gastric acid secretion, irrespective of the stimulus. As the binding of esomeprazole to the (H⁺, K⁺)-ATPase enzyme is irreversible and new enzyme needs to be expressed in order to resume acid secretion, esomeprazole's duration of antisecretory effect that persists longer than 24 hours.

Pharmacokinetics

Absorption: Esomeprazole is well absorbed after oral administration. **Distribution:** It is widely distributed in the body in protein bound form. **Metabolism:** Esomeprazole is extensively metabolized in the liver. **Excretion:** It is excreted mainly in the urine and small amount in feces

Adverse Effects

Diarrhoea, Nausea, Abdominal pain, Constipation, Headache, Flatulence. Dry mouth

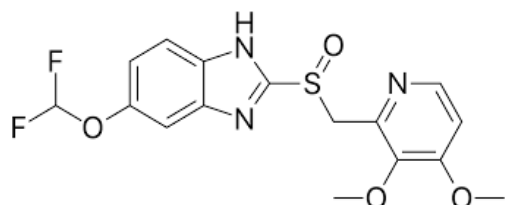
Medicinal Uses

GERD: A chronic disorder characterized by reflux, regurgitation, heartburn, coughing, hoarseness, chest pain, and trouble swallowing.

NSAID-associated peptic ulcers: Peptic ulcers caused by the prolonged use of nonsteroidal anti-inflammatory drugs (NSAIDs) like aspirin, Advil (ibuprofen), and Aleve (naproxen).

***H. pylori* eradication:** Prevention of the recurrence of ulcers in patients undergoing antibiotic therapy to eradicate *H. pylori* (a bacterial infection closely linked to peptic ulcers).

Hypersecretory disorders: Rare digestive disorders like Zollinger-Ellison syndrome that result in the overproduction of stomach acid.

Pantoprazole**Mechanism of action**

Pantoprazole is a proton pump inhibitor (PPI) that suppresses the final step in the gastric acid production by covalently binding to the (H⁺/K⁺) ATPase enzyme system at the secretory surface of the gastric parietals cell. This effect leads to inhibition of both basal and stimulated gastric acid secretion, irrespective of the stimulus.



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The binding of pantoprazole to H⁺/K⁺ ATPase is irreversible in nature, and effectively inhibit acid secretion until new enzyme is synthesized. [12,13]

Pharmacokinetics

Rapidly adsorbed after oral administration. on set of action is within 2-4hrs. Duration of action is about 24 hrs. Peak concentration (C_{max}) is 2.5 µg/ml; the time to reach the peak conc. (t_{max}) is 2.5 h. The drug is subject to low first pass-hepatic excretion, the oral bioavailability is 77% approximately 71% of the dose was excreted in the urine, with 18% excreted in the faces through biliary excretion. There was no renal excretion of unchanged pantoprazole. In geriatric, only slight to moderate increase in pantoprazole AUC (43%) and C_{max} (26%) were found in elderly volunteers (64 to 76 years of age) after repeated oral administration, compared with younger subjects. No dosage adjustment is recommended based on age. [14,15]

Administration**Gender**

There is a modest increase in pantoprazole AUC and C_{max} in woman compared to men. However, weight normalized clearance values are similar in woman and men. No dosage adjustment is recommended based on gender.[16]

Renal impairment

In patients with severe renal impairment, pharmacokinetic parameters for pantoprazole were similar to those of healthy subjects. No dosage adjustment is necessary in patients with renal impairment or in patients undergoing hemodialysis. In hepatic impairment, no dosage adjustment is needed in patients with mild to severe hepatic impairment.[17]

Medicinal uses

- To treat ulcers in the stomach and the part of the gut called the duodenum
- To reduce acid reflux which may cause heartburn or inflammation of the gullet (esophagitis). These conditions are sometimes called gastroesophageal reflux disease (GERD).
- As one part of treatment to get rid of helicobacter pylori – a germ (bacterium) found in the stomach, which can cause ulcers.
- To help prevent and help ulcer associated with anti-inflammatory medicines called non-steroidal anti-inflammatory drugs (NSAIDs).
- In a rare condition called Zollinger-Ellison syndrome.
- In other condition where it's helpful to reduce acid in the stomach.[18]

Adverse side effect

Common side effect - abdominal pain, diarrhea, nausea, vomiting, headache, dizziness.

Rare side effect-

Gastrointestinal: constipation, dry mouth, hepatitis

Blood problems: Low white blood cell count, thrombocytopenia

Immunologic: Stevens-Johnson syndrome, toxic epidermal necrolysis

Metabolic: Elevated creatine kinase, elevated cholesterol levels, elevated liver enzymes (AST/ALT), swelling

Musculoskeletal: Muscle disorder, bone fracture and infection, clostridium difficile infection, osteoporosis-related hip fracture, rhabdom.

Long-term

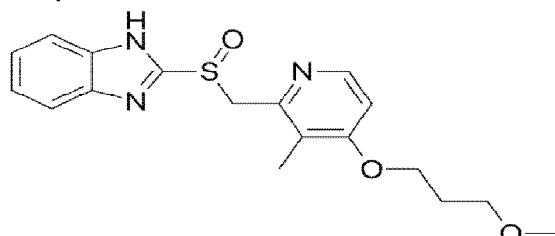
Osteoporosis and bone fracture have been observed in patient on high-dose and/or long term (over 1 year) prescription proton pump inhibitors. Hypo magnesias has been observed in patient on medications like pantoprazole





when taken for longer periods of time (generally 1 yr or more, although cases have been reported with regimens as short as 3 months).[19]

Rabeprazole



A new substituted benzimidazole proton pump inhibitor PPI with several difference compared with existing PPIs. Contains 2 enantiomers (R and S) both of which are pharmacological active and lipophilic.

Enteric coated, acid activated prodrug.[20]

Differs from other PPIs in

The degree of accumulation in the parietal cell.

This led to quicker activation \conversion to active moiety.

Mechanism of Action

- Due to its more rapid rate of activation. Rabeprazole result in a faster mode of action and faster symptom control than other PPIs.
- Rabeprazole achieve more rapid and profound inhibition of acid secretion than older agent (omeprazole lansoprazole and pantoprazole).
- They sustain this suppression to provide acid control and symptom relief over 24 hours.
- The balance hepatic metabolism of rabeprazole, involving both cytochrome P450(CYP) mediated reaction in the liver and nonenzymatic reaction., appears to confer an advantage over other PPIs including esomeprazole.[21]

Pharmacokinetic Action

Absorption

Food does not affect the degree of absorption.

Bioavailability

52%

Metabolic effects

Exhibits extensive, stereoselective, hepatic metabolism, involving CYP3A and CYP 2C19.

Elimination

Elimination as urinary metabolites and in the feces.

Timing of effects

Reach of steady state for optimum acid suppression in about 3 days.[28]

Administration

Dosing-20mgod – Because PPIs inhibit only actively secreting proton pumps, gastric acid suppression is optimal when the PPI is taken about 30min before a meal.

Instructions – Patients should not crush, chew or split the tablets

Special- No dose adjustment is necessary in renal in mild to moderate hepatic impairment, elderly subjects. Even in severe liver disease, drug accumulation in Unlikely with rabeprazole but dose adjustment has not been assessed.[22]



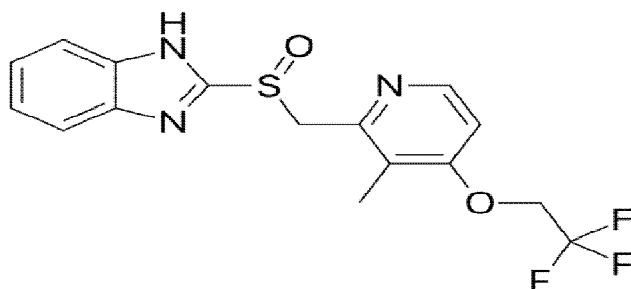
**Rajesh Ranjan Pradhan et al.****Adverse Effects**

Common adverse events assigned to rabeprazole have been headache, diarrhea, rhinitis, nausea, pharyngitis and abdominal pain.

Histological changes, increase in serum gastrin levels are unremarkable and seen as a direct result of acid inhibition but return to pretreatment levels within 1 week of discontinuing the drug.

The incidence of high gastrin levels, defined as >400 mol/L, is approximately.

Low incidence of mild, transient adverse events. [23]

Lansoprazole

The sulfonamide metabolites of lansoprazole covalently bind at critical sites of the H^+/K^+ ATPase, the final, pathway of gastric acid secretion, this agent inhibits both basal and stimulate acid secretion. In adults, lansoprazole (30mg) decreases mean stimulated gastric acid secretion to 19 ± 2 m mole/h compare to $96-114 \pm 12-16$ m mole/h with placebo. In geriatric patient >60 yrs. of age, decrease in gastric acid secretion was even more significant to a rate of 2 ± 1 m mole/h. Lansoprazole increase the mean gastric pH in a dose dependent manner. [24,25]

Pharmacokinetics

In pediatric patients who received lansoprazole daily for 5 days, the mean gastric pH increases for pH 2.5 (base line) to pH 3.6 with lansoprazole (15mg) and form pH 2.3-3.8 with lansoprazole (30mg). in children >30 kg, lansoprazole (15mg) maintains a gastric pH $>3-4$ on day 5 for 23-54% of the time compare to 12 -41% prior to lansoprazole therapy. In pediatric patients >30 kg who received lansoprazole (30mg\days), the percentage of time the gastric pH.3-4 was increase from 20-60%compare to 9- 49% prior to treatment, respectively. [26]

Mode of Action

Its mechanism of action is to selectively inhibit the membrane enzyme H^+/K^+ ATPase in gastric parietal cells. In clinical trials, lansoprazole is more effective than placebo or histamine (H_2)-receptor antagonists in the treatment of reflux esophagitis. [26]

Administration

30 mg lansoprazole once daily for 4 weeks. The majority of patients will be healed after the first course. For patients who have not fully healed within this time, a further 4 weeks treatment using the same dosage regimen is indicated. For long-term management, a maintenance dose of 15 mg or 30 mg once daily can be used dependent upon patient response.

Adverse Effect

Most commonly reported lansoprazole capsule side effect with an incidence with an incidence rate of 1% or more include diarrhea, abdominal pain, nausea, vomiting, constipation.

Infrequent: dry mouth, insomnia, drowsiness, blurred vision, rash, pruritus.

Rare and very rare: Taste disturbance, liver dysfunction, peripheral oedema, hypersensitivity reaction, photosensitivity, fever, sweating, depression, interstitial nephritis. [27]



**Rajesh Ranjan Pradhan et al.****Contraindications**

PPI contraindications include patients with known hypersensitivity to that class of drugs, and their use requires caution in patients with severe hepatic disease. As mentioned above, PPIs undergo metabolism by the cytochrome P450 system of the liver, mostly by CYP2C19; hence, any severe dysfunction in this metabolism serves as a relative contraindication. That said, clinically, clinicians often use PPIs in patients with severe liver disease with increased monitoring. PPIs can also alter the activity of specific cytochrome enzymes and delay the clearance of certain drugs such as phenytoin, warfarin, and diazepam. As such, the use of these drugs requires caution in those undergoing PPI therapy. Furthermore, the stomach's acidic environment is necessary for the effective absorption of ketoconazole, and it is advisable to use other antifungals in the setting of long-term PPI use. Conversely, the same acidic environment potentiates the absorption of digoxin, and thus this drug's use merits extreme caution due to the severity of its side-effect profile.[9][6]

Monitoring

There is evidence supporting the monitoring of magnesium (especially in kidney transplant patients). Monitoring of vitamin B12 levels in patients on long-term PPIs is more controversial but reasonable to consider in select cases. Currently, there is limited evidence to support bone density scanning and/or calcium supplementation as an effective means of reducing osteoporosis.[10][11]

CONCLUSION

Proton Pump Inhibitors are FDA-approved to relieve GI-related symptoms, including GERD, PUD, NSAID-induced ulcer, H. pylori treatment and hyperacid secretion.[29] PPIs have been used as strong acid suppression agents in clinics for over many years and are mainly used in the treatment of acid-related diseases, such as peptic ulcer disease, gastroesophageal reflux disease, NSAID-associated gastrotoxicity and so on.[30] Some of the novel uses of PPIs, such as the treatment of viral infections and respiratory diseases as well as cancer cell suppression, etc., still need more investigation, and most of the studies on the treatment of cancer with PPIs remain in the laboratory (verified in cell or animal experiments). With intensifying research, combination therapy with PPIs can benefit more patients in the near future. However, we need to pay more attention to the potential adverse effects induced by long-term PPI use, especially in the elderly population.[31]

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Conflicts of interest

The authors of the article have no conflicts of interest to declare.

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Table 1: Pharmacokinetic Properties of Proton Pump Inhibitor

	Omeprazole	Esomeprazole	Lansoprazole	Dexlansoprazole	Pantoprazole	Rabeprazole
Bioavailability, %	30-40	64-90	80-85	-	77	52
Time to peak plasma level (t _{max} , hr.)	0.5-3.5	1.5	1.7	1-2,4-5	2-3	2-5
Protein Binding, %	95	97	97	96	98	96.3
Half-life, hr.	0.5-1	0.5-1	1-1.5	1-2	1-1.9	1-2
Primary Excretion	Hepatic	Hepatic	Hepatic	Hepatic	Hepatic	Hepatic
Liver Metabolism	CYP2C19	CYP2C19	CYP2C19	CYP2C19 CYP3A4	CYP2C19 CYP3A4	CYP2C19

Table 2: Commercially Available Proton Pump Inhibitors

Drug	Dosage, mg	IV	Liquid or Suspension	Generic	Over-The-Counter
Omeprazole	10,20,40	Yes	No	Yes	Yes
Esomeprazole	20,40	Yes	Yes	Yes	Yes
Lansoprazole	15,30	Yes	Yes	Yes	Yes
Dexlansoprazole	30,60	No	No	No	No
Pantoprazole	20,40	Yes	Yes	Yes	No
Rabeprazole	20	No	No	Yes	No





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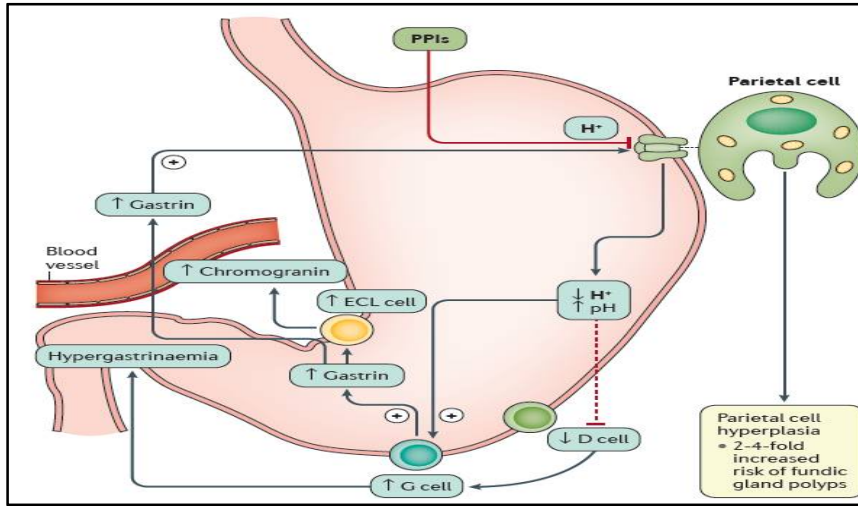


Figure 1- Effect of PPIs on gastric physiology.





Re-Utilization of Automobile Wash Water Treatment By Using Natural Materials

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ABSTRACT

The effectiveness of chemical and physical methods in treating wash water collected from car service stations. The washing water was collected from a service station in all cities of India, and the effluent was characterized by different parameters such as pH, total hardness, turbidity, total dissolved solids, oil and fat, detergents. For the chemical treatment, alum and locally available natural materials were used as sugarcane **bagasse** and **wood chips** they were used for physical treatment. Alum at different concentrations was stirred with the effluent for a prescribed contact period (30 min) which led to the formation of flocs. The filtered samples were analyzed and the percentage of oil and fat reduction was correlated with the depth and type of filter medium. Physical and chemical treatment methods revealed that natural materials are effective in removing important parameters such as oil, grease, and detergents from car effluent and thus provide a viable solution due to its environmental friendliness. From experimental studies it is observed that in physical treatment. As an adsorption technique, the adsorption capacity of any material depends on its porosity, specific surface area and thickness of the filter bed.

Keywords: Bagasse, wood chips, Alum, Automobile, Adsorption.

INTRODUCTION

On-site wastewater treatment is a prospective direction towards the reduction of pollution load to the municipal or combined urban wastewater. One of such areas is automobile service station and car-washing. Some of the existing petrol pumps, fuel service stations are facilitated with car-washing. If not treated and discharged, waste water will be produced, which will have a huge impact on the environment. Wash wastewater include oil and grease, detergents, phosphates, hydrofluoric acid, ammonium bi-fluoride products (ABF) etc. These substances when released into water bodies lead to soil and water pollution.



**Vijay Miditana and Mohan Marumudi****Adsorption**

'Adsorption' can be defined as the aggregation phase of any substance with a higher concentration of molecular species on the surface of another substance than that of the bulk. Molecules from the gas or solution phase collect or settle on the surface when a solid surface is exposed to a gas or a liquid. The molecular concentration phenomenon of a gas or liquid on a solid surface Adsorption, it is named.

"Adsorption" is a technique that is well known and efficient. 'Adsorption' is a well-established and potent process for the disposal of domestic and industrial waste. The most popular method of water treatment is the "adsorption" of activated carbon to the soil.

Adsorbate: Adsorbate is a material that concentrates on the surface.

Adsorbent: An adsorbent is called the substance on whose surface the adsorption takes place.

In water treatment, the most widely used method is to "adsorb" on the surface of activated carbon.

Adsorption Principles

The basic principle of operation for carbon adsorption is the mass transfer and adsorption of a molecule from a liquid or gas to a solid surface. Adsorption occurs because the pollutant has low solubility in waste. Depending on the type of attraction between adsorbate and adsorbent, adsorption can be divided into two types. There are attractive forces between adsorbate and adsorbent. These attractive forces can be due to Vanderwaal attractive forces, which are weak forces, or due to chemical bonds, which are strong attractive forces. On the basis of the type of attractive forces that exist between the adsorbate and the adsorbent, adsorption can be classified into two types

- Physical Adsorption
- Chemical Adsorption

Material Used

- Sugarcane bagasse
- Wood chips
- Alum
- Filter mesh
- PVC Pipe(110 mm)
- Collection container

Physical Properties Of Materials Used As Filter Bed**Sugarcane Bagasse**

Bagasse is a by-product of the sugar industry and an important fuel resource for the industry. This is a low-density fiber material with a wide range of moisture content for size and height of Particle. Sugarcane is one of the world's most promising sources of agricultural biomass energy. The composition of bagasse depends on the variety and maturity of sugarcane as well as on the harvesting methods applied and the efficiency of the sugar processing. The bagasse is generally burned in furnaces to produce steam for power generation. Bagasse is also emerging as an attractive raw material for bioethanol production. It is also used as a raw material for the production of paper and as a raw material for livestock. The value of Bagasse as a fuel depends to a large extent on its calorific value, composition, Moisture and its sucrose content. Moisture is the key calorific value determinant, that is, the lower the moisture content, the higher the Calorific value. A good grinding process will result in a lower humidity of 45%, while a humidity of 52% would indicate a low grinding efficiency. Most mills produce bagasse with a moisture content of 48%, and boilers are designed to burn bagasse with around 50% moisture. Bagasse also contains an approximately equal proportion of fiber (cellulose), the components of which are C (carbon), H₂ (hydrogen) and O₂ (oxygen), some C₁₂H₂₂O₁₁ (sucrose) (one to two %) and ash from foreign matter. The foreign matter content is higher with mechanical harvesting and subsequently results in a lower calorific value. For every 100 tons of crushed sugar cane; a sugar factory produces almost 30 tons of wet bagasse.



**Vijay Miditana and Mohan Marumudi****Wood Chips**

Wood chips are a by-product of carpentry operations. Wood dust is also a by-product of certain birds, insects and animals that live in wood, such as woodpeckers and wood ants. In some manufacturing industries, it can be a significant fire hazard and a source of occupational dust exposure. Wood chips are the main component of particle board. Wood dust is a form of particulate matter or particles. Research on the health hazards of wood dust belongs to the field of occupational health sciences, and the study of wood dust control belongs to the field of indoor air quality engineering. The main physical properties of wood chips are color, texture and odor; Moisture, including porosity, water retention, and water drainage were tested to demonstrate suitability for use as a filter media.

Material preparation:

The materials are collected (i.e. sugarcane bagasse and wood chips) and then these are dried for twenty four hours and then these washed and dried again for twenty four hours. After that the fibre content is separated from sugarcane bagasse. And it is used as filter bed. Whereas the wood chips are dried and can be directly used.

Coagulant Used

Alum is used as coagulant which is the hydrated form of potassium aluminium sulphate and has the chemical formula $KAl(SO_4)_2 \cdot 12H_2O$. However, it is considered that any of the compounds with the empirical formula $AB(SO_4)_2 \cdot 12H_2O$ is an alum. Alum is often seen in its crystalline form, but it is marketed more commonly as a powder. Potassium alum is a fine white powder which you can find with kitchen spices or pickling ingredients.

Uses of Alum:

Alum has many industrial and household applications. While ammonium alum, ferric alum, and soda alum can be used for many of the same purposes, potassium alum is used most frequently.

- Drinking water purification as a chemical flocculating agent
- Styptic pencil to avoid bleeding from small cuts
- The adjuvant in vaccines (a chemical that enhances the immune response)
- Deodorant "rock"
- Pickling agent to help keep pickles crisp
- Flame retardant
- Acidic part of certain kinds of baking powder
- An ingredient in some homemade and commercial modelling clay
- An ingredient in some depilatory (hair removal) waxes
- Skin whitener
- Ingredient in some brands of toothpaste.

Alum Sources and Production

Several minerals are used as the source material to produce alum, including alum schist, alienate, bauxite, and cryolite. The particular method used to extract the alum relies on the original mineral. When alum is obtained from alienate, the alienate is calcined. The resulting material is kept moist and exposed to air until it turns to a powder, which is lixiviated with sulphuric acid and hot water. The solvent is decanted, and from the solution the alum crystallises.

Description of Site

It conducted in a garage at all major cities in Andhra Pradesh, India. The garage is owned by Municipal Corporation and usually handles the operation Buses, Bikes, Cars and Autos etc. These are used either from the container site or from the transfer station to move solid waste from. There are altogether 40 nos. of vehicles including recovery unit, storage van, jeep etc. in the garage.



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The activities of the Garage yard includes, Vehicle washing and servicing section, Tyre repairing section, Body building section, Engine overhauling section, Vehicle running maintenance section, Break down maintenance section, Ancillary section, Machine shop and Procurement cell for collecting spare parts of vehicles.

Wastewater Survey

Wastewater is generated mainly from the washing of different types of vehicles. In the existing facility, 2 to 3 vehicles are checked on a rotating basis. Washing is done by spraying high pressure water jets through a nozzle guided by the compressor motor assembly. In general, 2 to 3 kilo liters of water are used per day for washing the vehicle. The grease gun is used to shoot lubricants at different parts of vehicles as a routine procedure. Each garage unit is provided with a wash bay. For washing, vehicles are lined up in the bay and a high pressure jet of water is sprayed on the vehicles. The washed wastewater is then drained into the municipal sewer system through the wash bay. The washing bay consists of a concrete cement platform. Spent water containing dirt, oils, and other solids is drained through gutters and then collected in a well. All the content of the raw sewage is led to the municipal drainage system.

Current Scenario Of Automobile Service Station

A service station is a place where in addition to caring for the motor vehicle, such as mechanical service and minor repairs, automobiles are supplied with gasoline, lubricated and cleaned; Washing and other types of simpler services are performed that are required on a daily basis. Generally includes a series of sections like general garage includes several sections like general garage service. A gas station is added to the available equipment. The garage is generally managed in conjunction with a sales agency for a particular type of motor vehicle to provide a comprehensive repair service for that particular vehicle. The equipment available, in a general garage, will be added with specialized equipment such as lifting tackle, and different types of jigs, accessories and tools specially designed to check, adjust and repair of a particular type and make of vehicle. A service station may consist of a machine shop that has a lathe, a drilling machine, etc. In the case of a large service station, special types of machines such as crankshaft grinding, valve grinding, surface grinding, grinding and drilling machine, and brake drum lathe will also be equipment. Over the past decade and a half, the passenger car population has steadily increased. This is primarily due to the considerable liberalisation of the Indian economy for all forms of industries.

India has around 30 models of passenger cars on locally developed roads and an equal number of models in the commercial vehicle segment. While there has been a decline in the sale of commercial vehicles, the sale of cars and other vehicles has been on the rise. All the major international passenger car manufacturers and two-wheeler manufacturers are showing great interest in the Indian market, and many have introduced new models. Indian industry, with its cost advantage and fundamental engineering capabilities, has become an important source. Many of these plants are found in India. Also the existing automakers - Marti, Fiat, Kia and Hindustan Motors are also bringing new models to the road. Several new brands such as Zen, Alto, Wagon - R, Santro, Accent, Fiat, Palio, Siena, and India are popular brands. The passenger car population in India is 6 cars per thousand, which is very low compared even to neighboring countries like Pakistan and Sri Lanka. There is an immediate need to increase this figure to 7 per thousand.

Waste water treatment using sugarcane bagasse and wood chips as filter bed:**Methodology**

p^H is an important parameter in determining the quality of water in an aquatic environment and is used to express the intensity of the acidic or alkaline condition of a solution. According to our study pH values of few samples are almost near to standard value. Turbidity is caused by the presence of suspended and dissolved matter, such as clay, silt, finely divided organic matter, plankton and other microscopic organisms, organic acids, and dyes. Cloudy water will appear cloudy, cloudy, or another color, which will affect the physical appearance of the water. Suspended solids and dissolved colored material reduce the clarity of the water creating an opaque, cloudy or cloudy appearance. Turbidity measurements are often used as an indicator of water quality based on clarity and estimated



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total suspended solids in the water. The total hardness of water is the sum of the concentrations of alkaline earth metals present in it. In fresh water, these are mainly attributed to calcium and magnesium, although other metals such as iron, strontium, and manganese can also affect hardness when present in appreciable concentrations.

Total dissolved solids are measured for inorganic salts, organic matter, and other dissolved materials in the water and can also cause toxicity to aquatic life through increased salinity, changes in the ionic composition of the water, and toxicity of chemicals. Individual ions. The dissolved or emulsified oil and fat are removed from the water by intimate contact with an extraction solvent. Some extractable fats and fatty acids, especially unsaturated ones, are easily oxidized; therefore, special precautions regarding temperature and solvent vapor shift are included to minimize this effect. Organic solvents stirred with some samples can form an emulsion that is very difficult to break. This method includes a means of handling such emulsions. Detergency is the ability to clean or remove dirt, generally associated with the action of a cleaning agent such as soap, detergent, or alkaline salt.

Oil, grease and detergents were taken as crucial parameters in the car effluent. Use of chemical and physical treatment methods with sugarcane bagasse and wood chips for different thicknesses of filter bed was explored. From the study it is concluded that. Uses of bio adsorbents (sugarcane bagasse & wood chips) are locally available and it has low expenditure. High dosage of alum concentration (225mg/l) gives good results for removal of oil & grease and detergents. By the mechanism of adsorption the percentage of removing dissolved solids will be higher. Concluded that wood chips were more effective than the sugarcane bagasse. From several studies it was concluded that the water samples from the automobile service station can be reused for first phase of wash of next car wash, after chemical process and physical process of treatment using low cost materials like sugarcane bagasse and wood chips. [Debabrata Mazumder *et al.* 2011]

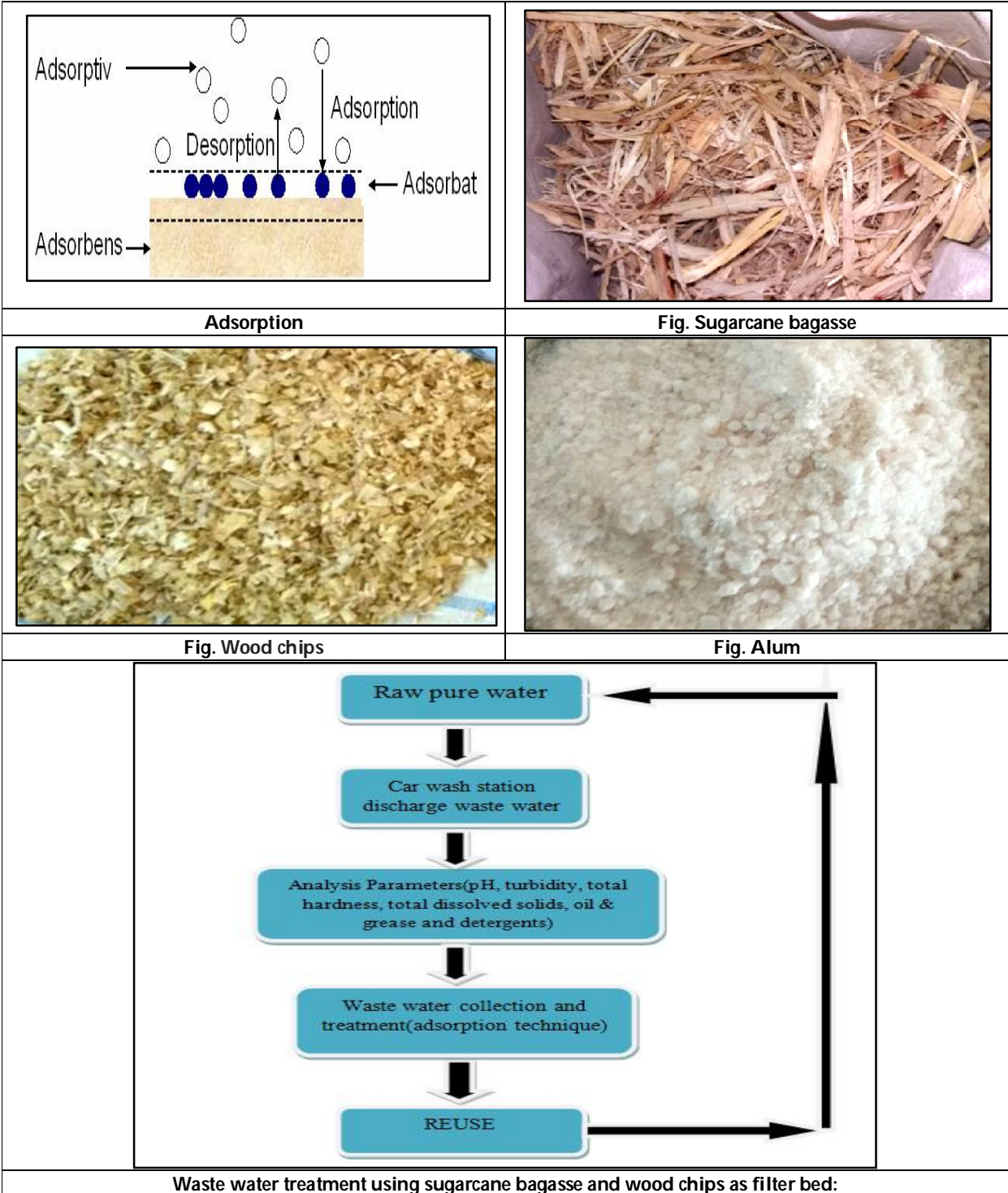
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ReHoMation: Low Cost, RF Based Remotely Home Automation without Microcontroller

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ABSTRACT

“ReHomation” is a low cost, easy to use, energy saving, and easy to maintain system for electronically automatic control, monitoring of household features, activity and applications. The system can be accessed within 20meters of radius. The system is designed and implemented by using 433 MHz radio, HT12E encoder integrated chip, 1 M ohm resistor, switch, PCB board, 9V battery, HT12D decoder integrated chip, 7805 V regulator, 0.1uF ceramic capacitor, 33 k ohm resistor, bulb, BC547 resistor, 1N4007 diode, 5V relay, 2 pin terminal block, 220V AC power supply and wires for connection. 433 MHz Radio frequency used to capture signals as transmitter and receiver; it is easy to use for the end user. Microcontrollers have a very complex structure, they cannot be directly interfacing with power devices, some controllers do not have analog input/output, that's the problem for supporting relay, and the number of executions is limited, for this reason our proposed system does not use microcontrollers. In this system, 5V relay is used, which will help to reduce voltage cost, other components used in this system are easily available on the nearby market and cost of the individual components are not highly expensive, which reduces the overall cost of the project.

Keywords: Home Automation, RFID, Relay, Power Proficient.



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INTRODUCTION

Popularity of home automation increases day by day for its comfort and quality of life living quality [1-2]. When people step into their houses after an extended, tiring day of labor, they would want to have a comforting environment[3]. It reduces the use of excessive or needless human efforts and improves the same old way of living of the humans in our society [4]. It is also the subsequent large thing to persuade entire digital industries and human life [5]. The entire gadgets of remote households can be cleanly managed, observed, and communicated without physical guidance [6]. The current model will be composed of 433 MHz Radio, HT12E encoder integrated chip, 1 M ohm resistor, switch, PCB board, 9V battery, HT12D decoder integrated chip, 7805 V regulator, 0.1uF ceramic capacitor, 33k ohm resistor, electric bulb, BC547 resistor, 1N4007 diode, 5V relay, 2 pin terminal block, 220V AC power supply and wires for remotely home automation. The user can access daily accessories like light, fan, AC, television etc., remotely within 20 meters of radius. The proposed system is low cost, power proficient, remotely accessed, easy to use system designed for home automation. The user can off/on home applicants by using one tap wirelessly in the house. The proposed system has a good impact on society for its comfort. As we discussed, the system is easy to use, so any aged person can start their relaxation journey from "ReHoMation".

The rest of the paper are as follows: section II will be discussed on literature survey, section III focused on proposed system, section IV discussed on contributions and motivation for the current work, section V focused on experimental results and last section will describe the conclusion of the current work.

Literature Survey

The article discusses the troubles of enhancing the efficiency of management and operation of smart residential constructing structures. The problem is solved with the aid of optimizing the running mode of automation systems on the layout stage. A study has been conducted and the software and experimental results of the improvement of a "smart sensor" based totally on an Arduino controller are presented. The issues of enlargement of management centers are proposed and applied. The trouble is solved by the use of intelligent sensors inside the manipulated machine. They encompass number one R, L, C sensors and a voltage size channel. Software equipment for interaction of number one sensors within the software program surroundings of the Arduino controller were advanced. The issues of selecting software tools for far flung control of these objects are discussed[7].

Home Automation is one of the most well-known regions of development in the electronics area. It has the gain of no interaction of people with the devices, and it usually calls for any other energy source to energy itself. In standard scenarios, a DC battery is used to electricity the microcontroller which is used for automation. With steady inclusion of smart power systems to automate home equipment, this paper proposes a domestic automation machine which is able to power the circuits on its own by photovoltaic cells and energizing the required set of masses wirelessly. Contrary to conventional methods, the proposed gadget employs a cascaded photovoltaic cellular to energize an Arduino board which aids in automating the gadget. The Arduino upon wi-fi enter feeds the relays which could spark off or deactivate the required load. A hardware prototype of the proposed machine is found out and demonstrated efficiently [8].

This paper affords radio frequency identity (RFID) based pay as you go energy meter and home automation system with an android utility running at subscriber's cellular station. The strength meter is credited even though RFID generation and the automation of various appliances are controlled with the aid of the subscriber via an android cellular software. The subscribers may test their cutting-edge credit, consumed units, modern load and they can manipulate home equipment remotely. We have also added a load management gadget, whilst load exceeds a positive defined level then appliances are robotically closed down. An automated theft detection mechanism has also been set in location for the gadget[9, 10].



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In designing an automation system to assist make it less difficult for people to control and monitor family appliances or clever houses often reveal in problems with the problem of estimating the increasing burden of electric modern as it makes use of additional tools to govern the household appliances. To lessen this view, it is able to be solved by way of regulating the electricity to be consumed from the family appliance by the use of a clever meter as a monitoring device especially designed with extra net to send information taken from the power meter and then the incoming data may be processed analyzed from the height modern-day call for of electrical contemporary using the User Habits method with a view to be blended with the power scheduling method and mixed with concept turning on or off the family appliances, so that it's miles predicted to offer comfort and effectiveness in the use of Home Automation. Effectiveness means that all home equipment or instruments should be strolling well first, along with KWH meters, the lamp, switches, dispensers, mini server (neighborhood saving), and statistics middle (worldwide saving). And then, after the effectiveness has been going for walks accurately or smoothly the writer continues his research into performance, specifically a power saving mode with an energy management procedure based on user habits[11, 12].

The essential objective of this paper is to layout and enforce a far flung sensing based home automation system using Arduino Uno Kit as a main controller for this scheme. The proposed machine has two operational situations. The first scenario is to manipulate the house devices from anywhere via using a smart phone with remote sensors and net technology controlling by using the consumer, it is known as a guide-state of affairs. The 2d situation is to screen and manipulate the house devices by an automatic management among the far flung sensors and the primary controller Arduino Uno Kit', it's far known as an automated scenario. To make an easy deal for a user the MATLAB GUI platform is designed as a great interface to control and reveal the gadget. The proposed system is proven to be simple, cost effective and flexible making it a suitable and an amazing candidate for the smart home future[13].

METHODOLOGY

In this paper a low cost and consumer friendly remote controlled domestic automation gadget is presented. The system is designed and implemented by using 433MHz Radio, HT12E encoder integrated chip, 1 M ohm resistor, switch, PCB board, 9V battery, HT12D decoder integrated chip, 7805 V regulator, 0.1uF ceramic capacitor, 33k ohm resistor, electric bulb, BC547 resistor, 1N4007 diode, 5V relay, 2 pin terminal block, 220V AC power supply and wires for connection. The proposed system has two main 2 parts, first one is transmitter and other is receiver.

Transmissing System

Fig.1., is the transmitting module of the proposed system. In this module the end user can press a switch for light "ON", the signal sends to the radiofrequency transmitter module through HT12E encoder integrated chip and the same procedure is applied for switch off also.

Receiving System

Receiving modules (as shown in Fig.2.) have some features to receive transmitting signals. 433 MHz radio frequency used to receive transmitting signal and send to the HT12D decoder integrated chip used to decoding the encoding signal, by using relay the home gadgets are controlled.

Brief Description of Technical Components

The components as shown in Table.1. are used for "ReHoMation" is as follows:

Radio Frequency

433 MHz Radio Frequency (RF) is used in this proposed system to transmit and receive the signals which are compatible with household devices wirelessly.





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Encoder

The encoder is the component designed for converting the information from one format to another. The encoder feedback signal will determine the position, speed, count and direction of the signal. The proposed system HT12E Encoder IC used to catch the signal.

Resistor

Light Dependent Resistors are variable resistors that alternate their resistance relying on the quantity of light falling on them.

PCB Board

Printed circuit forums (PCBs) are used to robotically aid and electrically join electronic additives using conductive pathways, tracks or sign traces etched from copper sheets laminated onto a non-conductive substrate, employed within the manufacturing of smart home components.

Battery

In home automation, a 9 volt battery, either disposable or rechargeable, is commonly utilized in smoke alarms, smoke detectors [10].

Decoder

The decoder is converting the encoding signal to decoding signal. The proposed system uses HT12D Decoder IC for decoding receiving signals.

Regularator

A regulator is the domestic automation controller is the brain in the back of the smart home. It is the device that controls all of smart home equipment and gadgets. These can variety anywhere from lightbulbs to tune systems, TVs, doorbells, thermostats, protection systems and so much more.

Diode

The 1N4007 diode is a well-known recuperation rectifier with a molded plastic case. The most contemporary wearing capability is 1A and it withstands peaks up to 30A. So, we will use this diode in circuits that are designed for much less than 1A.

Relay

A 5v relay is an automated switch that is normally utilized in an automated managed circuit and to control a high-modern use of a low-current sign.

Contributions and Motivations

The advantages of the proposed device are as follows:

Remotely Access

The proposed system uses radio frequency which wirelessly controls home gadgets.

Power Proficient

The system also solved the power failure problem by avoiding the voltage source; it will be great advantages for the end user.

Low Cost

In this system, 5V relay is used, which will help to reduce voltage cost, other components used in this system are easily available on the nearby market and the cost of the individual components are not highly expensive, which reduces the overall cost of the project.



**Sima Das et al.,****Easy to Access**

The system is remotely accessible and easy to handle by any aged person.

Easy to Maintenance

The design of the system is simple, so easy to maintain.

Simple Structure and Sufficient Execution

Microcontrollers have some limitations like: it does not interact with power devices directly, some issues to connect relay, complex structure, not enough execution with home applications, for these advantages the proposed work does not use microcontrollers.

Energy Savings

Now-a-days all are busy with their life, after work they are so tired of electrical gadgets, the proposed system is controlled remotely, that's the reason for energy saving based on the user's habits.

RESULTS AND DISCUSSIONS

In this section we will discuss the experimental result for remotely home automation. Fig.3 shows that remotely light off and Fig.4 shows that light are on using RF based remote home automation.

CONCLUSION

The "ReHoMation" is designed for home gadgets controlled remotely. The system is easy to handle for that reason the proposed device will be used by any aged peoples. The device is not embedded with a microcontroller for its complexity and execution limitation. In short, the proposed device is remotely accessed, power proficient, low cost, easy to access, simple structure, sufficient execution and energy savings based on the user's habits. The system controls the home equipment and creates a smart home, humans can easily on/off switches that help to reduce unnecessary energy. The device also can apply on Buildings, offices, hospitals.

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Table 1. Components Required For Proposed System

#	Components Required	
	Transmitter System	Receiver System
1	433 MHz Radio Frequency Transmitter Module	433 MHz Radio Frequency Transmitter Module
2	HT12E Encoder Integrated Circuit	HT12D Decoder Integrated Circuit
3	1M ohm Resistor	Regulator
4	On/off Switch	On/off Switch, Resistor, Diode
5	PCB Board	5Volt Relay
6	9Volt Battery	0.1 uF Ceramic Capacitor
7	Wire	2pin Terminal Block





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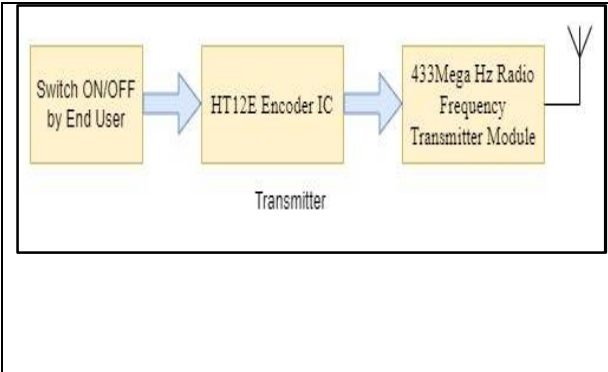


Fig. 1. Block Diagram for Transmitter system of Proposed System

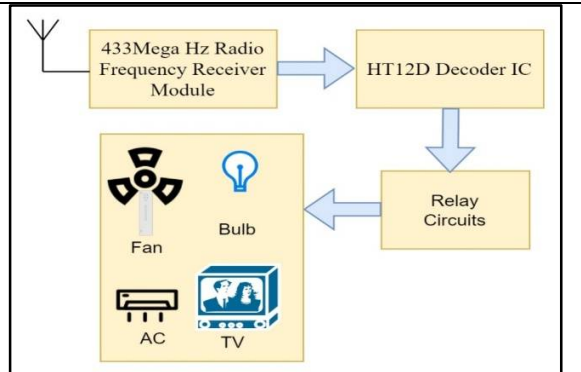


Fig. 2. Block Diagram for Receiver system of Proposed System

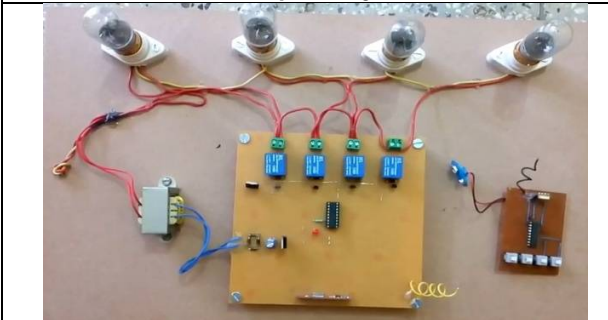


Fig. 3. Remotely Light off using RF Module



Fig. 4. Remotely Light on using RF Module





Insights to MDM2 Functional Domains: Is There Any Way for P53 to Evade Death

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ABSTRACT

Ubiquitin E3 ligases are a well-known gene family that actively regulates the triple enzyme signaling pathway with the other two enzymes E1 (ubiquitin-activating enzyme) and E2 (ubiquitin-conjugating enzyme). The important role of E3 ubiquitin ligase is to catalyze the proteasomal degradation by transferring the ubiquitin-protein to bind to the lysine residues of targeted substrates. There are many types of E3 ubiquitin but they are grouped into four main types according to the presence of specific functional domains. Deregulation in the ubiquitination pathway can lead to a variety of human disorders, particularly cancer. Because of their effective regulation and substrate selectivity during the ubiquitination cascade, E3 ligases are essential for influencing cellular homeostasis. Proliferation, invasion, apoptosis, DNA damage and repair, metabolism, immunity, and many other facets of cancer progression are all affected by E3 ligases. Therefore, E3 ubiquitin ligase could be a promising target in cancer therapy. The primary aim of the current study is to unravel the target binding sites of the RING-type murine double minute 2 (MDM2), which is known to be one of the vital E3 ligases involved in cancer development. Previous reports highlight that the MDM2 protein is over-expressed in several human malignancies. Since MDM2 is a negative regulator of the P53 tumor suppressor, thus the molecular basis of the interaction between MDM2 and P53 was investigated. A detailed analysis of the functional domains of MDM2 by bioinformatic tools and protein-protein docking studies revealed that the initial 150 amino acid residues of the N-terminal region of MDM2 are critical for interaction with P53 whereas the removal of the C-terminal region did not affect the interaction between the two proteins. Also, the deletion mutants of MDM2 where the zinc finger domains (241-480) were systematically removed did not alter the MDM2-P53 interaction. Due to both its oncogenic potential and negative



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regulation of P53, MDM2 is thought to be a striking and meaningful drug target for cancer therapy. Therefore, our preliminary studies may lead to the development of various strategies to combat cancer by blocking specific sites of MDM2, resulting in the evasion of P53 from proteasomal degradation.

Keywords: Ubiquitination, an E3 ubiquitin ligase, ubiquitin-proteasomal degradation, MDM2

INTRODUCTION

The MDM2-P53 link has been a hot issue in the study and development of MDM2 inhibitors for cancer treatment. The tumor suppressor protein P53 is a potent anti-proliferative and pro-apoptotic protein that can damage healthy cells [1]. The number of cellular P53 in non-stressed cells must be kept under control. MDM2 has long been recognized as having a crucial function to play in this control. MDM2 and P53 work together to form a complicated autoregulatory mechanism. In a feedback loop, the two proteins regulate each other's cellular levels [1,2]. P53 controls mdm2 gene production by interacting with its promoter (P1 promoter) [8, 9,10]. MDM2 binds to and inactivates P53 when its levels grow by directly blocking the P53 trans-activational region and directing the P53 protein towards ubiquitin-dependent proteasomal degradation [12, 15]. MDM2 and P53 were discovered to be linked via their N-terminal domains [4]. According to Poyurovsky et colleagues [5], the MDM2-P53 connection is diminished when the P53 C terminus is removed, altered, or acetylated. They demonstrated that a peptide fragment from the P53 C terminus directly binds the MDM2 N terminus in vitro utilizing a variety of approaches, providing a new interface for MDM2-P53 interaction [6]. Because MDM2's binding site largely overlaps with P53's transactivational domain, it significantly suppresses P53 transcriptional activity [7]. The mdm2 gene is embryonic lethal in mice; however, mdm2/ animals may be successfully rescued by concurrently deleting the TP53 gene, which encodes P53 [8]. Even though MDM2 has been identified as the primary regulator of P53 stability and activity, new data suggests that MDM2 is not the only protein involved in P53 control. PIRH2 (P53-induced protein with RINGH2 domain that promotes P53 ubiquitination and destruction independent of MDM2), COP1 (constitutively photomorphogenic 1), and ARF-BP1 (ARF-binding protein 1) have all been shown to bind P53 and function as P53 ubiquitin ligases. There is presently no evidence that any of these P53 ubiquitin ligases can replace MDM2 in the regulation of P53 stability, which is consistent with the embryonic mortality of mdm2 mutant animals [9,10,11].

Ubiquitin is added to proteins as a precursor tag for protein breakdown. Proteolysis occurs primarily through two main pathways firstly autophagy and secondly ubiquitin-proteasome system "UPS" [14]. Both of which are required for the maintenance of the cell. Autophagy is an important adaptive mechanism in response to various cellular stresses through lysosome-mediated degradation of abnormal or excessive cellular proteins [15]. UPS is a flux reaction and an important way to degrade short-lived, folded, and damaged proteins [16]. As shown, UPS can regulate the breakdown of more than 80% of intracellular proteins and its dysregulation has been revealed in most cancer markers [17]. Importantly, E3 couplings are an important part of the UPS and can regulate the enzyme chain's final step, including ubiquitin-activating enzymes (E1) and ubiquitin-conjugating enzymes (E2) [18]. E3 ligases are the main precursors which help the ubiquitin to attach with lysine, serine, threonine, or cysteine moieties to specific substrates. In the ubiquitylation process, one ubiquitin or ubiquitin-like protein attaches to cellular proteins which have an important role in the fate of the protein [19]. The main role of proteasomes is to degrade rapidly those proteins that are either defective or scheduled to be killed. So, they have to choose them properly by the cell markers known as ubiquitin (Ub) [18]. The oncogene CDC4 promotes a faulty surrounding response, which is required for the regulation of cyclic-independent kinases [19]. Each of the histones can undergo enzymatic modification by methylation, acetylation, ADP-ribosylation, phosphorylation, glycosylation, sumoylation, or ubiquitination. Such changes affect the net charge, conformation, and other properties of histones, as well as the structural and functional properties of the chromatin, and they play a role in transcriptional regulation [20,21]. Therefore, the ubiquitin-proteasome degradation process is an important mechanism for controlling protein expression levels. Ubiquitination has also great effects on cell localization, protein interaction, and protein stability [22]. The current study emphasizes the importance of MDM2 and P53 in maintaining cellular homeostasis and thus aligns with one of the objectives on



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United Nations formulated Sustainable Development Goals (SDGs); SDG3 which ensures healthy lives and promotes well-being for all at all stages.

METHODOLOGY

Determination of protein sequences and putative protein partners

UniProt is a publicly available database of protein sequence and functional information, with many entries coming from genome sequencing efforts. It offers a wealth of information gleaned from the scientific literature regarding the biological function of proteins. It is managed by the UniProt Consortium, which is made up of numerous European bioinformatics organizations and a foundation based in Washington, DC. By using UniProt, the function, taxonomy, subcellular localization, disease/phenotypes, PTM/processing, expression, interaction, structure, family, domains, sequence, and isoforms of MDM2-Human E3 ubiquitin ligase (Q00987) and P53 were determined.

Determination of three-dimensional configurations of proteins

Swiss model is the part of Swiss-ProtKB is used as a structural bioinformatics web server dedicated for homology modeling of 3D protein structure. Homology modeling is currently the most accurate methods to generate reliable 3D protein models and is routinely used in many practical applications. Homology modeling method makes use of experimental protein templates to build models for evolutionary related targets. Three dimensional configurations of proteins of MDM2 and P53 were obtained from Swiss-Prot. It is accessed in the web server <https://swissmodel.expasy.org/>.

Visualization of three dimensional protein structures

The three dimensional structures of native proteins and interaction of proteins were primarily visualized by PyMOL. PyMOL is an open source but proprietary molecular visualization system created by Warren Lyford DeLano. The private software company by DeLano scientific LLC dedicated to creating useful tools that become universally accessible to scientific and educational communities. Currently it is commercialized by Schrodinger,inc.as original software license was a permissive license they were able to remove it, new versions are no longer released under the python license, but under a custom license and some of the source code is no longer to released. PyMOL can produce high quality 3D images of small molecules and biological macromolecules such as proteins. According to original author by 2009, almost a quarter of all published images of 3D protein structures in the scientific literature were made using PyMOL. It is one of the few mostly open source model visualization tools available for use in structural biology. It uses OpenGL Extension wrangler library (GLEW) and free GLUT and can solve poisson Boltzmann equation using adaptive poisson Boltzmann solver. Anyone can either compile an executable from the python licensed source code or pay for a subscription to support service to obtain access to precompile executable.

Protein-protein interactions

The HDock server is a highly integrated suite of homology search, template-based modeling, structure prediction, macromolecular docking, biological information incorporation and job management for robust and fast protein-protein docking. We used for protein-protein docking by using the server <https://hdock.phys.hut.edu.in/>.

RESULTS AND DISCUSSION

Domain organization and putative protein interactors of MDM2

MDM2 is an E3 ubiquitin-protein ligase that mediates ubiquitination of P53/TP53, leading to its degradation by the proteasome. MDM2 inhibits P53/TP53- and p73/TP73-mediated cell cycle arrest and apoptosis by binding its transcriptional activation domain. It contains 491 amino acid residues (Figure 1). Putative protein targets of MDM2 are TP53, TP73, CDKN2A, UBE2D1, DAXX, EP300, USP7, MDM4, RPL5, and RPL11. The 3-dimensional configuration of target proteins: MDM2 and P53 were retrieved from PDB and Swiss-ProtKB (Figure 2-4).



**Smruti Subhadarshinee et al.****The protein-protein Interactions of wild type MDM2, mutants with P53**

The interaction between wild type MDM2-P53 and the interaction between mutant types MDM2- P53 was obtained from H-DOCK. Using the h-dock module, the docking scores for protein-protein interactions were predicted. The wild type and domain mutants of MDM2 were included in this study (Table 1, Figure 5). It was observed that the docking score for the wild type MDM2-P53 was -245.75. The docking score for MDM2 (Δ 1-120)-P53 was -204.64. the docking score for MDM2 (Δ 121-240)-P53 was -280.67. The docking score for MDM2 (Δ 241-360)-P53 was -245.36. the docking score for MDM2 (Δ 361-480)-P53 was -247.98. From the dockings obtained from the h-dock, it is confirmed that the first 120 amino acid sequences of MDM2 play an important role in the interaction between MDM2 and P53. If the first 120 sequences are removed or blocked, then the docking score decreases, and the stability between these two proteins becomes weak. The amino acids between 121 and 240 also have an important role in the MDM2-P53 pathway. If this region is mutated or deleted, then the docking score suddenly increases. From this, it is clear that the 121-240 region has the regulatory property and function as a regulator.

CONCLUSION

The primary aim of the current study is to unravel the target binding sites of the RING-type murine double minute 2 (MDM2), which is known to be one of the vital E3 ligases involved in cancer development so there could be a novel therapeutic inhibitor that could be designed to prevent the interaction between MDM2-P53. A detailed analysis of the functional domains of MDM2 by bioinformatic tools and protein-protein docking studies revealed that the initial 120 amino acid residues of the N-terminal region of MDM2 are critical for interaction with P53 whereas the removal of the C-terminal region did not affect the interaction between the two proteins. Also, the deletion mutants of MDM2 where the zinc finger domains (299-328 and 438-479) were systematically removed did not alter the MDM2-P53 interaction. There is also an important region which is worked as a regulator is 121-240 amino acid residues. This region should be activated during cancer treatment for the efficient restriction of interaction between MDM2 and P53. Due to both its oncogenic potential and negative regulation of P53, MDM2 is thought to be a striking and meaningful drug target for cancer therapy. Therefore, our preliminary studies may lead to the development of various strategies to combat cancer by blocking specific sites of MDM2, resulting in the evasion of P53 from proteasomal degradation. These evidences widens up the possibility of administering potential peptides when the P53 expression is inhibited. Our results paves way forward in improving our understanding on the functional aspects of critical protein factors such as MDM2 and P53.

Statements and Declarations**Competing Interests**

The authors declare that they have no conflict of interest.

Ethical Approval and consent to participate

No ethics approval is required.

Consent to publish

Not applicable.

Human and animal rights

No animals were used in the study.

Availability of data and materials

Not applicable.



**Smruti Subhadarshinee et al.****Credit authorship contribution statement**

All the authors have substantial contribution for the preparation of the manuscript. Gagan Kumar Panigrahi conceived the idea. Data curation and writing: Smruti Subhadarshinee, Rahul Mohanty, Bishnupriya Patalsingh, Annapurna Sahoo and Gagan Kumar Panigrahi. All the authors have read and approved the final manuscript before submission.

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Table 1: Docking score of protein-protein interactions of wild-type and mutants of MDM2 with P53

Sl. No.	Interaction between MDM2 and P53	Docking scores
1	Wild type MDM2-P53	-245.75
2	MDM2 (Δ 1-120)-P53	-204.64
3	MDM2 (Δ 121-240)-P53	-280.67
4	MDM2 (Δ 241-360)-P53	-245.36
5	MDM2 (Δ 361-480)-P53	-247.98

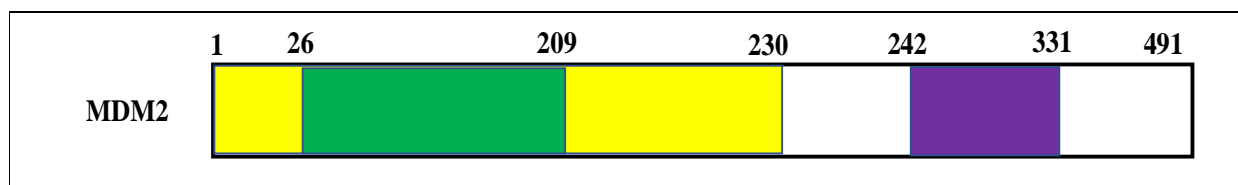


Figure 1: Functional domains of MDM2: 26-209= RING finger domain; 1-230= region 1: sufficient for binding with P53 and inhibiting its G1 arrest and apoptosis functions; 242-331= region 2: contains central acidic region required for interaction with ribosomal protein L5 and a putative C4-type zinc finger.

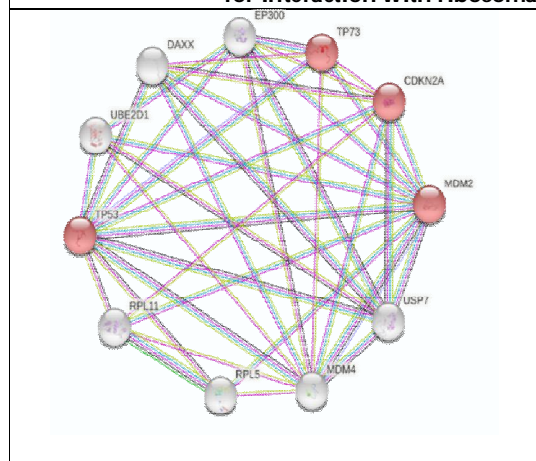


Figure 2: Putative protein interactors of MDM2

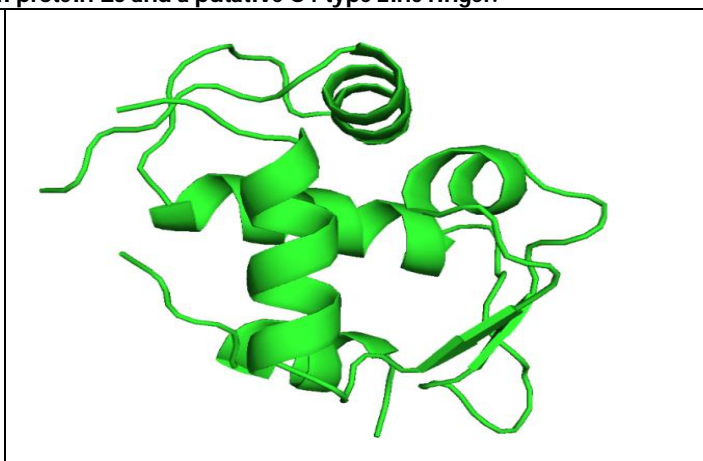


Figure 3: 3-d structure of MDM2





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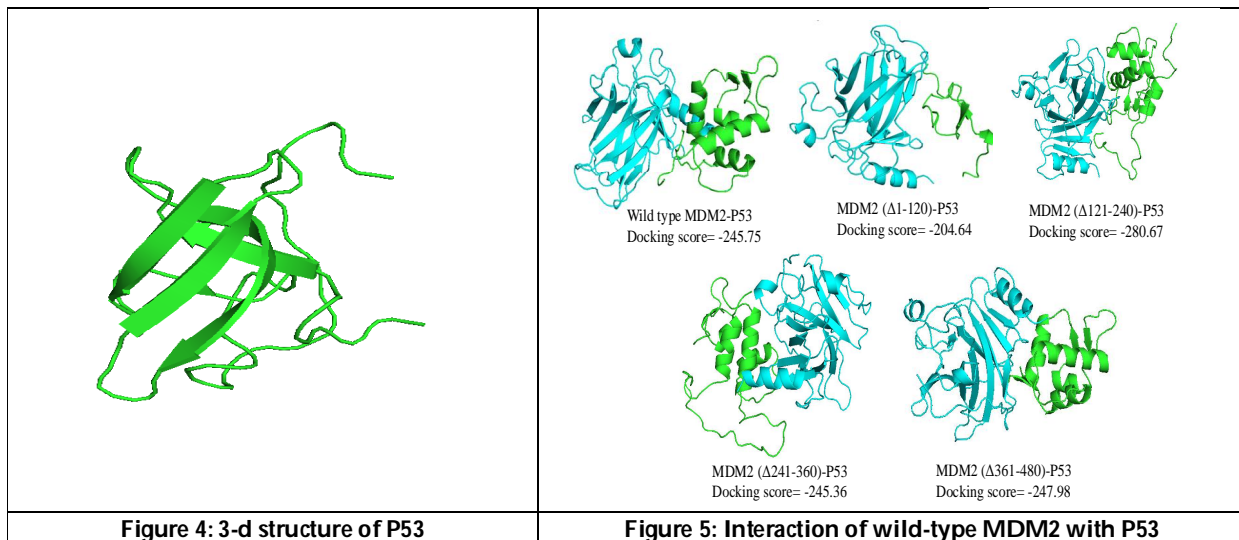


Figure 4: 3-d structure of P53

Figure 5: Interaction of wild-type MDM2 with P53





Alteration in Different Chemical Constituents Present in Orange Juice Due to Addition of Preservative (Vinegar)

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ABSTRACT

Now-a-days, different types of preservatives are added to preserve food items. In order to know the impact of preservative like vinegar on orange juice, a study has been undertaken. This paper aimed to study the elemental content present in freshly prepared and vinegar treated orange juice which contain 100% fruit content without water and any sweeteners. The addition of preservative leads to severe health problem that's why, we have made a comparative study on freshly prepared and vinegar treated orange juice. Oranges were collected, peeled and washed it properly by using distilled water and grounded it to make juice. Two kinds of juices were prepared. One was normal juice and another one was prepared with preservatives, i.e 1:10 ratio of vinegar to juice. The samples were collected and analyzed for its elemental content by using X-Ray fluorescence technique. Due to addition of preservative (vinegar), there is of some element was found and also the concentration is found to be slightly decrease.

Keywords: Food Security, Orange juice, Preservative, XRF, Elemental content

INTRODUCTION

Fruit juice refers to 100% refined juice made from the pulp of fresh fruit. There is no addition of water, sugar, flavorings and sweeteners. Orange juice can be extracted easily by squeezing orange peels. Orange has different varieties- navel orange, blood orange, tangerine, Valencia orange, clementine[1,2]. The orange juice looks like shades of orange to yellow. The red or blood orange have reddish in color [3]. Freshly prepared orange juice had taste very similar to chewing recently peeled orange and had a tangy taste [4]. Orange juice is rich in antioxidants and there is also micronutrients are present such as vitamin C, potassium, and folate [5]. Vitamin C subsistence immune system and effective to fighting against common cold. Folate helps in active fetal growth. Also improved heart health, reduce risk of kidney stones, decrease inflammation [6]. If we drink excess amount of orange juice it may causes digestive problems such as abdominal cramps, diarrhea. Due to its acidic nature, it causes severe heartburns, vomiting, headache, insomnia etc [7]. X-ray Fluorescence (XRF) refers to the emission of characteristic secondary X-



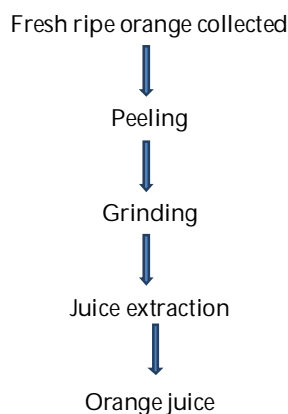
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rays from a material that has been excited by being bombarded with high-energy X-rays. This method is widely used in elemental analysis, chemical analysis in investigation of metals, ceramics, glass etc [8]. It is one of the most widely used methods because of its low cost of sample preparation, relative ease, and stability and use of X-ray spectrometers. One of the best analytical techniques to perform elemental analysis in all kind of samples, i.e. solid, liquid or loose powders [9].

Experimental

Fresh ripe orange was collected and then it was grinded by using grinder. Then the juice was extracted. The juice was then divided into two equal parts. One part was added with vinegar and the other part was normal one. Both the normal juice and vinegar added juice were subjected to XRF analysis to know the elemental present in it.

Flow Chart Of Making Orange Juice



RESULTS AND DISCUSSION

Fruits are excellent source of vitamins, minerals and fiber. It also provides health-boosting antioxidants, including flavonoids. The alteration of different chemical constituents present in banana juice were investigated by X-ray Fluorescence analyser. Table-1 and Fig-1 depicted about elemental content present in orange juice without employing any type of preservative. In a very similar way, Table-2 and Fig-2 represent elemental content present in orange juice with addition of preservative as vinegar. From the present study, we have found that fresh orange juice contains elements like P, S, Cl, K, Ca, Mn, Fe, Sn, as well as H₂O content, whereas after addition of vinegar the preserved juice contain an extra element like Si. The percentage of water is also reduced after adding vinegar to it.

CONCLUSION

XRF analysis gives information about elemental composition present in both freshly prepared orange juice and vinegar added orange juice. All the elements present in orange juice are considered as micronutrients for all plants and animals. So, consumption of orange juice is also considered as healthy diet due to the presence of all essential nutrients. But it cannot be preserved for a longer period. As vinegar is not having any harmful constituents, so addition of vinegar can be recommended to preserve it for longer time period. This research paper reflects the idea about improvement of nutritional value, which is coming under SDG-2.





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Table-1: Elemental contents present in freshly prepared orange juice

Elements Name	Unit	Concentration
Si	ppm	473.5
p	ppm	621.1
S	ppm	289.3
Cl	ppm	371.8
K	ppm	552.7
Ca	ppm	302.8
Fe	ppm	16.2
Sn	ppm	57.6
H ₂ O	%	99.731

Table-2: Elemental contents present in orange juice after adding preservative (vinegar)

Elements Name	Unit	Concentration
P	ppm	552.9
S	ppm	319.8
Cl	ppm	300.4
K	ppm	494.9
Ca	ppm	295.1
Fe	ppm	15.5
Sn	ppm	41.3
H ₂ O	%	99.797





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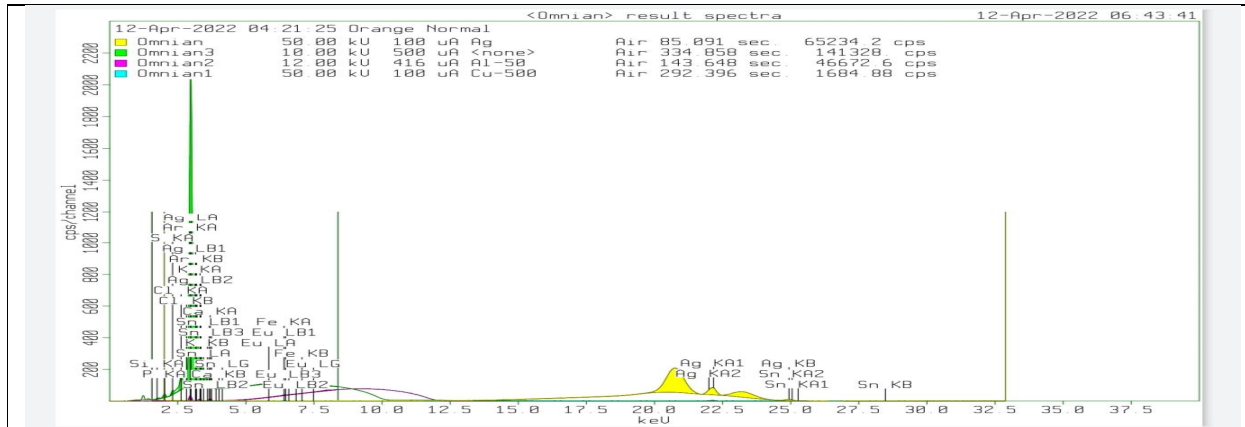


Figure 1: X-Ray Fluorescence of fresh Orange juice

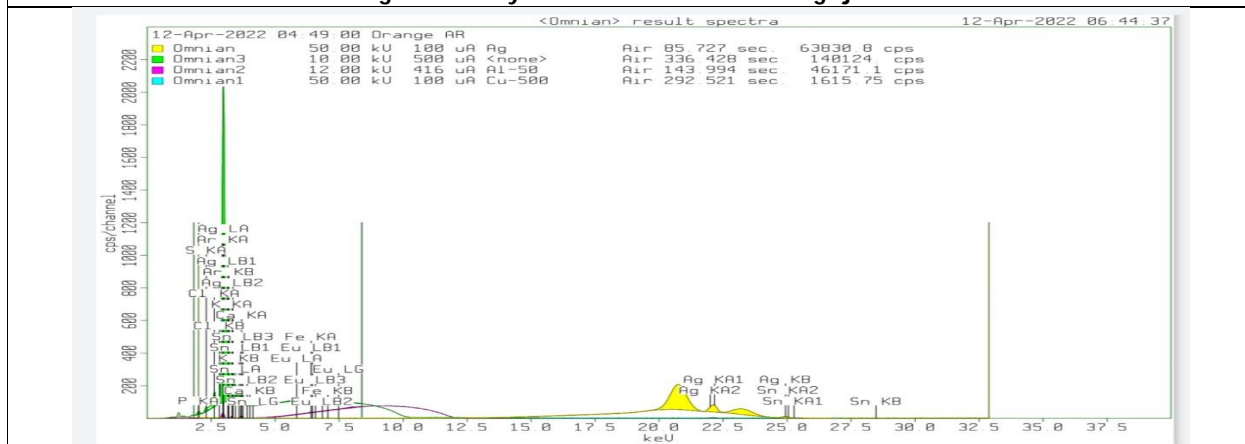


Figure 2: X-Ray Fluorescence of orange juice orange juice after adding preservative (vinegar)

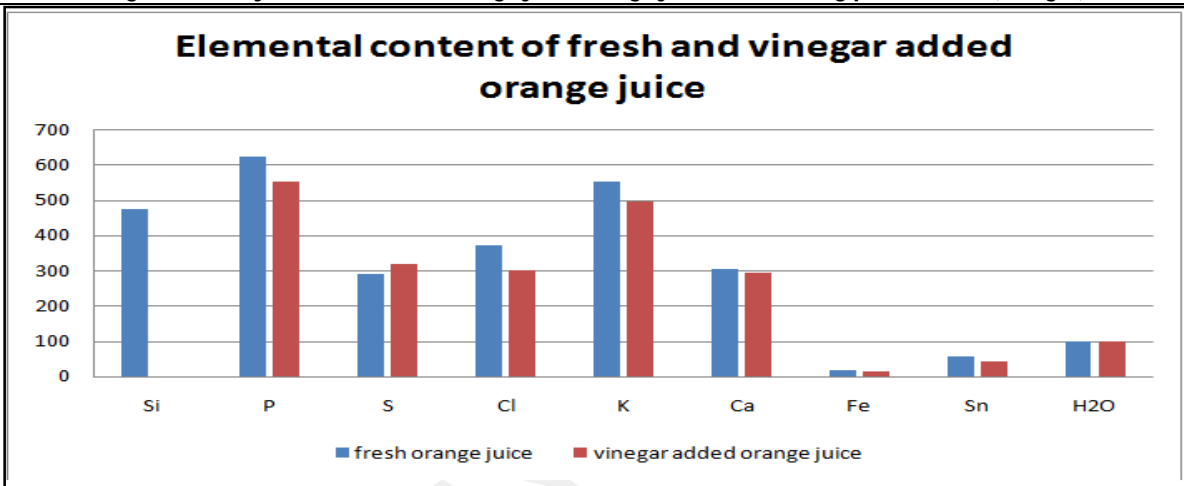


Figure 3: Graph of elemental content of fresh and vinegar added orange juice





Length Biased Quasi Shanker Distribution with Time Dependent Covariates and Estimation of the Parameters

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ABSTRACT

In this study, we present the length biased quasi Shanker distribution, which is a length biased form of the quasi Shanker distribution. A detailed case of a weighted distribution is the length biased distribution. Various statistical properties like order statistics, moment generating function, Entropies and likelihood ratio test are addressed in the proposed distribution. The suggested distribution's parameters are also estimated by using the maximum likelihood estimation method. Finally, the newly proposed distribution is presented using two different data sets, demonstrating its utility and superiority.

Keywords: Weighted distribution, Maximum likelihood estimation, Quasi Shanker distribution, Order statistics, Reliability analysis and Time Dependent covariates.

INTRODUCTION

When an investigator proceedings of an report by overwhelming of a stochastic regression model, weighted distributions are useful. Weighted distributions are useful in distribution theory because they deliver a fresh accepting of existing standard probability distributions and approaches for extending current standard probability distributions used for modelling lifetime data due to the outline of an additional parameter in the model, which permits the model to become more flexible. In some situations appearing in numerous practical disciplines for example medical sciences, engineering, and so on, weighted probability models performance a significant role. These





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distributions emerge when observations from a sample are gathered with unequal probability, and they contribute a unified method for problems encompassing non-experimental, non-replicated, and non-random observations. When the recorded statement from an event cannot random sample from the actual distribution, weighted distributions are compulsory. This occurs when the original observation is spoiled and an event occurs that is not noticeable. The resulting values are decrease as outcome of these improper scenarios, and units or events do not take the equal probability of occurring as if they followed the exact distribution. Weighted distributions are applied in biomedicine, ecology, reliability and branching processes, and many more fields. Modeling and interpreting lifetime data is critical in many practical fields, including engineering, medicine, behavioural science, finance, insurance, and others. A continuous distributions, such as the weibull, Gamma, lindley, exponential, lognormal, and lindley, can be used to model this type of lifetime data. If the initial observation X has a pdf $f(x)$, then in the event of any sampling bias, a weighted function, say $w(x)$, which is a random variable function, will be used to simulate the scenario. Fisher (1934) planned the concept of weighted distributions to represent ascertainment bias. While standard distributions were not suited to record these observations with the same probabilities, Rao (1965) established this idea in a unified approach while modelling statistical data. As a outcome, in such cases, weighted models were developing to capture the data overwhelming a weighted function. When the weight function considers solely the length of the elements, The weighted distribution become a length biased distribution. Cox and Zelen (1969) were the main to establish the concept of length biased sampling (1974).

The resulting distribution is called size-biased while the sampling process picks units with a probability proportional to certain measure of unit magnitude. There are a number of worthy sources that describe weighted distributions in depth. The many weighted probability models have been inspected and considered by some authors, who have highlighted their applications in various domains. The length biased weighted form of Lomax distribution with features and applications was exposed by Afaq et al. (2016). The characterization and estimation of length biased weighted generalised uniform distributions were considered by Rather and Subramanian (2018). The characterization of the length biased Nakagami distribution were considered by Mudasar and Ahmad (2018). The length biased weighted Er-lang distribution was discovered by Reyad et al. (2017). Hassan et al. (2019, 2018a, 2018b) accessible three weighted probability models with applications in engineering and medical sciences data. With the usage of life time data, Rather and Ozel (2020) recognised the weighted power Lindley distribution. The length biased Aradhana distribution with applications was proposed by Rajagopalan, Ganaie, and Rather (2019). Ganaie and Rajagopalan (2021) have discussed the length biased two parameter Pranav distribution with real-world applications, which they establish to be flexible and reliable than the classical distribution. In this study, we further examine the survivor data addressed the values of time-dependent covariates in order to examine the relationship among partial logistic regression. We may suggest a work on blood cancer data and model for ungrouped data with time-dependent covariates by extending the partial logistic regression model for clustered data based on partial likelihood.

We presented the length biased version of quasi Shanker distribution is known as the length biased quasi Shanker distribution, in this paper. The quasi Shanker distribution is a new two-parameter probability distribution expressed by Shanker (2017), who discussed its several structural properties, such as moments and moment-based measures, stochastic ordering, hazard rate function, stress-strength reliability, and Bonferroni and Lorenz curves. The two-parameter quasi-Shanker distribution is a subgroup of the one-parameter Shanker distribution. The proposed two-parameter quasi Shanker distribution excels the one-parameter Lindley and exponential distributions in terms of data processing versatility.

Length Biased Quasi Shanker (LBQS) Distribution

The quasi Shanker distribution's probability density function is defined by

$$f(x; \theta, \alpha) = \frac{\theta^3}{\theta^3 + \theta + 2\alpha} (\theta + x + \alpha x^2) e^{-\theta x}; \quad x > 0, \theta > 0, \theta^3 + \theta + 2\alpha > 0 \quad (1)$$

and the cumulative distribution function of the quasi Shanker distribution is provided by





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$$F(x; \theta, \alpha) = 1 - \left(1 + \frac{\alpha\theta^2 x^2 + \theta x(\theta + 2\alpha)}{\theta^3 + \theta + 2\alpha} \right) e^{-\theta x}; x > 0, \theta > 0 \tag{2}$$

Suppose X is a non-negative random variable with probability density function $f(x)$. Let $w(x)$ be the non-negative weight function then the probability density function of the weighted random variable X_w is defined by

$$f_w(x) = \frac{w(x)f(x)}{E(w(x))}, x > 0.$$

Where $w(x)$ be the non - negative weight function and $E(w(x)) = \int w(x)f(x)dx < \infty$.

In this paper, we have to obtain the length biased version of quasi Shanker distribution called as length biased quasi Shanker distribution. We should note that we have different choices of weighted function $w(x)$ gives different weighted models. Consequently, when $c=1$, then $w(x) = x$, the resulting distribution is called length biased distribution and the probability density function of length biased quasi Shanker distribution is given by

$$f_l(x; \theta, \alpha) = \frac{xf(x; \theta, \alpha)}{E(x)}, x > 0 \tag{3}$$

Where $E(x) = \int_0^\infty xf(x; \theta, \alpha)dx$

$$E(x) = \frac{\theta^3 + 2\theta + 6\alpha}{\theta(\theta^3 + \theta + 2\alpha)} \tag{4}$$

We can get the pdf of a length biased quasi Shanker distribution by substituting equations (1) and (4) in equation (3) as

$$f_l(x; \theta, \alpha) = \frac{x\theta^4(\theta + x + \alpha x^2)e^{-\theta x}}{(\theta^3 + 2\theta + 6\alpha)} \tag{5}$$

and the length biased quasi Shanker distribution's cumulative distribution function is

$$F_l(x; \theta, \alpha) = \int_0^x f_l(x; \theta, \alpha)dx$$

$$F_l(x; \theta, \alpha) = \int_0^x \frac{x\theta^4(\theta + x + \alpha x^2)e^{-\theta x}}{(\theta^3 + 2\theta + 6\alpha)} dx$$

$$F_l(x; \theta, \alpha) = \frac{1}{(\theta^3 + 2\theta + 6\alpha)} \int_0^x x\theta^4(\theta + x + \alpha x^2)e^{-\theta x} dx$$

Put $\theta x = t, \theta dx = dt, As x \rightarrow 0, t \rightarrow 0$ and $x \rightarrow x, t \rightarrow \theta x$

We get the cumulative distribution function of a length biased quasi Shanker distribution after simplification as

$$F_l(x; \theta, \alpha) = \frac{1}{(\theta^3 + 2\theta + 6\alpha)} \left(\theta^3 \gamma(2, \theta x) + \theta \gamma(3, \theta x) + \alpha \gamma(4, \theta x) \right) \tag{6}$$





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Reliability Analysis

The proposed length biased quasi Shanker distribution's reliability function, hazard function, and reverse hazard rate function have all been computed in this section.

Reliability function

The reliability function or the survival function of length biased quasi Shanker distribution is calculated as

$$R(x) = 1 - F_l(x; \theta, \alpha)$$

$$R(x) = 1 - \frac{1}{(\theta^3 + 2\theta + 6\alpha)} \left(\theta^3 \gamma(2, \theta x) + \theta \gamma(3, \theta x) + \alpha \gamma(4, \theta x) \right)$$

Hazard function

The hazard function is also known as hazard rate defined as the instantaneous failure rate or force of mortality and is given by

$$h(x) = \frac{f_l(x; \theta, \alpha)}{R(x)}$$

$$h(x) = \frac{x\theta^4(\theta + x + \alpha x^2)e^{-\theta x}}{(\theta^3 + 2\theta + 6\alpha) - (\theta^3 \gamma(2, \theta x) + \theta \gamma(3, \theta x) + \alpha \gamma(4, \theta x))}$$

Reverse hazard function

The reverse hazard function of length biased quasi Shanker distribution is given by

$$h_r(x) = \frac{f_l(x; \theta, \alpha)}{F_l(x; \theta, \alpha)}$$

$$h_r(x) = \frac{x\theta^4(\theta + x + \alpha x^2)e^{-\theta x}}{(\theta^3 \gamma(2, \theta x) + \theta \gamma(3, \theta x) + \alpha \gamma(4, \theta x))}$$

Survival model with time dependent covariates.

If t is a continuous lifetime variable, and covariates are a vector of time-fixed covariates. According to Klein (2003) and Lawless (2003), the Cox's proportional hazards model says that the hazard during time t is the combination of two elements (Klein, 2003).

$$h(t; Y) = h_0(t) \exp \left[\sum_{i=1}^l c_i y_i \right]$$

where c is a coefficients vector. The proportional hazards procedure assumes that the baseline hazard is a function that excludes the numbers of covariates x measured at the start of a period to estimate short-term survivability. The survival function of each individual in the analysis of data having time-dependent variables are dependent on time t and the baseline hazard function. This means survival function cannot be expressed as a power of a baseline survivor function. Kalbfleish and Prentice (2002), Marubini and Valsecchi (1995).





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Moments and Associated Measures

In this section, The different statistical features of the length biased quasi Shanker distribution will be discussed.

Moments

The r^{th} order moment $E(X^r)$ of a length biased quasi Shanker distribution is provided as follows: Let X be a random variable of a length biased quasi Shanker distribution with parameters θ and α . then

$$E(X^r) = \mu_r' = \int_0^\infty x^r f_l(x; \theta, \alpha) dx$$

$$E(X^r) = \mu_r' = \int_0^\infty x^r \frac{x\theta^4 (\theta + x + \alpha x^2) e^{-\theta x}}{(\theta^3 + 2\theta + 6\alpha)} dx$$

$$E(X^r) = \mu_r' = \frac{\theta^4}{(\theta^3 + 2\theta + 6\alpha)} \int_0^\infty x^{r+1} (\theta + x + \alpha x^2) e^{-\theta x} dx$$

$$E(X^r) = \mu_r' = \frac{\theta^4}{(\theta^3 + 2\theta + 6\alpha)} \left(\theta \int_0^\infty x^{(r+2)-1} e^{-\theta x} dx + \int_0^\infty x^{(r+3)-1} e^{-\theta x} dx + \alpha \int_0^\infty x^{(r+4)-1} e^{-\theta x} dx \right)$$

After simplification, we obtain

$$E(X^r) = \mu_r' = \frac{\theta \Gamma(r+2) + \theta^{r+2} \Gamma(r+3) + \alpha \theta^{r+1} \Gamma(r+4)}{\theta^{2r+1} (\theta^3 + 2\theta + 6\alpha)} \tag{7}$$

From equation (7) the first four moments of a length biased weighted quasi Shanker distribution can be obtained when $r = 1, 2, 3$ and 4 .

$$E(X) = \mu_1' = \frac{2\theta + 6\theta^3 + 24\alpha\theta^2}{\theta^3 (\theta^3 + 2\theta + 6\alpha)}$$

$$E(X^2) = \mu_2' = \frac{6\theta + 24\theta^4 + 120\alpha\theta^3}{\theta^5 (\theta^3 + 2\theta + 6\alpha)}$$

$$E(X^3) = \mu_3' = \frac{24\theta + 120\theta^5 + 720\alpha\theta^4}{\theta^7 (\theta^3 + 2\theta + 6\alpha)}$$

$$E(X^4) = \mu_4' = \frac{120\theta + 720\theta^6 + 5040\alpha\theta^5}{\theta^9 (\theta^3 + 2\theta + 6\alpha)}$$

$$\text{Variance}(\mu_2) = \frac{6\theta + 24\theta^4 + 120\alpha\theta^3}{\theta^5 (\theta^3 + 2\theta + 6\alpha)} - \left(\frac{2\theta + 6\theta^3 + 24\alpha\theta^2}{\theta^3 (\theta^3 + 2\theta + 6\alpha)} \right)^2$$

$$S.D(\sigma) = \sqrt{\left(\frac{6\theta + 24\theta^4 + 120\alpha\theta^3}{\theta^5 (\theta^3 + 2\theta + 6\alpha)} - \frac{(2\theta + 6\theta^3 + 24\alpha\theta^2)^2}{(\theta^3 (\theta^3 + 2\theta + 6\alpha))^2} \right)}$$





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Harmonic mean

The statistical average is the harmonic mean, the number of observations is divided by the reciprocal of each number in the series to arrive at this figure. As a result, this same harmonic mean is the reciprocal of the reciprocal's arithmetic mean. The harmonic mean of proposed distribution is given as

$$\begin{aligned}
 H.M &= E\left(\frac{1}{x}\right) = \int_0^{\infty} \frac{1}{x} f_I(x; \theta, \alpha) dx \\
 &= \int_0^{\infty} \frac{\theta^4 (\theta + x + \alpha x^2) e^{-\theta x}}{(\theta^3 + 2\theta + 6\alpha)} dx \\
 &= \frac{\theta^4}{(\theta^3 + 2\theta + 6\alpha)} \left(\theta \int_0^{\infty} e^{-\theta x} dx + \int_0^{\infty} x e^{-\theta x} dx + \alpha \int_0^{\infty} x^2 e^{-\theta x} dx \right) \\
 &= \frac{\theta^4}{(\theta^3 + 2\theta + 6\alpha)} \left(\theta \int_0^{\infty} e^{-\theta x} x^{(2-2)} dx + \int_0^{\infty} e^{-\theta x} x^{(2-1)} dx + \alpha \int_0^{\infty} e^{-\theta x} x^{(3-1)} dx \right)
 \end{aligned}$$

After simplification, we obtain

$$H.M = \frac{\theta^4}{(\theta^3 + 2\theta + 6\alpha)} (\theta\gamma(2, \theta x) + \gamma(2, \theta x) + \alpha\gamma(3, \theta x))$$

Moment Generating Function

In this sub section, we derive the moment generating function and characteristic function of length biased weighted quasi Shanker distribution. To begin, we'll look at the well-known definition of the moment generating function, which is as follows:

$$\begin{aligned}
 M_X(t) &= E(e^{tx}) = \int_0^{\infty} e^{tx} f_I(x; \theta, \alpha) dx \\
 &= \int_0^{\infty} \left(1 + tx + \frac{(tx)^2}{2!} + \dots \right) f_I(x; \theta, \alpha) dx \\
 &= \int_0^{\infty} \sum_{j=0}^{\infty} \frac{t^j}{j!} x^j f_I(x; \theta, \alpha) dx \\
 &= \sum_{j=0}^{\infty} \frac{t^j}{j!} \mu_j' \\
 &= \sum_{j=0}^{\infty} \frac{t^j}{j!} \left(\frac{\theta\Gamma(j+2) + \theta^{j+2}\Gamma(j+3) + \alpha\theta^{j+1}\Gamma(j+4)}{\theta^{2j+1}(\theta^3 + 2\theta + 6\alpha)} \right) \\
 M_X(t) &= \frac{1}{\theta(\theta^3 + 2\theta + 6\alpha)} \sum_{j=0}^{\infty} \frac{t^j}{j! \theta^{2j}} (\theta\Gamma(j+2) + \theta^{j+2}\Gamma(j+3) + \alpha\theta^{j+1}\Gamma(j+4))
 \end{aligned}$$





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Characteristic function

The characteristic function of each and every real-valued random variable entirely describes the probability distribution of a random variable in probability theory and statistics. Even though the moment generating function doesn't really exist, the characteristic function does. The characteristic function of length biased quasi Shanker

$$\varphi_X(t) = M_X(it)$$

distribution is provided by

$$M_X(it) = \frac{1}{\theta(\theta^3 + 2\theta + 6\alpha)} \sum_{j=0}^{\infty} \frac{(it)^j}{j! \theta^{2j}} \left(\theta \Gamma(j+2) + \theta^{j+2} \Gamma(j+3) + \alpha \theta^{j+1} \Gamma(j+4) \right)$$

Order Statistics

Let $X_{(1)}, X_{(2)}, \dots, X_{(n)}$ represents of the order statistics of a random sample X_1, X_2, \dots, X_n from a continuous distribution with the cumulative distribution function $F_X(x)$ and probability density function $f_X(x)$, then the probability density function of r^{th} order statistics $X_{(r)}$ is provided by

$$f_{X(r)}(x) = \frac{n!}{(r-1)!(n-r)!} f_X(x) (F_X(x))^{r-1} (1-F_X(x))^{n-r}, \quad r = 1, 2, 3, \dots, n \tag{8}$$

The probability density function for r^{th} order statistics of a length biased quasi Shanker distribution was obtained by using equations (5) and (6) in (8).

$$f_{X(r)}(x) = \frac{n!}{(r-1)!(n-r)!} \left(\frac{x\theta^4(\theta+x+\alpha x^2)e^{-\theta x}}{(\theta^3+2\theta+6\alpha)} \right)^{r-1} \left(\frac{1}{(\theta^3+2\theta+6\alpha)} (\theta^3\gamma(2,\theta x) + \theta\gamma(3,\theta x) + \alpha\gamma(4,\theta x)) \right)^{r-1} \\ \times \left(1 - \frac{1}{(\theta^3+2\theta+6\alpha)} (\theta^3\gamma(2,\theta x) + \theta\gamma(3,\theta x) + \alpha\gamma(4,\theta x)) \right)^{n-r}$$

As a result, the probability density function of a length biased quasi Shanker distribution as first order statistics $X(1)$ as determined by

$$f_{X(1)}(x) = \frac{nx\theta^4(\theta+x+\alpha x^2)e^{-\theta x}}{(\theta^3+2\theta+6\alpha)} \left(1 - \frac{1}{(\theta^3+2\theta+6\alpha)} (\theta^3\gamma(2,\theta x) + \theta\gamma(3,\theta x) + \alpha\gamma(4,\theta x)) \right)^{n-1}$$

The probability density function of length biased quasi Shanker distribution n^{th} order statistics $X(n)$ is provided by

$$f_{X(n)}(x) = \frac{nx\theta^4(\theta+x+\alpha x^2)e^{-\theta x}}{(\theta^3+2\theta+6\alpha)} \left(\frac{1}{(\theta^3+2\theta+6\alpha)} (\theta^3\gamma(2,\theta x) + \theta\gamma(3,\theta x) + \alpha\gamma(4,\theta x)) \right)^{n-1}$$





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Likelihood Ratio Test

Let X_1, X_2, \dots, X_n be a random sample of size n and the quasi Shanker distribution or length biased quasi Shanker distribution. We assume the hypothesis for testing.

$$H_0 : f(x) = f(x; \theta, \alpha) \quad \text{against} \quad H_1 : f(x) = f_l(x; \theta, \alpha)$$

The following statistical test is used to determine whether the random sample of size n derived from the quasi Shanker distribution or the length biased quasi Shanker distribution.

$$\Delta = \frac{L_1}{L_0} = \frac{\prod_{i=1}^n f_l(x_i; \theta, \alpha)}{\prod_{i=1}^n f(x_i; \theta, \alpha)}$$

$$\Delta = \frac{L_1}{L_0} = \frac{\prod_{i=1}^n \left(\frac{x_i \theta^4 (\theta^3 + \theta + 2\alpha)}{\theta^3 (\theta^3 + 2\theta + 6\alpha)} \right)}{\prod_{i=1}^n \left(\frac{\theta^4 (\theta^3 + \theta + 2\alpha)}{\theta^3 (\theta^3 + 2\theta + 6\alpha)} \right)}$$

$$\Delta = \frac{L_1}{L_0} = \left(\frac{\theta^4 (\theta^3 + \theta + 2\alpha)}{\theta^3 (\theta^3 + 2\theta + 6\alpha)} \right)^n \prod_{i=1}^n x_i$$

If the null hypothesis is true, we should reject it.

$$\Delta = \left(\frac{\theta^4 (\theta^3 + \theta + 2\alpha)}{\theta^3 (\theta^3 + 2\theta + 6\alpha)} \right)^n \prod_{i=1}^n x_i > k$$

In the same way, we reject H_0

$$\Delta^* = \prod_{i=1}^n x_i > k \left(\frac{\theta^3 (\theta^3 + 2\theta + 6\alpha)}{\theta^4 (\theta^3 + \theta + 2\alpha)} \right)^n$$

$$\Delta^* = \prod_{i=1}^n x_i > k^*, \text{ Where } k^* = k \left(\frac{\theta^3 (\theta^3 + 2\theta + 6\alpha)}{\theta^4 (\theta^3 + \theta + 2\alpha)} \right)^n$$

Accordingly a large sample of size n , $2 \log \Delta$ is distributed like a one-degree-of-freedom chi-square distribution, and the p -value is calculated from the chi-square distribution. When the probability value is provided by,

$p(\Delta^* > \lambda^*)$, Where $\lambda^* = \prod_{i=1}^n x_i$ is less than a specified level of significance and $\prod_{i=1}^n x_i$ is the observed value of the statistic Δ^* .

Bonferroni and Lorenz Curves

The Bonferroni and Lorenz curves are used in a variety of domains, including reliability, medicine, insurance, and demography, to investigate the distribution of income or wealth, or income and poverty. One of the most prominent





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indications of how wealth is distributed is the Bonferroni and Lorenz curves. The bonferroni and Lorenz curves are calculated as follows:

$$B(p) = \frac{1}{p\mu_1'} \int_0^q xf_I(x; \theta, \alpha) dx$$

and $L(p) = pB(p) = \frac{1}{\mu_1'} \int_0^q xf_I(x; \theta, \alpha) dx$

Where $\mu_1' = E(X) = \frac{(2\theta + 6\theta^3 + 24\alpha\theta^2)}{\theta^3(\theta^3 + 2\theta + 6\alpha)}$ and $q = F^{-1}(p)$

$$B(p) = \frac{\theta^3(\theta^3 + 2\theta + 6\alpha)}{p(2\theta + 6\theta^3 + 24\alpha\theta^2)} \int_0^q \frac{x^2\theta^4(\theta + x + \alpha x^2)e^{-\theta x}}{(\theta^3 + 2\theta + 6\alpha)} dx$$

$$B(p) = \frac{\theta^7}{p(2\theta + 6\theta^3 + 24\alpha\theta^2)} \int_0^q x^2(\theta + x + \alpha x^2)e^{-\theta x} dx$$

$$B(p) = \frac{\theta^7}{p(2\theta + 6\theta^3 + 24\alpha\theta^2)} \left(\theta \int_0^q e^{-\theta x} x^{(3-1)} dx + \int_0^q e^{-\theta x} x^{(4-1)} dx + \alpha \int_0^q e^{-\theta x} x^{(5-1)} dx \right)$$

After simplification, we obtain

$$B(p) = \frac{\theta^7}{p(2\theta + 6\theta^3 + 24\alpha\theta^2)} (\theta\gamma(3, \theta q) + \gamma(4, \theta q) + \alpha\gamma(5, \theta q))$$

$$L(p) = pB(p) = \frac{\theta^7}{(2\theta + 6\theta^3 + 24\alpha\theta^2)} (\theta\gamma(3, \theta q) + \gamma(4, \theta q) + \alpha\gamma(5, \theta q))$$

Entropies

Entropy is a mathematical concept that expresses the intuitive sense of which processes are impossible, particularly if they do not contradict the fundamental law. Entropies are essential in a variety of fields, including probability and statistics, communication theory, physics and economics. Entropies are a measure of a system's diversity, uncertainty, or randomness. The entropy of a random variable X is a measurement of the uncertainty's variation.

Renyi Entropy

In ecology and statistics, the Renyi entropy is used as a measure of diversity. The Renyi entropy is also useful in quantum information since it may be used to calculate entanglement. Renyi entropy is defined as follows for a given probability distribution:

$$e(\beta) = \frac{1}{1 - \beta} \log \left(\int f_I^\beta(x) dx \right)$$

Where, $\beta > 0$ and $\beta \neq 1$





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$$e(\beta) = \frac{1}{1-\beta} \log \int_0^\infty \left(\frac{x\theta^4 (\theta + x + \alpha x^2) e^{-\theta x}}{(\theta^3 + 2\theta + 6\alpha)} \right)^\beta dx$$

$$e(\beta) = \frac{1}{1-\beta} \log \left(\left(\frac{\theta^4}{(\theta^3 + 2\theta + 6\alpha)} \right)^\beta \int_0^\infty x^\beta e^{-\theta\beta x} (\theta + x + \alpha x^2)^\beta dx \right)$$

$$e(\beta) = \frac{1}{1-\beta} \log \left(\left(\frac{\theta^4}{(\theta^3 + 2\theta + 6\alpha)} \right)^\beta (\theta + x + \alpha x^2)^\beta \int_0^\infty e^{-\theta\beta x} x^{(\beta+1)-1} dx \right)$$

$$e(\beta) = \frac{1}{1-\beta} \log \left(\left(\frac{\theta^4}{(\theta^3 + 2\theta + 6\alpha)} \right)^\beta (\theta + x + \alpha x^2)^\beta \frac{\Gamma(\beta+1)}{(\theta\beta)^{\beta+1}} \right)$$

Tsallis Entropy

Tsallis introduced an entropic expression through a index q in 1988, subsequent in non-extensive data. The non-extensive statistical mechanics is based on Tsallis entropy. Tsallis's generalisation of Boltzmann-Gibbs (B.G) statistical properties have attracted a lot of attention.

$$S_\lambda = \frac{1}{\lambda-1} \left(1 - \int_0^\infty f_I^\lambda(x) dx \right)$$

$$S_\lambda = \frac{1}{\lambda-1} \left(1 - \int_0^\infty \left(\frac{x\theta^4 (\theta + x + \alpha x^2) e^{-\theta x}}{(\theta^3 + 2\theta + 6\alpha)} \right)^\lambda dx \right)$$

$$S_\lambda = \frac{1}{\lambda-1} \left(1 - \left(\frac{\theta^4}{(\theta^3 + 2\theta + 6\alpha)} \right)^\lambda \int_0^\infty x^\lambda e^{-\lambda\theta x} (\theta + x + \alpha x^2)^\lambda dx \right)$$

$$S_\lambda = \frac{1}{\lambda-1} \left(1 - \left(\frac{\theta^4}{(\theta^3 + 2\theta + 6\alpha)} \right)^\lambda (\theta + x + \alpha x^2)^\lambda \int_0^\infty e^{-\lambda\theta x} x^{(\lambda+1)-1} dx \right)$$

$$S_\lambda = \frac{1}{\lambda-1} \left(1 - \left(\frac{\theta^4}{(\theta^3 + 2\theta + 6\alpha)} \right)^\lambda (\theta + x + \alpha x^2)^\lambda \frac{\Gamma(\lambda+1)}{(\lambda\theta)^{\lambda+1}} \right)$$

Maximum Likelihood Estimation and Fisher's Information Matrix

The maximum likelihood estimation method for estimating the parameter of the proposed distribution, as well as the Fisher's Information matrix, will be described in this section. If X1, X2,..., Xn is a random sample of size n drawn from the length biased quasi Shanker distribution, then the likelihood function is

$$L(x) = \prod_{i=1}^n f_I(x; \theta, \alpha)$$





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$$L(x) = \prod_{i=1}^n \left(\frac{x_i \theta^4 (\theta + x_i + \alpha x_i^2) e^{-\theta x_i}}{(\theta^3 + 2\theta + 6\alpha)} \right)$$

$$L(x) = \frac{\theta^{4n}}{(\theta^3 + 2\theta + 6\alpha)^n} \prod_{i=1}^n \left(x_i (\theta + x_i + \alpha x_i^2) e^{-\theta x_i} \right)$$

The log likelihood function is provided by

$$\log L(x) = 4n \log \theta - n \log(\theta^3 + 2\theta + 6\alpha) + \sum_{i=1}^n \log x_i + \sum_{i=1}^n \log(\theta + x_i + \alpha x_i^2) - \theta \sum_{i=1}^n x_i \tag{9}$$

The maximum likelihood estimating a parameters θ and α it can be obtained by differentiating equation (9)

$$\frac{\partial \log L}{\partial \theta} = \frac{4n}{\theta} - n \left(\frac{3\theta^2 + 2}{(\theta^3 + 2\theta + 6\alpha)} \right) + \sum_{i=1}^n \left(\frac{1}{(\theta + x_i + \alpha x_i^2)} \right) - \sum_{i=1}^n x_i = 0 \tag{10}$$

$$\frac{\partial \log L}{\partial \alpha} = -n \left(\frac{6}{(\theta^3 + 2\theta + 6\alpha)} \right) + \frac{\sum_{i=1}^n x_i^2}{(\theta + x_i + \alpha x_i^2)} = 0 \tag{11}$$

The system of non-linear equations is extremely difficult to solve algebraically because to the complex structure of the likelihood equations. As a result, we estimate the required parameters of the proposed distribution using R and Wolfram mathematics. The confidence interval we can use the asymptotic normality outcomes. We have that if

$\hat{\lambda} = (\hat{\theta}, \hat{\alpha})$ denotes the MLE of $\lambda = (\theta, \alpha)$. we can state the results as follows

$$\sqrt{n}(\hat{\lambda} - \lambda) \rightarrow N_2(0, I^{-1}(\lambda))$$

Where $I^{-1}(\lambda)$ is the Fisher information matrix

The variables of Fisher's Information Matrix number 2x2 are listed below

$$I(\lambda) = -\frac{1}{n} \begin{pmatrix} E \left(\frac{\partial^2 \log L}{\partial \theta^2} \right) & E \left(\frac{\partial^2 \log L}{\partial \theta \partial \alpha} \right) \\ E \left(\frac{\partial^2 \log L}{\partial \alpha \partial \theta} \right) & E \left(\frac{\partial^2 \log L}{\partial \alpha^2} \right) \end{pmatrix}$$

Where

$$E \left(\frac{\partial^2 \log L}{\partial \theta^2} \right) = -\frac{4n}{\theta^2} - n \left(\frac{(\theta^3 + 2\theta + 6\alpha)6\theta - (3\theta^2 + 2)(3\theta^2 + 2)}{(\theta^3 + 2\theta + 6\alpha)^2} \right) - \sum_{i=1}^n \left(\frac{1}{(\theta + x_i + \alpha x_i^2)^2} \right)$$





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$$E\left(\frac{\partial^2 \log L}{\partial \alpha^2}\right) = n\left(\frac{36}{(\theta^3 + 2\theta + 6\alpha)^2}\right) - \sum_{i=1}^n \left(\frac{E(x_i^4)}{(\theta + x_i + \alpha x_i^2)^2}\right)$$

Also,

$$E\left(\frac{\partial^2 \log L}{\partial \theta \partial \alpha}\right) = E\left(\frac{\partial^2 \log L}{\partial \alpha \partial \theta}\right) = -n\left(\frac{6(3\theta^2 + 2)}{(\theta^3 + 2\theta + 6\alpha)^2}\right) - \sum_{i=1}^n \left(\frac{E(x_i^2)}{(\theta + x_i + \alpha x_i^2)^2}\right)$$

Since λ being unknown, we estimate $I^{-1}(\lambda)$ by $I^{-1}(\hat{\lambda})$ and this can be used to obtain asymptotic confidence intervals for θ and α

Data Evaluation

In this paper, We investigate whether the length biased quasi Shanker distribution fits better than the Shanker, Exponential, Quasi Shanker and Lindley distributions with time dependent covariates in one direction in two real life data. The following tworeal data sets listed below as follows.

Data Set 1: A group of 40 people with blood cancer (leukaemia) from one of Saudi Arabia's ministry of the health institute is described in the following data set (see Abouammah et al.). The data set is shown in table 1 below.

Data set 2: The second data set is described by Xu et al. (2003). The following data illustrates the time to failure of a turbocharged engine with a unique type of turbocharger (103h). Table 2 continues to display the data.

The unknown parameters of the model along with criterion values are estimated by using the R Software. We use criteria values such AIC (Akaike information criterion), AICC (corrected Akaike information criterion), and BIC (Bayesian information criterion) to compare the Length Biased Quasi Shanker distribution with Quasi Shanker, Shanker, Exponential, and Lindley distribution. Lowest values of AIC, AICC, BIC, and $-2\log L$ values determine the superiority of distribution. The AIC, AICC, and BIC general formulae are as follows:

$$AIC = 2k - 2 \log L \qquad AICC = AIC + \frac{2k(k+1)}{n-k-1} \qquad \text{and} \qquad BIC = k \log n - 2 \log L$$

Where k is the number of parameters in the model, n is the sample size and $-2\log L$ is the maximized value of the log-likelihood function under the considered model.

From table 3, According to the findings, the length biased Quasi Shanker distribution has lower AIC, AICC, BIC, and $-2\log L$ values than the quasi Shanker, Shanker, Exponential, and Lindley distributions, implying that the length biased Quasi Shanker distribution fits better than the quasi Shanker, Shanker, Exponential, and Lindley distributions. As a result, the Length Biased Quasi Shanker distribution outperforms or better fit than the quasi Shanker, Exponential, Shanker and Lindley distribution.

CONCLUSION

This manuscript deals with the new modification of Quasi Shanker distribution known as Length Biased Quasi Shanker distribution. The Length Biased method is used to produce the subject distribution, with the two parameter





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Quasi Shanker distribution as a base distribution. The statistical properties are also derived. The parameters of the proposed distributions are estimated to use the maximum likelihood estimation method, and the Fisher's information matrix is described. The supremacy of a suggested distribution have also been investigated by fitting two real lifetime data sets, and it has been discovered that the Length Biased Quasi Shanker distribution fits quite well over Quasi Shanker, Shanker, Exponential, and Lindley distributions based on the results of two data sets. As a result, the Length Biased Quasi Shanker distribution fits the data better than the Quasi Shanker, Shanker, Exponential, and Lindley distribution.

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Table 1 Data regarding the blood cancer (leukaemia) patients (n=40) from ministry of health hospitals in Saudi Arabia

0.315	0.496	0.616	1.145	1.208	1.263	1.414	2.025	2.036
2.162	2.211	2.37	2.532	2.693	2.805	2.91	2.912	3.192
3.263	3.348	3.348	3.427	3.499	3.534	3.767	3.751	3.858
3.986	4.049	4.244	4.323	4.381	4.392	4.397	4.647	4.753
4.929	4.973	5.074	5.381					

Table 2 Data regarding the time to failure of turbocharger (n=40) studied by Xu et al. (2003)

1.6	3.5	4.8	5.4	6.0	6.5	7	7.3	7.7	8
8.4	2	3.9	5	5.6	6.1	6.5	7.1	7.3	7.8
8.1	8.4	2.6	4.5	5.1	5.8	6.3	6.7	7.3	7.7
7.9	8.3	8.5	3	4.6	5.3	6	8.7	8.8	9

Table 3 Shows parameter estimates, corresponding Standard errors, Criterion values and Performance of the fitted distribution.

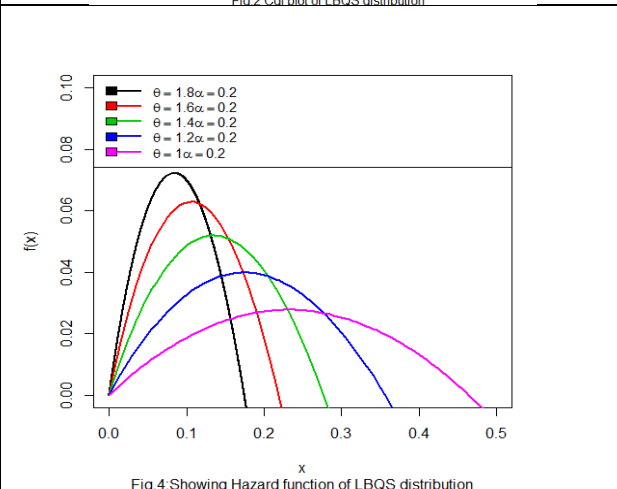
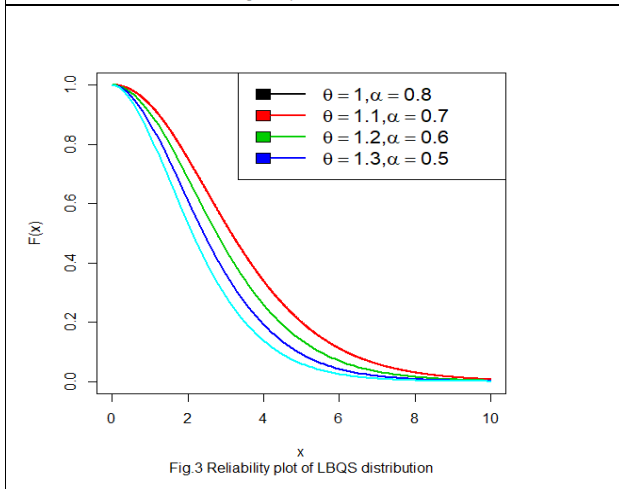
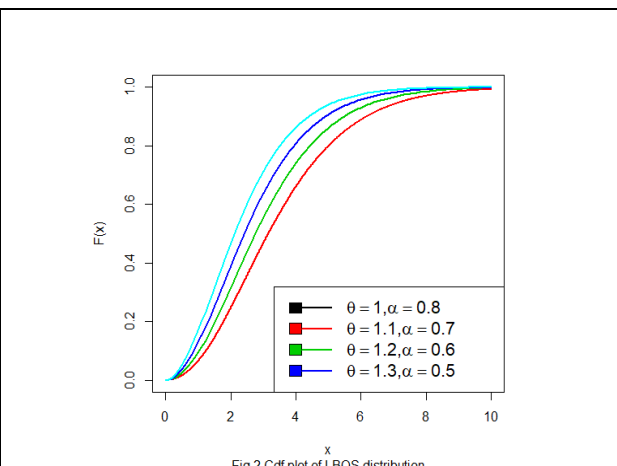
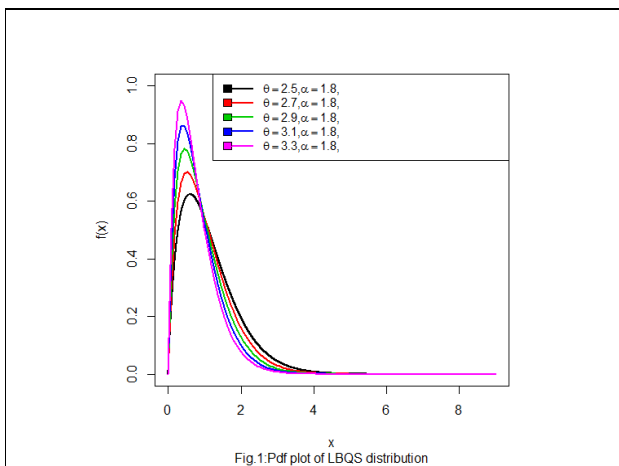
Data sets	Distribution	MLE	S.E	-2logL	AIC	BIC	AICC
1	Length Biased Quasi Shanker	$\hat{\alpha} = 2.6956263$ $\hat{\theta} = 1.1853536$	$\hat{\alpha} = 3.3201493$ $\hat{\theta} = 0.1211352$	144.8703	148.8703	152.248	149.19462
	Quasi Shanker	$\hat{\alpha} = 21.26758816$ $\hat{\theta} = 0.93678656$	$\hat{\alpha} = 58.79441352$ $\hat{\theta} = 0.09723243$	147.3439	151.3439	154.7216	151.66822
	Shanker	$\hat{\theta} = 0.54874483$	$\hat{\theta} = 0.05724169$	157.8358	159.8358	161.5247	159.9410
	Exponential	$\hat{\theta} = 0.31839887$	$\hat{\theta} = 0.05034278$	171.5563	173.5563	175.2452	173.6615
	Lindley	$\hat{\theta} = 0.52692132$	$\hat{\theta} = 0.06074766$	160.5012	162.5012	164.19	162.6064
	Length Biased Quasi Shanker	$\hat{\alpha} = 1.378807$ $\hat{\theta} = 6.397082$	$\hat{\alpha} = 1.677786$ $\hat{\theta} = 5.057400$	182.2407	186.2407	189.6185	186.56502





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2	Quasi Shanker	$\hat{\alpha} = 1.328420$ $\hat{\theta} = 4.797644$	$\hat{\alpha} = 1.677870$ $\hat{\theta} = 4.379816$	189.0107	193.0107	196.3884	193.33502
	Shanker	$\hat{\theta} = 0.3016707$	$\hat{\theta} = 0.0325865$	203.8728	205.8728	207.5617	205.9780
	Exponential	$\hat{\theta} = 0.15993820$	$\hat{\theta} = 0.02528746$	226.6385	228.6385	230.3274	228.7437
	Lindley	$\hat{\theta} = 0.28445407$	$\hat{\theta} = 0.03219978$	208.5708	210.5708	212.2597	210.6760





Localization Error Analysis on WLAN Finger Printing Indoor Positioning System with Different Approaches

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ABSTRACT

Wireless Local Area Networks (WLANs) have become an hopeful choice for indoor positioning to localize the mobile and stationary users indoors as the only existing and established infrastructure. Initially WLAN designed for wireless networking and not positioning, the localization task based on WLAN signals has several challenges. Amongst the WLAN positioning methods, Among the WLAN situating strategies, WLAN fingerprinting confinement has as of late accumulated extraordinary consideration because of its promising result. Notwithstanding, WLAN fingerprinting faces several challenges. In this paper, our goal is to overview WLAN fingerprinting challenges and corresponding state-of-the-art solutions. Since all proposed methods in the WLAN fingerprinting literature have been shown and experienced in different settings, the reported results are not readily comparable. So, we compare some of the representative localization schemes in a single real environment and assess their localization accuracy, positioning error statistics, and complexity. Our results depict an illustrative evaluation of the approaches in the literature and guide to future improvement opportunities.

Keywords: Indoor localization, WLAN fingerprinting localization, Distance estimation, Fingerprinting Location Algorithm, localization error.



**Brijeshkumar U Patel et al.,**

INTRODUCTION

In recent times, the demand for Indoor Positioning System (IPS) has gradually increased. Due to the complications in the line of sight (LOS) the global positioning system (GPS) technology cannot play a vital role in indoor environments such as shopping malls, universities, airports, hospitals, tunnels etc. Many technologies have been planned to overcome such adverse effects, e.g., Wi-Fi, Bluetooth, RFID, ultra-wideband (UWB), Zig-Bee and the inertial measurement unit (IMU) [1], [2]. These techniques make use of wireless signals for location extraction. Some of the methods for extracting the distance of the user are the Time of Flight, Time of Arrival (ToA), and received signal strength indicator (RSSI). For example, ToA uses the packet transmission to estimate the time lags between wireless devices. This method has high precision, but its high hardware costs and implementation difficulties limit its applications. On the other hand, the RSSI usually depends on the environment and surrounding structure and has limited accuracy. Because there is always a trade-off between accuracy and practicability in designing an Indoor Positioning System, the RSSI, being a very cost-effective method with reasonable accuracy, is currently the most widely used technique for indoor positioning systems.

Inertial measurement unit (IMU) sensor used in PDR systems includes the accelerometer, magnetometer and gyroscope sensors and these sensors give user position based on user heading and step length information [3]. RSSI-based position estimation for an indoor tracking system is designed using propagation models to estimate the distance between devices [4]. Usually, the propagation models do not take obstacles into consideration; hence, this is not considered an effective method for obtaining the position. However, this problem can be recited by using fingerprinting techniques, i.e., by matching the trained positioning data with the real-time observed data. In the fingerprinting method, reference points are assigned with the collection of unique signal strengths called fingerprints. The fingerprints are stored in a database and used in the localization phase through pattern recognition and machine-learning algorithms. These techniques can be useful for both deterministic and probabilistic methods [5]. Generally, the probabilistic approach introduces mathematical analysis considering the variance of the signal strength to obtain a better result than the deterministic approach.

Another approach for enhancing the indoor positioning system employs IMUs, which consist of an accelerometer, a gyroscope, a magnetometer, and a barometer. The most common approach using IMU sensors for navigation is pedestrian dead reckoning (PDR). Here, the accelerometer is used to estimate the displacement of the user, while the gyroscope and magnetometer are used to calculate the heading direction. PDR is a very low-cost system and does not require additional devices. However, there are drawbacks; e.g., the initial position of the user is required, and the drift error accumulates with time. To overcome these difficulties, RSSI fingerprinting and IMU-assisted positioning can be combined to eliminate the drawbacks of each method. There are various filtration methods, e.g., the Kalman filter, the Particle filter, and their variants [6], [7]. The Kalman filter is generally used with linear and Gaussian models, whereas the particle filter is used with nonlinear models. The particle filter provides an expressively better estimation of the position in noisy and inaccurate measurements. However, it requires higher computation power and is more complex than the Kalman filter [8]. Because minimum computation and complexity are preferred in smartphone environments, considering the memory use and power consumption, the Kalman filter is widely used for eliminating noise and accurately estimating the location.

Indoor Positioning Based Parameter

This section presents measurement parameters for indoor position systems. There are many parameters utilized to determine the target position for indoor positioning systems. The fundamental wireless signal measuring theorems in indoor positioning systems are RSSI, TOA, and AOA or DOA, TDOA, RTT, angle difference of arrival (ADOA), phase difference of arrival (PDOA), POA, CSI, RSRP, and RSRQ are also used in indoor positioning and tracking environments. As shown in figure Indoor positioning based parameter are divided into two categories one is distance-based and another direction-based signal measurement parameters for indoor positioning systems.



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The received signal strength indicator (RSSI) is a comparative measurement of the RSS which has random units and is commonly described by a single chip vendor [9]. RSSI is a commonly used metric to find distance estimation between a target device and the access point without resorting to complicated calculations. It computes distance by power loss, the signal strength deficiency between two nodes. As shown in Figure 2 shows the RSSI-based distance estimation method can work using only a couple of nodes to obtain distance estimation [10]. To achieve higher accuracy than other methods RSSI based algorithm uses only the received signal strength and doesn't require time synchronization. RSSI technique can be categorized into a range-based and range-free approach. The first approach is an RSSI based on a path loss model. The propagation model involves building a map associated with the physical regulations of the wireless signal. The precision and flexibility of the environment are poorer in the range-based method, which can locate the position of the object by using trilateration, min-max, and maximum likelihood algorithms. The latter approach generates the use of a fingerprinting database (radio map) for indoor position [11]. A range-free method does not require distance or angle measurements among nodes. The fingerprinting technique is higher in accuracy and can be used for various indoor environments. However, RSSI measurement can cause an error due to environmental effects. The real indoor environment consists of numerous obstacles that affect radio signal propagation [1]. RSSI is susceptible to noise and multipath effects which significantly decreases its localization accuracy [12].

TOA

Time of Arrival (TOA) is also known as TOF [13] and is described as the first period within which the signal reaches the receiver. It can estimate the distance to the node by computing the broadcast time travel of a wireless radio signal [14] as shown in Figure 3. The traditional TOA schemes need a minimum of two or three reference nodes in a LoS situation with a target, to support a high level of position accuracy [15]. The nodes can be synchronized or the miss-synchronization in TOA and the signal must consist of the timestamp data [16]. To solve these problems, the TDOA method, as well as the round trip time of arrival (RTOA) method, also called RTOF, is implemented. RTOA ranging mechanisms are identical to TOA, but it does not need a corporate time reference within nodes. TOA is partial by multipath and additive noise. Additive noise emulates the precision of the signal arrival time. This problem can be fixed by applying the TDOA instead of TOA [17]. On the other hand, the multi-signal wants two different types of signals that have varying propagation speeds to compute its distance to another node. The accuracy of TDOA is due to composite indoor propagation such as multipath transmission and shadowing. The radio signals reaching the receiving antenna by different paths cause multipath transmission and also the method needs extra equipment. The ultrasound or audible frequency can be used in this method using the same algorithm [17]. The achievement of the TDOA is subject to synchronization between the anchor nodes and the precision of the timestamp taken.

RTT

Wi-Fi-based two-way ranging approaches have been proposed for indoor positioning and tracking systems to improve the localization accuracy. These positioning systems are based on fine time measurement (FTM) of the RTT of a signal between an access point and a smartphone (target). The RTT or RTOF technique estimates the distance by the broadcast timestamp of the FTM message and the response of its acknowledgement [18] in Figure 5. This measurement approach is based on the TOF and implemented to solve the synchronization problem subjected to the use of TOA. The RTT measurement based method does not need the clock synchronization between the nodes that means high reliability and less complexity. In addition, the ranging error and range between couples of devices are closely independent when the clock operates at the equal rate on the nodes. Reflection, fading, shadowing, and unstable clock speed due to phase noise as well as a different processing time delay is limitation of RTT ranging measurement. Moreover, the FTM protocol has a concurrent processing capacity problem and an access point cannot concurrently reply to higher amounts of FTM inquiries [19].

One approach is the Wi-Fi RTT-based indoor positioning system in car parks [20]. The approach used a trilateration method and a probabilistic method to estimate the car's location. The result of this system shows that the Wi-Fi RTT



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is preferable for industrial indoor positioning in a dynamic environment. An average accuracy of 2.33 m is achieved by this system and the accuracy can be improved with higher radio communication or a larger number of access points. Another approach is a hybrid algorithm based on the RTT and RSS, which was exploited to solve the restrictions of the Wi-Fi RTT ranging technique [19]. This approach presents the RTT estimation with a clock skew and investigates the RTT range error distribution. It also eliminates the RTT ranging offset at the emitter end by using the calibration method. The proposed system achieves scalability and precision in static and dynamic experiments in both the outside and inside environment. The average location error of this work is 1.435 m and an update rate is 0.19 s in a real environment. Therefore, the frequency diversity method was introduced for the accurate position estimation using weighted averages of evaluations with uncorrelated errors acquired in various networks [21].

AOA and ADOA

AOA is a technique of determining the position of objects by taking the angular data of that object with respect to the orientation of the receivers. A simple AOA calculation is to work on an antenna array on one sensor node. The angle-based method needs a minimum of three reference nodes coordinated to determine the position of the object by using a triangulation method [22]. In general, the AOA method can obtain angle data using radio array techniques and can estimate by using directional or multiple antennas. In multiple antennas, this acts by analyzing the phase or time variation between the signals at different array items that have seen locations regarding the center element. In directional antennas, it acts by computing the RSSI ratio between many directional antennas that are carefully located to have a similarity between their major beams [23]. AOA determinations with the support of exact antenna design or hardware apparatus are utilized for inference the location of the receiver. The improved complexity and the hardware necessity are the major interferences for the extensive success of AOA-based location systems [24].

AOA is also disturbed by noise, NLoS and the multipath. Moreover, the defects of LoS can be more serious than those of TDOA- or RSS-based techniques [25]. AOA needs additional space to offer spatial diversity and extra hardware that is a real waste of power, but it does not require time synchronization between nodes [26]. Both TOA and AOA parameters require reference units that can decide the arrival time and angle of the received signal which is unattainable to common WLAN devices. Thus, the RSSI technique is most extensively used in an indoor localization, positioning and tracking system. ADOA does not need the information on angles as it can be ignored in the variance between two AOA values. This means that the receivers are to be located towards a definite angle. AOA-based optical indoor positioning systems are more challenging due to the necessity to identify the orientation of the receiver. The optical receiver is either limited to certain orientations or it must be combined with gyroscopes and accelerometers to define its exact orientation. To solve this problem, ADOA is used for an optical indoor positioning system [27]. Hence, the ADOA does not require extra sensors like gyroscopes [28].

DOA

DOA-based measurements use the angle information of the received signal to estimate its position [29]. The DOA approach, also called AOA, is simpler than time-based measurements because of the estimation of the 2D position with only two angle measurements. The DOA-based positioning system is the appraisal of the signal AOA. The accuracy of the DOA-based indoor position system is highly impactful with regard to multipath effects. However, this technique depends on accurate angle measurements. The DOA estimate can be done by using an antenna array or direction. In addition, DOA-based systems have proposed and applied for an indoor position system integrating with different measurement techniques such as RSS, TOF, TDOA, and RTOF. There are several different antenna implementations such as the narrowband system, switch beam, phase antenna array, and UWB-based system estimate indoor position based on DOA algorithms [30]. The DOA-based indoor position systems need a suitable antenna with different requirements. DOA-based techniques are divided into the offline and online techniques based on the applications [29]. In the offline method, this computes multiple times, and the average value is labeled as the fingerprints. By using these fingerprints, the triangulation method estimates the location. The offline systems have larger complexity and can be utilized for offline applications. In the online method, the angles are determined from



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the received signals and the triangulation method estimates the position. These methods have smaller complexity and utilize real time applications. The DOA techniques have been presented for an indoor position system to estimate channel characteristics and focus on the multipath propagation interference problem [31]. Moreover, a hybrid joint direction and time difference of arrival (JDTDOA) approach has introduced the precision of the system performance [32].

POA and PDOA

POA is also called received signal phase (RSP) ranging techniques to estimate the distance by measuring the phase of the carrier signal. There are a number of POA measurements that have been used in RFID-based indoor position systems. The POA-based approach was introduced to increase accuracy and decrease disturbances due to multipath propagation in passive RFID 2D indoor position systems [33]. The results of the estimated POA existed in an unlimited number of paths due to the 2 uncertainty in phase estimations. By means of the frequency-stepped continuous-waveform principle, the distance of the propagation path can be computed for a high bandwidth system. The POA techniques can be used integrated with different techniques such as TOF, TDOA, and RSSI to increase their performance. However, POA-based approaches may need LoS for high accuracy. The ranging measurement based on PDOA uses the phase difference of the propagation path between the anchor nodes or the reader to the tag to calculate its distance [34]. It is also mostly used in RFID and wireless sensor networks (WSNs) systems. The phase errors can be small due to the very small signal bandwidth. Unfortunately, unavoidable ambiguities can occur during the evaluation of the true distance due to the multipath effects and a 2 phase periodicity [35].

CSI

With new technology developments in wireless communication systems, 4G long-term evolution (LTE) mobile transmissions, and Wi-Fi systems have used orthogonal frequency division multiplexing (OFDM). OFDM converts information on several altered subcarriers at one band. In the IEEE 802.11 standard, the receiver wants to approximate CSI in the physical (PHY) layer for the data translation. The CSI is the channel frequency response of each subcarrier under the OFDM system within the frequency field. Thus, CSI utilizes dozens of times more data than traditional RSSI in the network features between the sender and the receiver [36]. In the frequency field, CSI is definitely the PHY layer data with a fine-grained characteristic value that defines the amplitude and phase of a single subcarrier [37]. In the field of narrowband transmissions, this denotes the network property of the transmission link that expresses the decrease in the signal in the development of communication between the two nodes, containing scattering, distance and environmental attenuation, as well as other information [38].

The CSI-based method uses the physical layer channel state information of a communication link. A corresponding CSI can be measured when a target is displayed indoors. The CSI fingerprint matching, triangulation, and trilateration method can be used to determine the location of the target [39]. The CSI-based method shows good stability and can achieve higher location accuracy than the RSSI-based method [40]. Moreover, CSI is favored more than RSSI, since it develops the frequency diversity of Wi-Fi networks and is not coarse-grained like RSSI. The CSI-based approach has many advantages such as the ease of arrangement given the pervasiveness of a Wi-Fi setup [41]. In addition, the CSI-based Wi-Fi indoor position system can achieve decimeter-level accuracy. On the other hand, CSI-based Wi-Fi schemes need a labor-intensive site survey to calibrate the access points (APs) location and the antenna array direction, which obstructs real-world implementation [42]. Another disadvantage is that the CSI-based fingerprinting method needs larger space and more comprehensive time due to a larger measurement of CSI compared with RSSI, which is not appropriate for most situations [42].

RSRP and RSRQ

The RSRP and RSQ parameters are physical layer data from the 4G cellular system that are used to reasonably forecast the user position [43]. The RSRP computation is based on RSSI. It calculates mean obtainable strength by cell-specific reference signals [44]. Thus, it can afford better signal strength information associated with various positions contrasting normal RSSI. The PHY layer RSRP decreases local disturbances in the surroundings. In the



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office building, the RSSI estimates from 4G towers produce an enhanced forecast than RSSI signals from 2G towers, due to the existence of small cells. The RSRQ parameter that provides the value of received signals within the object device is developed from the RSSI and RSRP value. RSRQ is influenced by adjacent station interference and thermal noise and thus, when only RSRQ is utilized, achieves fewer precision than RSRP estimates. On the other hand, the accuracy of RSRQ-based systems is better than that by the signals when RSRQ values are used together with RSRP values [43].

Radio Signals-Based Positioning

This section describes radio-based systems for Indoor Position System. Radio Signals based Positioning technologies are Wi-Fi, ZigBee, RFID, Bluetooth low energy (BLE), UWB, long-range radio (LoRa), sigfox, near field communication (NFC) and cellular have been used in Indoor Positioning System.

Wi-Fi Technology

Wi-Fi, which is a wireless local area network (WLAN), is a well-known technology in broadband communications, specifically for machine-to-machine schemes and human communication [46]. The Wireless Ethernet IEEE 802.11 (Wi-Fi) devices generally transmit over 2.4 GHz, nevertheless, now 5 GHz is widely being utilized for transmission due to less interference, less noise, higher constant connection, and enhanced speed [47]. The Wi-Fi network is available through mobile devices such as laptops, tablets, mobile phones and others in consequence of an active saleable off-the-shelf simple infrastructure for an IPS [48]. Wi-Fi signal is used to focus the problem of indoor positioning and tracking, due to the ubiquitous placement of Wi-Fi access points, low cost over other indoor wireless technologies, low energy consumption, and without additional hardware requirements [49]. Several algorithms and ranging parameters have been presented to increase Wi-Fi-based IPS; however, most of the algorithms and measurement solutions need large computing properties and specific hardware [50]. Wi-Fi localization algorithms are introduced, including an AOA-based algorithm (triangulation) [51], trilateration algorithm [52], RSSI-based fingerprinting algorithm [53] and CSI-based fingerprinting algorithm [54]. Among the algorithms, the fingerprinting algorithm and the trilateration algorithm are often employed in Wi-Fi-based indoor localization. However, fingerprinting based localization algorithms give the best performance and attract the researcher's attention due to easy implementation, low complexity, no need for the LoS measurements of APs and specialized hardware [55]. The average localization errors are described as 2-3 m in Wi-Fi-based positioning algorithms [45]. Wireless signals of Wi-Fi access points can protect huge areas, however, they need multipart hardware and software collaboration with each other [56]. In addition, Wi-Fi-based positioning implementation can be extremely affected by environmental effects such as the geography of the barrier, people's mobility or crowdedness, and weather [45]. The multipath fading of Wi-Fi signals affects the time-varying RSSI of signals that influence the precision of the Wi-Fi location. Furthermore, Wi-Fi scanning time, around 3-4 s in common smartphones, gives the low quality of its services in the context of a refreshment time [45].

Bluetooth Technology

Bluetooth low energy (BLE) is mostly supported by smart devices today. It is based on the Institute of Electrical and Electronics Engineers (IEEE) 802.15 standard. The Bluetooth 4.0 protocol was distributed and it was announced in 2010 [57]. BLE signal is a kind of electromagnetic signal that works in the range from 2.4 GHz to 2.4835 GHz band in Industrial Scientific and Medical (ISM) [58]. In 2013, a new iBeacon technology was presented by Apple Inc [59]. The iBeacon technology was created based on BLE technology that can send directly with smartphones and it has lower power and a lower cost than conventional Bluetooth and Wi-Fi technologies [59-62]. In addition, the launch of Google's Eddystone TM open standard in 2015 produced new and better broadcast formats that have aided in the development of interest in the widespread use and embedding of Bluetooth beacon platforms [63]. BLE is designed with very short ranged wireless transmissions. Hence, the estimated errors using Wi-Fi-based systems are normally much higher than those in BLE-based systems [64]. The sensing length of Bluetooth is at most 10 m, with great power cost and is only ideal for a small space [65]. Bluetooth devices are varied because of different productions, rated voltage, and energy, and therefore, the RSS can change as much as 20 dBm [66]. Moreover, in reality, Bluetooth



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broadcast power takes time-varying characteristics [60]. Although the Bluetooth-based system needs further hardware devices in contrast with the Wi-Fi-based system, it can attain accuracies in the range of 1.2 m [49].

Fingerprinting Localization Algorithm

In Indoor Positioning System (IPS) and indoor location-based services there are many algorithms such as proximity algorithm, triangulation algorithm, multilateration algorithm, Min-Max algorithm, Maximum Likelihood Algorithm and fingerprinting, the fingerprinting (FP) localization method is an established method to attempt the optimizing of position accuracy using range-free information in building structures, for example, in campus buildings, shopping malls, convenience shops, market places, hospitals, airports, industries, offices and smart buildings. To solve the difficulties in Indoor Positioning System, the fingerprinting localization algorithm has the capability to obtain high positioning accuracy, decreasing the hardware complexity and undesirable influence of the multipath effect, better than the range-based method. The fingerprinting method is normally framed in two phases, the offline phase (training) and online phase (testing). The basic operation of this method is as shown in Figure 5.

The spatial-temporal RSS data from each AP location are gathered and saved in the database as current location coordinates, called RPs. Moreover, the database of previously known patterns received from a known Wi-Fi base is collected by uniformly selecting RSS measurements for each point as an fingerprinting. In the online phase, the mobile device or receiver accepts the new RSS measurements from different APs. Then, the comparison and recognition processes are accomplished between the measured RSS values and reference fingerprinting for position estimations. An FP localization technique brings new challenges that the primarily fingerprints database should be accurate for the requirement of better performance and chosen positioning accuracy. Fingerprinting method could find the target's position by utilizing RSSI measurements that come from various transmitters or different network sources. Many different APs' locations diminish the positioning accuracy due to RSS noise and attenuation. RSSI works in MAC which is known as the datalink's sub layer in the OSI model, which is the available wireless network interface controller by access points (APs).

In the MAC layer, a radio map can construct itself by using the signal strength of access points which is known through offline processing. Especially, wireless-based positioning, and RSSI measurements, are stored in the database and matching between the information of stored data and the current target position of the RSSI radio map measurements. However, the conventional time-based method is not sufficient for the RSS ranging aspect of indoor performance. Generally, the fingerprinting based on radio maps can be divided into deterministic and probabilistic approaches. Deterministic and probabilistic approaches are utilized for measurements of indoor positioning using RSSI as shown in Figure 5. The deterministic approach is based on the fixed values of known variables; it only takes certain variable values without the consideration of uncertain random variables. Indeed, a deterministic algorithm is finding the optimization of similarity between the new measurements of online data and the dataset of FPs offline. In [82], the RADAR system is concerned with the deterministic location approach, and proved competent to determine the user's location with the nearest neighbour of Euclidian distance by using scalar values. The classification method of nearest neighbour (NN), K-nearest neighbour (KNN), and weighted K-nearest neighbour (WKNN) are implemented for the matching of nearest locations in the online phase [73]. These mathematical equations are able to compute the mobile device's actual position. In addition to this, the support vector machine (SVM) is used as an advanced deterministic approach for the WLAN standard which can also give better accuracy on type location [83]. The probabilistic approach is based on the conditional probability distribution function (PDF) of unknown variables by providing more accurate results with statistical framework [83]. It can guess the position of dimension between reference points (RPs) of FP and target measurement depending on the statistical conditions [84].

Comparison of Representative Fingerprinting Localization Approaches and Technical Details

For Fingerprinting Localization there are many approaches are Crowdsourcing, Machine learning approach, Filtering Approach, Reference-Free Approach and Uncooperative Localization Approach. Table 1 describes the location accuracy and performance comparison of calibration and human effortlessness. The collection of (RSS)



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information needs to be updated quickly by user phones and to remain for a certain distance and time, because crowd source data are normally inaccurate. However, the mobile crowdsourcing idea is becoming an attractive way to construct the radio map without pre-labeled reference points and manual calibration [67]. Crowdsourcing data can be received from the updated fingerprinting RSSI information in a database which is provided by the IMU sensor and PDR trajectory. Then, the radio map is automatically constructed at the indoor location [68]. Most of the wireless indoor locations are regarded as a continuous structure independent of the environment changes. WRMs [69] location based approach effectively solved the calibration process and maintenance process due to the changing state in the environment. FreeLoc [70] location accuracy based provide consistent localization accuracy in an environment where the device heterogeneity and the multiple surveyor problems exist. Horus [71] location accuracy based on crowd sourcing presents a feature distinguishability measurement technique to evaluate the performance of different feature extraction methods.

Experiments revealed that selected fingerprints will improve position distinguishability. RCILS [72] location accuracy based extensive experimental results show that the Activity Sequence based Map Matching and Labeling Wi-Fi observations algorithm facilitates the acquisition of accurate heading direction and coordinates of the user WKNN [73] location accuracy based experimental results show that the W-KNN method can achieve a better positioning effect compared with the KNN, Rank, Coverage-area, and GPR algorithms. KRR [74] location accuracy based on crowdsourcing experimental results indicated that the KRR method was less dependent on the density of the reference points and had higher positioning accuracy than the commonly used positioning methods, and it adapts to different application environments. LASSO [75] results show that they can localize the user with significantly high accuracy and resolution which is superior to the results from competing WLAN fingerprinting localization methods. PCA-KRR [76] location accuracy based on crowdsourcing the experimental results indicated that the PCA-KRR method was less dependent on the density of the reference points and had higher positioning accuracy than the commonly used positioning methods, and it adapts to different application environments.

KLFDA [77] location accuracy based on crowdsourcing by performing KLFDA, the discriminating information contained in RSS is reorganized and maximally extracted. Prior to feature extraction, they performed outlier detection on RSS data to remove any anomalies present in the data. Experimental results show that the proposed approach obtains higher positioning accuracy by extracting maximal discriminate location features and discarding outlying information present in the RSS data. KDDA [78]. Machine learning based approach that the quartile analysis adequately represents the RSSI values, since the instances acquire discriminating feature. DZ-ELM [79] Machine learning based approach method does not solve the problem that the localization error is higher when the target tag falls into the edges and corners. EKF [80] Based on Filtering experiment results show that the EKF system achieves a good trade-off in terms of network setup complexity. GBF [81]. Based on filtering appropriate selection or even fusion of diverse approaches may be the solution to obtain more robust systems. Localization errors of these methods are visualized in figure 7.

CONCLUSION

This paper analyzes the comprehensive description of indoor positioning systems, based on fingerprinting positioning issues due to the signal variance of multipath propagation, hardware and software complexity, real-time processing and the changing dynamic environment. As we analyze due to the dynamic environment signal, there is the variance of multipath propagation and also due to the hardware and software complexity, real-time processing is difficult. These algorithms noticeably deal with the depletion of battery usage, the reduction in numerous Reference point build-up and the precision of the estimated current position. As per workload reduction, radio map development can progressively offer precise positioning for an unfamiliar environment of building. The machine learning approaches and crowdsourcing approaches method can calculate the localization accuracy and medium error in the respective area by executing the calibration effortlessness and mitigation of RSS variation. Occasionally, the collected crowdsourcing data cannot be exchanged during the recording time with a long period in each existing



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place which causes the multiplicity of smartphones. To improved accuracy, the hybrid integration of the machine learning and particle filtering approach is analyzed in this paper. Classification and clustering algorithms are able to figure the accuracy score and forecast the value of the nearest location.

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Table 1: Comparison of location accuracy

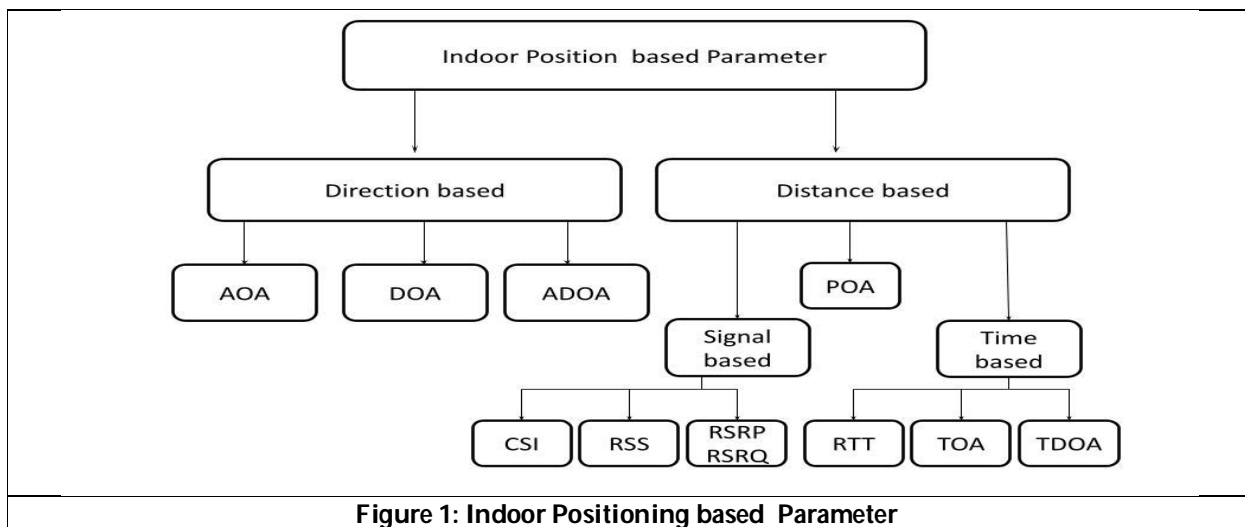
Approach	Technologies	Method	Infrastructure	Performance (m : Meter)
LiFS[67] location accuracy based on crowdsourcing.	Wi-Fi, accelerometer sensors	calibration of fingerprints is crowdsourced and automatic, Floyd - Warshall algorithm, Minimum Spanning Tree	Office building	1.33 meter Average Localization Error
iLocScan [68] location accuracy based on crowdsourcing.	Wi-Fi, Accelerometer, Gyroscope, Compass	ACMod, ALMod and LSMoD	Office building	7 meter Average Localization Error
WRMs[69] location accuracy based on crowdsourcing.	Wi-Fi	Unsupervised learning	Office building floor plan	Around 3 m Manual calibration effortless
FreeLoc[70] location accuracy based on crowdsourcing.	Wi-Fi	unsupervised learning	University building.	Heterogeneity devices error (around 2 and 4 robust and consistent m)
Horus[71] location accuracy based on crowdsourcing	Wi-Fi, IMU	Gaussian probability distributions And Bayesian method	Office building, floor area 4600 m ² and corridor area 411 m ²	Positioning accuracy RSS changing 1.5 m
RCILS[72]. location accuracy based on crowdsourcing	Wi-Fi, accelerometer, compass gyroscope and barometer.	Activity Sequence based Map Matching And Labeling WiFi Observations	Office building, 2756.25m ² floor plan.	Medium error 1.6 m





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WKNN[73] location accuracy based on crowdsourcing	Wi-Fi	Weighted K-Nearest Neighbors (WKNN) classifier	Office Building	Average error 2.8 m
KRR[74] location accuracy based on crowdsourcing	Wi-Fi	sparse recovery algorithm	Office Building	Average error 2.7 m
LASSO[75] location accuracy based on crowdsourcing	Wi-Fi	sparse recovery algorithm	Office Building	Average error 2.6 m
PCA-KRR[76] location accuracy based on crowdsourcing	Wi-Fi	Principal component analysis, kernel ridge regression	Building	Average Error : 2.13 m
KLFDA [77] location accuracy based on crowdsourcing	Wi-Fi	kernel local Fisher discriminant analysis	Building	error distance of 2 m
KDDA [78] Machine learning based approach	Wi-Fi	kNN Classifier	Building	Positioning errors are 1.5m.
DZ-ELM [79] Machine learning based approach	Wi-fi	Dead zone extreme learning machine	Building	Localization accuracy of 2.19 m
EKF [80] Based on Filtering	Wi-fi +IMU	Extended Kalman filter	Building	Localization error : 1.2 m
GBF [801] Based on filtering	Wifi+ IMU	grid-based Bayesian filter	Building	Localization error : 1.4 m



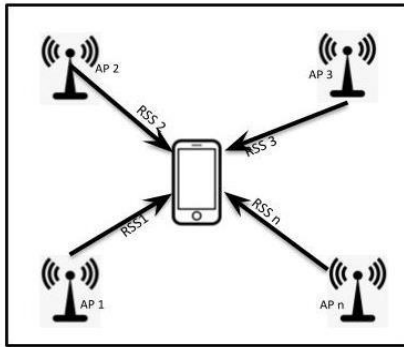


Figure 2: RSSI based distance estimation.

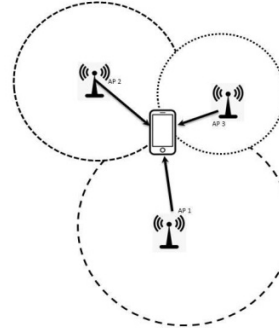


Figure 3: TOA based distance estimation

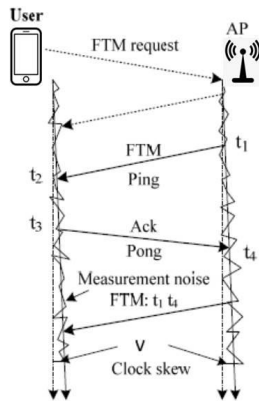


Figure 4: RTT based distance estimation

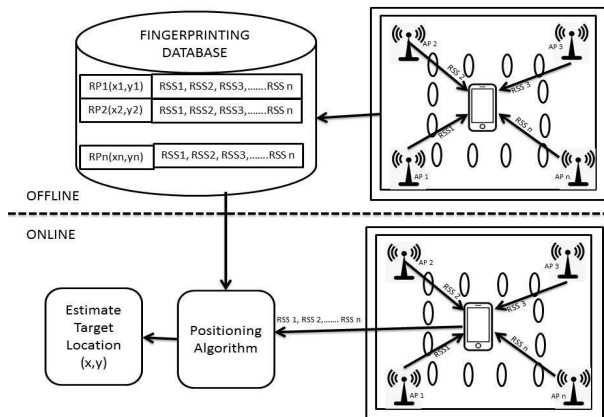


Figure 5: Fingerprinting based positioning system

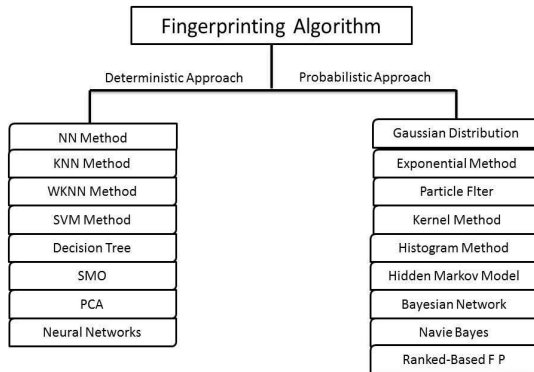


Figure 6: Illustration of the fingerprinting algorithm

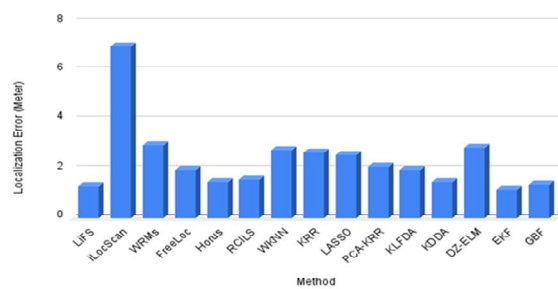


Figure 7: Result analysis of localization error





Knowledge and Satisfaction Regarding the Safe Injection Practices – A Hospital based Cross Sectional Study

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ABSTRACT

"One of the most prevalent medical treatments in health-care is injections." Patients, communities, and health-care staff are all affected by the problem of dangerous injection procedures. When oral alternatives are available for common diseases, injections are recommended unnecessarily. Unsafe injection equipment handling can be hazardous to health-care workers, waste handlers, and the general public. To measure patients' knowledge and satisfaction with safe injection techniques. The research design used in this study was cross sectional descriptive survey research design. The sampling techniques used for this study was simple random sampling. The participant's were 360 patients who were visited to different health facilities for their illness in Surat city. The tool consists of socio demographic data of patients and structured knowledge questionnaires & observational checklist to assess knowledge and satisfaction level of patients about safe injection practices by health care providers. Data analysis was planned on the basis of objectives of the study using descriptive and inferential statistics in consideration with hypothesis of the research study. Overall, 957 patients (66.45%) had strong understanding of safe injection practice, while 483 patients (33.54%) had low knowledge. The study's main findings revealed that the majority of patients (87.87%) were satisfied with the overall aspect of the safe injection administration technique by health care providers, while the remaining patients (12.12%) were dissatisfied. Through exit interviews with patients, health care practitioners recognized some features of safe injection practices in the examined health care institutions. However, there are still some sectors where harmful practices continue to exist, putting patients and health care personnel at risk.

Keywords: Safe injection practice, injection practice, Exit interview, Health care provides, Patient safety.





INTRODUCTION

Injection is one of the most common health care procedures. Each year at least 16 billion injections are administered in developing and transitional countries. The vast majority around 95%, are given in curative care. Immunization accounts for around 3% of all injections, with the remainder for other indications, including use of injections for transfusion of blood and blood products and contraceptives [4]. There are 40% of injections administered with unsterilized faulty techniques, reused syringes and needles. This proportion goes up to 70% in some developing country exposing millions of people to risk of infection and needle stick injuries [2]. Poor collection and disposal of dirty injection equipments plays vital role to exposes health care provider and community people to the risk of needle stick injuries. There are some black markets that recycled unsafe disposals and resale it in some counties which is highly risky to health care providers and community people [3].

To prevent the risk to the health care providers and community people, some country has their policies or legislation to use safety syringe or another method for administering medicines whenever required [5]. Open burning of syringes in some countries is declared unsafe by the WHO.(Injection (medicine) [6]. Almost 77 percent of service providers had unsafe injection practices, including the use of a boiling pan for sterilization, recapping of needles and exposures to body fluids. The proportion of unsafe injection practices was higher among government health service providers [7]. The prevalence of needle stick injuries among service providers was 52.2 percent and the annual incidence of needle stick injuries was 19 percent (Pandit N.B, 2008) [1]. In 2000, WHO estimated that contaminated injection might have cause 250000 HIV infection among injection recipients and 1000 among injection providers [8]. In developing country, it is estimated that 20%- 50% of all injections administered are unsafe or done with reused syringes [9]. In additions, in some country of WHO eastern Mediterranean region like Egypt and Pakistan, unsafe injection have been significant mode of transmission responsible for the introduction of HCV. Unsafe injection do not harm the patients but also carry risk to the health care workers [2].

Needle stick injury commonly encountered by the health care workers. About thirty different infectious diseases can be transmitted by needle stick injury (WHO,2002) [10]. Finding of the National wide population based cluster survey suggest that in India, there were three billion injections approximately to be administered annually. 1.89 billion were consider as unsafe. Findings with Evidence suggests that there would be micro-level leadership for reducing injection overuse and responsibilities lies within prescriber to make it safe.(Arora,N2012) [8] . At least 19 outbreaks associated with single-dose/single-use medications are due to unsafe injection practices. Out of 19, seven involved blood borne pathogens and remain bacterial infections which needed immediate hospitalization (CDC, 2007) [11]. Prescribers and health care providers have a key role to play in making the right choices that support safe injections and reduce unnecessary injections (WHO) [12].

Objectives

The objectives of this study were to assess the knowledge and satisfaction of patients related to safe injection practices in the health facilities of Surat city.

MATERIAL AND METHODS

Study Design

The present Descriptive Cross-sectional Survey study was conducted in the selected health care facilities of Surat city. This study were consist of observation of health care facilities, injection events and interview with all the patients who were received injection by health care providers to assess the knowledge, opinion and satisfaction level of patients regarding safe injection among the health care facilities of surat city.



**Sanjay Kumar Dabhi and Niraj. B. Pandit****Study population**

The population of the study comprises of patients who were received injection by health care providers in the selected different health care facilities of Surat city.

Sampling and sampling method

There are seven zones in Surat city. First of all, health care facilities of the present study will be selected with the simple random method from the seven zones of Surat city. The patients who were visited selected health care facilities were observed for injection events and interview were taken to assess knowledge, opinion and satisfaction level regarding safe injection practices. There were 360 patients randomly selected from government, Surat Municipal Corporation and health care facilities of each zone of Surat city. Total 26 health care facilities were selected by simple random lottery method.

Size of the sampling

Size of the sample was decided by the OPEN EPI software which is online available at the confidence level of 95% and margin of error is 5%, the approximate sample size for present study was 360.

Inclusion Criteria

- All the patients male or female, who were visited selected health care facilities of surat city.
- They able to read write and understand Gujarati and Hindi.
- They must be voluntarily to participate.
- Patients required injection as per their illness were selected.
- Patients available during the study were selected.

Exclusion Criteria

- Patients who were not willing to participant.
- Patients who didn't required injection.
- Patients didn't available at the time of data collection.

Study Area and Study Setting

The study was conducted among the patients of selected health care facilities of different zones of Surat city. The study was conducted in selected OPD of Government, semi government, municipal hospitals, private hospitals, clinics of selected different health care facilities of different zones of surat city.

Research Tool and Techniques

First of all, Surat city was divided in seven zones. Out of seven zones, one zone was selected by simple random lottery method for pilot study. Remain were selected for main study. Simple Random Sampling were use to select patients for exit interview from selected health care facilities of the different zones of Surat. To collect the data for present study, tool were selected and modified from the WHO Revised tool guideline and were constructed with help of it. Tool were in the form of structured knowledge questionnaire for exit interview. The content validity of the tool will be tested by the opinion of experts in the field nursing and medical profession, who had done MD, M.sc. and PhD in their respected field and having minimum 3 years experience in teaching or clinical side. The structured knowledge questionnaires were administered randomly to the sample population; reliability was tested by split half method and item analysis or through computer software.

Pilot study

After reliability and validity, Pilot study was conducted at different ward of new civil hospital, Surat. The sample characteristics were similar to the final study samples. The pilot study was conducted to find out clarity, reliability & feasibility of the tools. There were no ambiguity found within it and language was found to be simple, Clear and understandable.





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Data Collection and Data Analysis

Plan for data collection

Data were collected after obtaining prior permission from the concerned authorities of the Surat city and from clearance of ethical committee, sumandeeep vidyapeeth and Government medical college, Surat. The list of selected zones were made, from that one zone were selected by lottery method without replacement for the pilot study. Remain zones were selected for main study. Each participant was visited during study and exit interview were conducted to collect data. If he/she will be not available, they will be replaced. Each participant got 30-40 minutes.

Data presentation

Data were presented in simple frequency statistical tables, charts and figures.

Statistical Tool and Techniques

Data were reviewed, edited and entered into computer and were analyze by software program statistical package for social sciences (SPSS) V16. Some variables under study were tested using chi squire test with p value less than 0.05 considering significant relation.

Data Analysis and Interpretation

Collected data were organizing systematically and were interpreted in the form of tables and charts for analysis. For interpretation of data descriptive statistical methods were used. In relation to the above table-1, findings of the study revealed that that majority of the patients 344 (95.6%) were satisfied with the patients' identification and verifying procedure prior to injection administration by the health care providers while rest of the participants 16 (4.4%) were unsatisfied. In relation to the taking history prior to the administration of injection data from the table -1 revealed that that majority of the patients 321 (89.2%) were satisfied with the health care providers while rest of the participants 16 (4.4%) were unsatisfied. As per the mention in above table -1, In relation to Detail information about injection prior to administration revealed that that majority of the patients 287 (79.7%) were satisfied with the health care providers while rest of the participants 73 (20.3%) were unsatisfied.

As per indicated in table -1, findings suggested that that majority of the patients 319 (88.6%) were satisfied with the health care providers while rest of the participants 41 (11.4%) were unsatisfied with the aspect of verbal or written permission taken prior to the injection administration. With regards to the table -1, data revealed that that majority of the patients 289 (80.3%) were satisfied with the health care providers while rest of the participants 71 (19.7%) were unsatisfied with the aspect of Preparation of required articles in injection tray or trolley prior to the injection administration. Findings of the above table -1 indicated that that majority of the patients 303 (84.2%) were satisfied with the health care providers while rest of the participants 57 (15.8%) were unsatisfied regarding aseptic technique maintained prior to the injection administration. With regards to the table -1, findings indicated that that majority of the patients 352 (97.8%) were satisfied with the health care providers while rest of the participants 8 (2.2%) were unsatisfied in relation to cleaning of the injection site prior to injection administration.

Findings regards to the table -1, revealed that that majority of the patients 313 (86.9%) were satisfied with the health care providers while rest of the participants 47 (13.1%) were unsatisfied with the aspect of Disposable syringe with one needle used prior to injection administration. In relation to the table -1, study findings suggest that majority of the patients 336 (93.3%) were satisfied with the health care providers while rest of the participants 24 (6.7%) were unsatisfied with the practice regarding injection site pressed with sterile gauze and applied tap after injection administration. With regards to the table -1, findings of the study indicated that majority of the patients 333(92.5%) were satisfied with the health care providers while rest of the participants 27 (7.5%) were unsatisfied with the practice regarding disposed of plastic syringe in red bag and needle in puncture proof container as per BMW protocol. As per the mentioned in above the table -1, data of the study showed that majority of the patients 312(86.7%) were satisfied with the health care providers while rest of the participants 48 (13.3%) were unsatisfied with the practice regards to the proper hand hygiene maintained after injection procedure. With data mentioned in



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the table -1, findings showed that majority of the patients 287(79.7%) were satisfied with the health care providers while rest of the participants 73 (20.3%) were unsatisfied with the aspect of properly documentation of injection procedure after injection administered.

In relation to the table-2, Major findings of the study revealed that majority of the patients 87.87 percentage were satisfied with the all over aspect of the safe injection administration procedure by the health care providers while rest of the patients 12.12 percentage were unsatisfied with it. Findings of the table-3 revealed that majority of the patients 289(80.27%) were prefer oral medication where 71 (19.7%) preferred injections. In relation to the transmission of disease by dirty syringe, 281(78.25%) patients agreed that dirty syringes spreads disease, rest of the patients 79 (21.94%) didn't agreed. In relation to the name of the spread by dirty syringes, 170(47.22%) patients knew the disease spread by dirty syringes but majority 190(52.77%) didn't know about it. In relation to the prescription of injection, majority of patients 217(60.27%) asked for injections from the prescriber while 143(39.72%) leave on the prescriber to decide. From the above table-3, we can conclude that overall, majority 957(66.45%) patients had good knowledge about safe injection practice where 483(33.54%) had a poor knowledge.

RESULTS

Overall, majority 957(66.45%) patients had good knowledge about safe injection practice where 483(33.54%) had a poor knowledge. Major findings of the study revealed that majority of the patients 87.87 percentage were satisfied with the all over aspect of the safe injection administration procedure by the health care providers while rest of the patients 12.12 percentage were unsatisfied with it.

DISCUSSION

The present study was done to assess the safe injection practices by taking a exit interviews of patents who were visited hospitals for their illness and received injection by health care providers of different health care facilities of Surat city. As per findings of exit interview, 87.87% injection practice was considered as a safe rest of the injection practice (12.12%) was unsafe. revealed that majority of the patients 289(80.27%) were prefer oral medication where 71 (19.7%) preferred injections. In relation to the transmission of disease by dirty syringe, 281(78.25%) patients agreed that dirty syringes spreads disease, rest of the patients 79 (21.94%) didn't agreed. In relation to the name of the spread by dirty syringes, 170(47.22%) patients knew the disease spread by dirty syringes but majority 190(52.77%) didn't know about it. In relation to the prescription of injection, present study revealed that majority of patients 217(60.27%) asked for injections from the prescriber while 143(39.72%) leave on the prescriber to decide. Notwithstanding these results, findings of the study of Arora-N, injection practices in India revealed that most of the times (70.6%), doctors took a decision about the prescription and the clients accepted it. Enquiries with clients underscored this, where a large proportion of clients 44.1% (95% CI: 42.7-45.6) accepted the doctor's decision to administer injections even when these were perceived to be unnecessary⁸. When clients who were insisting on an injection were questioned about why they prefer to receive injections, 73.8% (95%CI: 72.5-75.1) cited certain benefits of the injections over oral medicines (e.g. quick relief, more effective method of illness treatment). From the above table-3, we can conclude that overall, majority 957(66.45%) patients had good knowledge about safe injection practice where 483(33.54%) had a poor knowledge.

CONCLUSION

Overall, majority 957(66.45%) patients had good knowledge about safe injection practice where 483(33.54%) had a poor knowledge. Major findings of the study revealed that majority of the patients 87.87 percentage were satisfied with the all over aspect of the safe injection administration procedure by the health care providers while rest of the patients 12.12 percentage were unsatisfied with it. Some aspects of the safe injection practices were noticed in the studied health care facilities by health care providers through exit interview of patients. but there remain a number



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of areas where unsafe practices still persists placing patient and health workers at risk of associated hazards. Training concentrating on injection safety, guidelines to dispose biomedical waste and monitoring of the activity is needed.

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Ethical Consideration

The written ethical approval was taken from the authority of ethical committee, Government Medical college, Surat prior to conduct the study and also from the sumandeep ethical committee. Patients were voluntary participate. Verbal and written consent was taken from patients. Privacy, anonymity and confidentiality of the data obtain were assured.

Feasibility of the Study

There is no feasibility issue applicable for the study.

Benefits of the Study

Benefit of this study was in favour of the participants. The participants were needed base action and recommendation for the safe injection practices.

Conflict of Interest

There are no conflicts of interest.

Financial Support & Sponsorship

Nil

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Table 1: Frequency distribution table of the Exit interview of the patients to assess the safe injection practice by HCP.

Q-NO	Aspect of safe injection practices must be fulfilled by the HCP.	Frequency distribution of patients regarding exit interview to get opinion (Satisfaction) regarding aspect of safe injection practice by HCP.				
		YES	PERCENTAGE	NO	PERCENTAGE	TOTAL (%)
1	Identification and verification of patient with full name, register number of case paper prior to injection administration.	344	95.6	16	4.4	100
2	Properly history taken prior to injection administration.	321	89.2	39	10.8	100
3	Detail information about injection prior to administration.	287	79.7	73	20.3	100
4	Written or verbal permission taken for injection administration	319	88.6	41	11.4	100
5	Preparation of required articles in injection tray or trolley.	289	80.3	71	19.7	100
6	Aseptic technique maintained. E.g. Proper hand hygiene, wear sterile glove and injection preparation done In front of patients.	303	84.2	57	15.8	100
7	Cleaning of the injection site prior to injection administration.	352	97.8	8	2.2	100
8	Disposable syringe with one needle used.	313	86.9	47	13.1	100
9	Injection site pressed with sterile gauze and applied tap after injection administration.	336	93.3	24	6.7	100
10	Disposed of plastic syringe in red bag and needle in puncture proof container as per BMW protocol	333	92.5	27	7.5	100
11	Proper hand hygiene maintained after injection procedure	312	86.7	48	13.3	100
12	Properly documentation of injection procedure	287	79.7	73	20.3	100
	TOTAL RESPONSES (4320)	3796		524		





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Table 2: Frequency distribution about opinion (Satisfaction) of patient regarding aspect of safe injection practice by HCP.

CATEGORY	FREQUENCY	PERCENTAGE
UNSATISFIED	524	12.13
SATISFIED	3796	87.87
TOTAL	4320	100

Table 3: Knowledge Score of Exit Interview of Patients

QUESTIONS	AREAS	FREQUENCY		PERCENTAGE	
		YES	NO	FREQUENCY	PERCENTAGE
Q-1	Do you prefer oral medication instead of injection?	289	71	80.27	19.72
Q-2	Do you think dirty syringe and needles can transmit diseases?	281	79	78.25	21.94
Q-3	When you go to the prescriber for any illness, do you ask for injection or do you leave it to the prescriber order to decide.	217	143	60.27	39.72
Q-4	Can you name any diseases that can be transmitted with dirty syringe and needles? If yes, Please mention it.	170	190	47.22	52.77
TOTAL(1440)	OVERALL	957	483	66.45	33.54

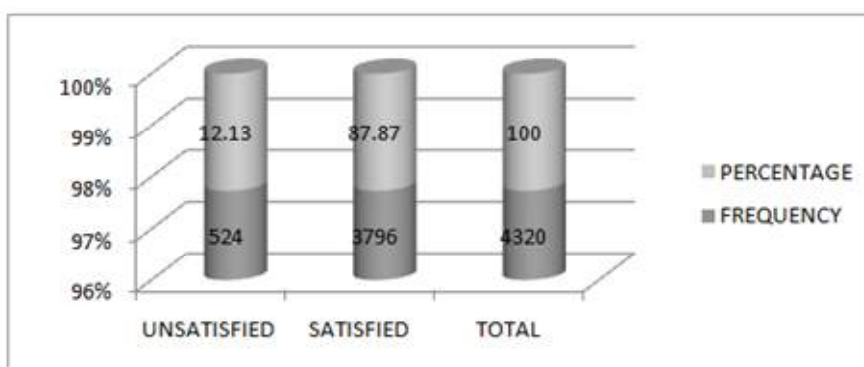


Figure 1. Frequency distribution table of the Exit interview of the patients to assess the safe injection practice by HCP.





Effects of Isolated and Combined Strength and Yogic Programme on Corporeal, Physiological and Skill Performance Variables among College Cricket Players

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ABSTRACT

Cricket performance is known to be influenced by skills to overall development. Present, training sessions typically involve fielding-specific drills and conditioning exercises. Scientific evidence for inclusion of a comprehensive yoga involvement in daily training and exercise sessions remains unknown. The present explored the effects of isolated and combined strength and yogic programme on corporeal, physiological and skill performance in cricket players. The study were conducted among 60 male college cricket player aged 18 to 25 years. The fitness and skill performance was evaluated to physical fitness variables as speed, physiological variables VO₂ Max Skill Performance Skills cricket batting before the training and after 8 weeks of training. The subjects were randomly assigned into four groups, namely strength training group, yogic training group, combined strength and yogic training and control group. Statistically significant improvements in baseline scores in speed, physiological variables VO₂ Max Skill Performance Skills cricket batting were comparable between the three groups of college cricket players. Speed improved by 6.68 in strength group, 6.83 in the yoga group 6.78 combined strength and yoga group 73.26 in the control group. VO₂ Max improved by 74.03 in strength group, 72.20 in the yoga group 6.78 combined strength and yoga group 69.89 in the control group. Batting ability improved by 8.05 in strength group, 6.28 in the yoga group 7.33 combined strength and yoga group 4.98 in the control group. Additional research on long-duration intervention in elite players may help to establish the role of yoga in conventional cricket-batting ability for training.

Keywords: Physical fitness, strength training, yogic training, cricket, VO₂ Max





INTRODUCTION

Sport performance is the manner in which sport participation is measured. Sport performance is a complex mixture of biomechanical function, emotional factors, and training techniques. When an athlete and the coach can isolate areas on which to focus in training, the ultimate result is likely to be improved. Body proportions, skills training, strength, flexibility and endurance. These five factors will influence what sport you play, what position you play and how good you can be at either. Each of these factors may individually or as a group affect your sport performance. Cricket is a team sport played using a bat and ball on an oval-shaped outdoor arena. During the course of a cricket game we experience long rest intervals with short bursts of high intensity. As a result, specific components of fitness are essential for a high-level of cricket performance. Cricket is a sport that generates a broad range of reaction from sports fans. Among those who are a part of more action-packed athletic traditions, cricket is variously seen as a boring, tedious game. In the present day the game of cricket has developed to such an extent that millions of people take part and many more around the world take an interest through the media to watch the game. Teaching, training and coaching in cricket are essentially an educational process. The cricketer is supervised and educated by the coach, trainer or physical education teacher. In cricket, offensive (batting) principles include scoring runs, avoiding getting out or defending the wicket (staying in), and hitting into space to achieve these offensive goals.

METHODOLOGY

The Methodology for the present investigation is on the effects of isolated and combined strength and yogic programme on corporeal, physiological and skill performance variables among inter collegiate cricket players. The purpose of study 60 male cricket students selected from various colleges. Their age ranges between 18 to 25 years. The subjects were randomly assigned into four groups, namely experimental group I (strength training), Experimental group II (yogic training), experimental group III (strength and yogic training) and control group. In order to ensure the full cooperation from the subjects, the scholar had a meeting with them and explained the purpose of the study. It was made clear by explanation in order to ascertain that there was no ambiguity among the players regarding the effort, which they had to put in for the successful completion of this study. Experimental group I participated for a period of 8 weeks resistance training with game specific training. Experimental group II participated for a period of 8 weeks yoga practices with game specific training. Experimental group III for a period of 8 weeks resistance and yoga training with game specific training and Control group only game specific training. The subjects were tested on selected criterion variables physical fitness variables as speed, physiological variables VO₂ Max and Skill Performance Skills cricket batting before the training and after 8 weeks of training.

Training Procedure

Experimental Group-I underwent strength training, experimental Group-II underwent yogic training and experimental Group-III underwent combined training respectively. The control group was not exposed to any specific training / conditioning programme. The experimental treatments namely strength training, yogic training and combined training was administered for duration of 82 weeks and the number of session per week was confined to three alternative days and each session lasted 60 minutes.

Statistical Technique

The collected data from the three groups prior to and after the experimental treatments on selected physical, physiological and performance variables were statistically analyzed by using the statistical technique of analysis of covariance (ANCOVA). Whenever the 'F' ratio for adjusted post-test means was found to be significant, Scheffe's test was followed as a post hoc test to determine which of the paired means difference was significant. In all the cases 0.05 level of confidence was fixed as a level of confidence to test the hypotheses.





RESULTS AND ANALYSIS

The influence of independent variables on each of the criterion variables is analyzed and presented below. The training period was limited to twelve weeks. The dependent variables selected for this study were Physical variables Speed Physiological variables, VO₂ Max and performance variables. All the subjects were tested prior to and immediately after the experimental period on the selected dependent variables. The data obtained from the experimental groups before and after the experimental period were statistically analyzed with dependent 't'-test and Analysis of covariance (ANCOVA). Whenever the 'F' ratio for adjusted post-test means was found to be significant, the Scheffe's Posthoc test was applied to determine the paired mean differences. The level of confidence was fixed at 0.05 level for all the cases.

CONCLUSION

The findings of the study showed that there was a statistically significant improvement in the physical fitness variables speed physiological variables VO₂ Max and Skill performance variables batting ability as compared to control group.

1. The results of the study shows that the experimental group-I that had undergone strength training group, improved corporeal variables namely Speed, physiological variables namely VO₂ Max, skill performance variables namely cricket batting ability of college level men cricket players.
2. The results of the study shows that the experimental group-II that had undergone yoga training group, improved corporeal variables namely Speed physiological variables namely VO₂ Max skill performance variables namely cricket batting ability of college level men cricket players.
3. The results of the study shows that the experimental group-III that had undergone combined training group, improved corporeal variables namely Speed physiological variables namely VO₂ Max skill performance variables namely cricket batting ability of college level men cricket players.

Recommendations

It is recommended that coaches and physical educators in the game of cricket should give due to include strength training group, yoga training group and combined training group in their training schedules. In the physical exercise, while designing the training programme the effect of varied training modalities is explained on positively on physical fitness parameters and skill performance variables of cricket players, the physical education teachers and coaches can prefer this type of training so as to achieve aim in time.

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Table 1: Analysis of covariance among strength training group I, yoga training group II, combined training group III and control group on speed

	Strength Training Group	Yoga Training Group	Combined Training Group	Control Group	Source of Variance	Sum of square	df	Mean square	F-value
Pre test Mean	7.04	7.05	7.02	7.06	Between	0.13	3	0.004	0.16
					Within	1.496	56	0.027	
Post test Mean	6.68	6.84	6.76	7.03	Between	1.019	3	0.340	14.12*
					Within	1.347	56	0.024	
Adjusted post mean	6.68	6.83	6.78	7.01	Between	0.859	3	0.286	67.21*
					Within	0.234	55	0.004	





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Table 2: Analysis of covariance among strength training group I, yoga training group II, combined training group III and control group on vo₂ max

	Strength Training Group	Yoga Training Group	Combined Training Group	Control Group	Source of Variance	Sum of square	Df	Mean square	F-value
Pre test mean	69.06	70.20	70.20	70.33	Between	15.783	3	5.261	0.79
					Within	373.06	56	6.662	
Post test mean	73.33	72.40	73.46	70.20	Between	102.58	3	34.194	5.24*
					Within	365.06	56	6.519	
Adjusted post mean	74.03	72.20	73.26	69.89	Between	143.33	3	47.778	20.70*
					Within	126.92	55	2.308	

Table 3: Analysis of covariance among strength training group I, yoga training group II, combined training group III and control group on cricket batting ability

	Strength Training Group	Yoga Training Group	Combined Training Group	Control Group	Source of Variance	Sum of square	Df	Mean square	F-value
Pre test mean	4.86	4.73	4.93	4.86	Between	0.317	3	0.106	0.17
					Within	33.33	56	0.595	
Post test mean	8.06	6.20	7.40	5.00	Between	82.40	3	27.46	44.03*
					Within	34.93	56	0.624	
Adjusted post mean	8.05	6.28	7.33	4.98	Between	79.98	3	26.663	93.52*



Figure 1: The adjusted post test mean values of experimental group I, experimental group II, experimental group III and control group on speed

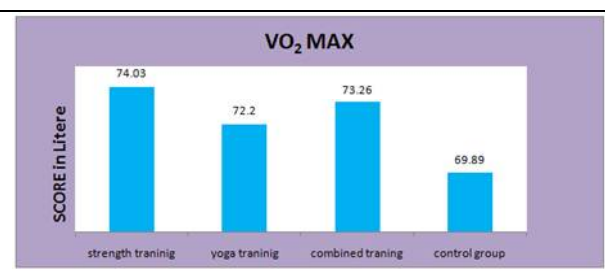


Figure 2: The adjusted post test mean values of vo₂ max of experimental group I, experimental group II, experimental group III and control group.

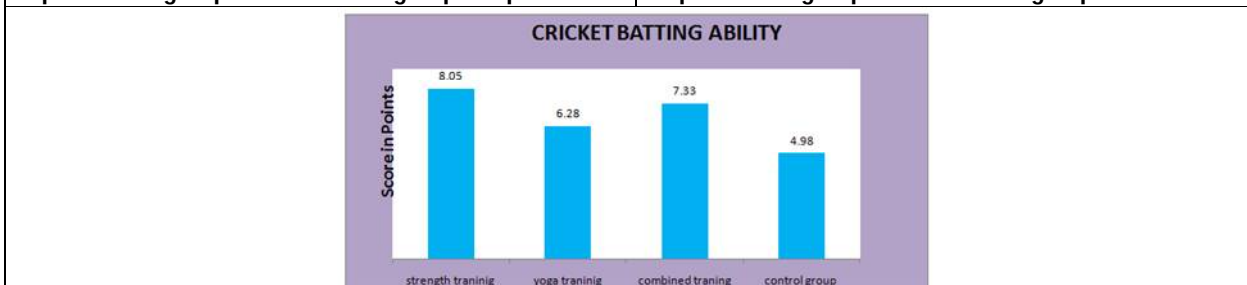


Figure 3: The adjusted post test mean values of cricket batting ability of experimental group I, experimental group II, experimental group III and control group.





Heat and Mass Transfer solution of MHD Absorbing Convective Flow Past an Exponentially Accelerated Vertical Plate

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ABSTRACT

An analysis is carried out to study the effects of heat and mass transfer on MHD flow be due a warm, incompressible, electrically conducting fluid to a vertical plate that's exponentially accelerated to a constant free stream are investigated analytically. Character of heat and mass transfer are examined beneath the influence of magnetic field with heat absorption. This model composes extremely non-linear governing equations that are transformed using similarity variables and are after that resolved by Laplace transform method. A parametric study illustrate the influence of varied flow parameters on velocity, concentration and temperature are investigated. Numerical results are presented for various parameters

Keywords: MHD; Free Convection; Exponential Plate; Laplace Transform Technique;

INTRODUCTION

Transform manages the transformation of one capacity to different capacity which will not be in a similar area. Laplace change is an incredible method that actually changes the differential condition into a basic mathematical articulation, again just changed into the arrangement of the real issues. The idea of Laplace Transform assumes a fundamental job in science and innovation, for example, fluid mechanics, electric and correspondence building, basic designing and quantum material science and so forth. Advance in research fields made it conceivable to reenact the Laplace transformable conditions. Michael [1] clarified the improvement of LTT from 1737 to 1937. Khan ([2]-[4]) contemplated the different issues, Shantha [5] examined a MHD free convection stream issue with permeable media and Ali [6] considered a precarious thin film stream of a second grade fluid through a permeable medium by LTT.

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Jagdev [7] examined a solid calculation for tackling stopped issues emerging in nanotechnology utilizing Laplace Transform method. Hayat [8] broke down the temperamental Couette stream of a second grade fluid in a layer of permeable medium. The impacts of illustrative movement, warm age/assimilation and thermo-dispersion on precarious free convective MHD stream of transmitting and artificially receptive second grade fluid almost an unbounded vertical plate through permeable medium have been considered by Kataria and Patel [9].

MHD is a part of fluid elements which examines the development of an electrically directing fluid in an magnetic field. Research works in the magnetohydrodynamics have been progressed fundamentally amid the most recent couple of decades after the pioneer work of Hartmann [10] in fluid metal conduit streams under outer attractive field. There are numerous applications for the allegorical movement, for example, sun oriented cookers, sunlight based concentrators and explanatory through sun powered gatherer. An allegorical concentrator type sun oriented cooker has an extensive variety of uses, for example, preparing, broiling and refining. Sun powered concentrators have their applications in expanding the rate of vanishing of waste water, in sustenance preparing, for making drinking water from salty and seawater. Murty *et al.* [11] manage assessment of warm execution of warmth exchanger unit for illustrative sun powered cooker and Raja *et al.* [12] manage structure and assembling of explanatory through sun based gatherer framework. Muthucuma raswamy and Geetha [13] talk about impacts of explanatory movement on an isothermal vertical plate with consistent mass transition. Akbar *et al.* [14] consider MHD stagnation point stream of Carreau fluid toward a porous contracting sheet. Sheikholeslami *et al.* [15], [16], [17] research Magnetic field impact on nanofluid stream, while Sheikholeslami and Ellahi [18] manage three dimensional mesoscopic recreation of attractive field impact on nanofluid. Sheikholeslami *et al.* [19] characterize the arrangement of constrained convection warm exchange with variable attractive field, and Sheikholeslami and Chamkha [20] contemplate free convection heat exchange of a nanofluid in a semi-annulus fenced in area with a sinusoidal divider, while explicitly ferro-nanofluid is likewise talked about by Sheikholeslami *et al.* [21], [22]. Kataria *et al.* [23] got the arrangement of impact of magnetic field on micropolar fluid between two vertical dividers. Sheikholeslami *et al.* [24], [25], and Kataria and Mittal [26] have examined about impact of warm radiation parameter on nanofluid stream. The essential law overseeing the stream of fluids through permeable media is Darcy's Law. Significance of permeable medium in MHD stream is displayed by Nadeem *et al.* [27] and Kataria and Mittal [28]. Then again the examination contemplates identified with heat producing or heat engrossing fluid stream are of extensive significance in a few physical issues viz. Abbasi *et al.* [29] manage blended convection stream of Maxwell nanofluid with warmth age, while Shehzad *et al.* [30] contemplate three dimensional MHD Casson fluid stream with heat age through permeable medium and Fetecau *et al.* [31] manage slip impacts on radiative MHD stream over a moving plate with heat source. A portion of the various critical uses of heat and mass transfer stream with synthetic response can be found in synergist substance reactors, sustenance handling, polymer generation, make of pottery and crystal, refining, experiencing exothermic or endothermic concoction response. Kataria and Patel [32] manage radiation and synthetic response impact on MHD Casson fluid course through permeable medium. Ajit Paul *et al.* [33] Heat and mass transfer effects on an unsteady hydromagnetic free convective flow over an infinite vertical plate embedded in a porous medium with heat absorption. E.M. Reddy *et al.* [34] Heat and Mass Transfer with Free Convection MHD Flow past a Vertical porous Plate

Consequently, in the present work, we have performed analytical examinations on MHD heat and mass transfer flow past an exponentially accelerated isothermal vertical plate within the sight of heat absorption and variable temperature by applying Laplace transform technique. The administering arrangement of coupled non-straight halfway differential conditions is comprehended by a proficient Laplace transform technique for the velocity, temperature and concentration with different thermo physical parameters. Further, the articulations for the nearby skin-friction, local Nusselt number and nearby Sherwood number coefficients have been inferred.

Mathematical Formulation

In the presence of heat absorption and variable temperature, the unstable MHD flow of viscous, electrically conducting incompressible fluid has been studied through an exponentially accelerated infinite vertical plate with





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uniform temperature and variable mass diffusion. Initially, the plate and the fluid are in stationary state at the same temperature T'_∞ in the stationary condition with concentration level C'_∞ at each point. At time $t' > 0$, the plate is accelerated exponentially with a velocity $u = u_0 \exp(at')$ within its own plane and as well the temperature of the plate is raised linearly with time and species concentration level close to the plate is also raised linearly with time t .

The temperature of the plate and thus concentration level also are raised or lowered to $T'_\infty + (T'_w - T'_\infty)At'$ and $C'_\infty + (C'_w - C'_\infty)At'$ respectively. Figure.1 shows the physical illustration and the set of coordinates. All of the fluid physical properties are considered stable for this investigation except for the effect of the expression of body force.

Applied transverse magnetic field of uniform strength B_0 is normal to the plate. The conductive property of the fluid is meant to be slight and thus the magnetic Reynolds number is lesser than unity and therefore the induced magnetic field is small as compared with the transverse magnetic field. Viscous dissipation and Joule heating in energy equation are neglected. According to Boussinesq's approximation, the unsteady flow is governed by the following set of equations:

Momentum Equation:

$$\left[\frac{\partial u'}{\partial t'} \right] = \mathcal{G} \left[\frac{\partial^2 u'}{\partial y'^2} \right] - \left[\frac{\sigma B_0^2}{\rho} \right] u' + [g\beta(T' - T'_\infty)] + [g\beta^*(C' - C'_\infty)] \tag{1}$$

Energy Equation:

$$C_p \left[\frac{\partial T'}{\partial t'} \right] = \kappa \left[\frac{\partial^2 T'}{\partial y'^2} \right] + [Q_o(T'_\infty - T')] \tag{2}$$

Species Diffusion Equation:

$$\left[\frac{\partial C'}{\partial t'} \right] = D \left[\frac{\partial^2 C'}{\partial y'^2} \right] - D[K_r(C' - C'_\infty)] \tag{3}$$

The corresponding initial and boundary conditions are

$$\left. \begin{aligned} t' \leq 0: & \quad u' = 0, \quad T' = T'_\infty, \quad C' = C'_\infty \text{ for all } y' \\ t' > 0: & \quad \left\{ \begin{aligned} u' = u_0 \exp(at'), \quad T' = T'_\infty + (T'_w - T'_\infty) At', \quad C' = C'_\infty + (C'_w - C'_\infty) At' \quad \text{at } y' = 0 \\ u' = 0, \quad T' \rightarrow T'_\infty, \quad C' \rightarrow C'_\infty \text{ as } y' \rightarrow \infty \end{aligned} \right. \end{aligned} \right\} \tag{4}$$

On introducing the following non-dimensional quantities into the Eqs. (1), (2) and (3)

$$\left. \begin{aligned} u = \frac{u'}{u_0}, \quad t = \frac{t'u_0^2}{\mathcal{G}}, \quad y = \frac{y'u_0}{\mathcal{G}}, \quad \theta = \frac{T' - T'_\infty}{T'_w - T'_\infty}, \quad \phi = \frac{C' - C'_\infty}{C'_w - C'_\infty}, \quad M = \frac{\sigma B_0^2 \mathcal{G}}{\rho u_0^2}, \quad Gr = \frac{g\beta \mathcal{G} (T'_w - T'_\infty)}{u_0^3}, \\ Gc = \frac{g\beta^* \mathcal{G} (C'_w - C'_\infty)}{u_0^3}, \quad Pr = \frac{\mathcal{G} C_p}{\kappa}, \quad Sc = \frac{\mathcal{G}}{D}, \quad S = \frac{Q_o \mathcal{G}^2}{\kappa u_0^2}, \quad a = \frac{a' \mathcal{G}}{u_0^2}, \quad \lambda = \frac{\mathcal{G} K_r}{u_0^2}, \quad Re_x = \frac{u_0 x}{\mathcal{G}}, \quad A = \frac{u_0^2}{\mathcal{G}} \end{aligned} \right\} \tag{5}$$

we obtained the following governing equations in dimensionless form:

Momentum Equation:

$$\frac{\partial u}{\partial t} = Gr\theta + Gc\phi + \frac{\partial^2 u}{\partial y^2} - Mu \tag{6}$$

Energy Equation:





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$$\frac{\partial \theta}{\partial t} = \frac{1}{Pr} \frac{\partial^2 \theta}{\partial y^2} - \frac{S}{Pr} \theta \tag{7}$$

Concentration Equation:

$$\frac{\partial \phi}{\partial t} = \frac{1}{Sc} \frac{\partial^2 \phi}{\partial y^2} - \frac{\lambda}{Sc} \phi \tag{8}$$

The initial and boundary conditions in dimensionless form are as follows:

$$\left. \begin{aligned} t \leq 0: & \quad u = 0, \theta = 0, \phi = 0 \quad \text{for all } y \\ t > 0: & \quad \left\{ \begin{aligned} u = \exp(at), \theta = t, \phi = t \quad \text{at } y = 0 \\ u = 0, \theta \rightarrow 0, \phi \rightarrow 0 \quad \text{as } y \rightarrow \infty \end{aligned} \right. \end{aligned} \right\} \tag{9}$$

The appeared physical parameters are defined in the nomenclature. The Skin-friction, Nusselt number and Sherwood number are important material parameters for this type of boundary layer flow. The Skin-friction at the plate, which in the non-dimensional form is given by

$$Cf = - \left(\frac{\tau'_w}{\rho u_o \vartheta} \right) = - \left(\frac{\partial u}{\partial y} \right)_{y=0} \tag{10}$$

The rate of heat transfer coefficient, which in the non-dimensional form in terms of the Nusselt number is given by

$$Nu = -x \frac{\left(\frac{\partial T'}{\partial y'} \right)_{y'=0}}{T'_w - T'_\infty} \Rightarrow Nu Re_x^{-1} = - \left(\frac{\partial \theta}{\partial y} \right)_{y=0} \tag{11}$$

The rate of mass transfer coefficient, which in the non-dimensional form in terms of the Sherwood number is given by

$$Sh = -x \frac{\left(\frac{\partial C'}{\partial y'} \right)_{y'=0}}{C'_w - C'_\infty} \Rightarrow Sh Re_x^{-1} = - \left(\frac{\partial \phi}{\partial y} \right)_{y=0} \tag{12}$$

Method Of Solution By Laplace Transform Technique:

Laplace transform technique (LTT) is an analytical method employed to solve an unsteady magneto hydromagnetic free convection flow problem in the presence of heat absorption and variable temperature obtained as follows:

$$\theta(y,t) = \left(\frac{t}{2} + \frac{yPr}{4\sqrt{S}} \right) \exp(y\sqrt{S}) \operatorname{erfc} \left(\frac{y\sqrt{Pr}}{2\sqrt{t}} + \sqrt{\frac{St}{Pr}} \right) + \left(\frac{t}{2} - \frac{yPr}{2\sqrt{S}} \right) \exp(-y\sqrt{S}) \operatorname{erfc} \left(\frac{y\sqrt{Pr}}{2\sqrt{t}} - \sqrt{\frac{St}{Pr}} \right) \tag{13}$$

$$\phi(y,t) = \left(\frac{t}{2} + \frac{y}{4} \sqrt{\frac{Sc}{\mu}} \right) \exp(y\sqrt{\mu Sc}) \operatorname{erfc} \left(\frac{y\sqrt{Sc}}{2\sqrt{t}} + \sqrt{\mu t} \right) + \left(\frac{t}{2} - \frac{y}{4} \sqrt{\frac{Sc}{\mu}} \right) \exp(-y\sqrt{\mu Sc}) \operatorname{erfc} \left(\frac{y\sqrt{Sc}}{2\sqrt{t}} - \sqrt{\mu t} \right) \tag{14}$$

$$u(y,t) = \frac{e^{at}}{2} \left[e^{y\sqrt{M+a}} \operatorname{erfc} \left(\frac{y}{2\sqrt{t}} + \sqrt{(M+a)t} \right) + e^{-y\sqrt{M+a}} \operatorname{erfc} \left(\frac{y}{2\sqrt{t}} - \sqrt{(M+a)t} \right) \right]$$





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$$\begin{aligned}
 & -\frac{\alpha}{2} \left[\frac{e^{bt}}{b^2} \left\{ e^{y\sqrt{M+b}} \operatorname{erfc} \left(\frac{y}{2\sqrt{t}} + \sqrt{(M+b)t} \right) + e^{-y\sqrt{M+b}} \operatorname{erfc} \left(\frac{y}{2\sqrt{t}} - \sqrt{(M+b)t} \right) + \exp \left(y \sqrt{\operatorname{Pr} \left(\frac{S}{\operatorname{Pr}} + b \right)} \right) \right\} \right. \\
 & \left. \operatorname{erfc} \left(\frac{y}{2} \sqrt{\frac{\operatorname{Pr}}{t}} + \sqrt{\left(\frac{S}{\operatorname{Pr}} + b \right) t} \right) - \exp \left(-y \sqrt{\operatorname{Pr} \left(\frac{S}{\operatorname{Pr}} + b \right)} \right) \operatorname{erfc} \left(\frac{y}{2} \sqrt{\frac{\operatorname{Pr}}{t}} - \sqrt{\left(\frac{S}{\operatorname{Pr}} + b \right) t} \right) \right] + \\
 & + \frac{1}{b} \left(t + \frac{1}{b} + \frac{y}{2\sqrt{M}} \right) \exp(y\sqrt{M}) \operatorname{erfc} \left(\frac{y}{2\sqrt{t}} + \sqrt{Mt} \right) - \frac{1}{b} \left(t + \frac{1}{b} - \frac{y}{2\sqrt{M}} \right) \exp(-y\sqrt{M}) \operatorname{erfc} \left(\frac{y}{2\sqrt{t}} - \sqrt{Mt} \right) \\
 & + \frac{1}{b} \left(t + \frac{1}{b} + \frac{y}{2} \sqrt{\frac{\operatorname{Pr}}{S}} \right) \exp(y\sqrt{S}) \operatorname{erfc} \left(\frac{y}{2} \sqrt{\frac{\operatorname{Pr}}{t}} + \sqrt{\frac{St}{\operatorname{Pr}}} \right) + \frac{1}{b} \left(t + \frac{1}{b} - \frac{y}{2} \sqrt{\frac{\operatorname{Pr}}{S}} \right) \exp(-y\sqrt{S}) \operatorname{erfc} \left(\frac{y}{2} \sqrt{\frac{\operatorname{Pr}}{t}} - \sqrt{\frac{St}{\operatorname{Pr}}} \right) \\
 & - \frac{\psi}{2} \left[\frac{\exp(dt)}{d^2} \left\{ \exp(y\sqrt{M+d}) \operatorname{erfc} \left(\frac{y}{2\sqrt{t}} + \sqrt{(M+d)t} \right) + \exp(-y\sqrt{M+d}) \operatorname{erfc} \left(\frac{y}{2\sqrt{t}} - \sqrt{(M+d)t} \right) \right\} \right. \\
 & \left. - \exp(y\sqrt{(Sc(\mu+d))}) \operatorname{erfc} \left(\frac{y}{2} \sqrt{\frac{Sc}{t}} + \sqrt{(\mu+d)t} \right) \right. \\
 & \left. - \exp(-y\sqrt{(Sc(\mu+d))}) \operatorname{erfc} \left(\frac{y}{2} \sqrt{\frac{Sc}{t}} - \sqrt{(\mu+d)t} \right) \right] \\
 & - \frac{1}{d} \left(t + \frac{1}{d} + \frac{y}{2\sqrt{M}} \right) \exp(y\sqrt{M}) \operatorname{erfc} \left(\frac{y}{2\sqrt{t}} + \sqrt{Mt} \right) - \frac{1}{d} \left(t + \frac{1}{d} - \frac{y}{2\sqrt{M}} \right) \exp(-y\sqrt{M}) \operatorname{erfc} \left(\frac{y}{2\sqrt{t}} - \sqrt{Mt} \right) \\
 & + \frac{1}{d} \left(t + \frac{1}{d} + \frac{y}{2} \sqrt{\frac{Sc}{\mu}} \right) \exp(y\sqrt{\mu Sc}) \operatorname{erfc} \left(\frac{y}{2} \sqrt{\frac{Sc}{t}} + \sqrt{\mu t} \right) + \frac{1}{d} \left(t + \frac{1}{d} - \frac{y}{2} \sqrt{\frac{Sc}{\mu}} \right) \exp(-y\sqrt{\mu Sc}) \operatorname{erfc} \left(\frac{y}{2} \sqrt{\frac{Sc}{t}} - \sqrt{\mu t} \right) \quad (15)
 \end{aligned}$$

Where $\alpha = \frac{Gr}{1 - \operatorname{Pr}}$, $\psi = \frac{Gc}{1 - Sc}$, $b = \frac{S - M}{1 - \operatorname{Pr}}$, $d = \frac{\mu Sc - M}{1 - Sc}$, $\mu = \frac{\lambda}{Sc}$.

We now study the expression for Skin-friction coefficient (C_f) from Eqs. (10) and (15) which measure Shear stress at the plate which is presented in the following form:

$$\begin{aligned}
 C_f = e^{at} & \left[\sqrt{(M+a)} \left\{ 1 - \operatorname{erfc} \left(\sqrt{(M+a)t} \right) \right\} + \frac{1}{\sqrt{\pi t}} \exp \left(-(M+a)t \right) \right] + \\
 \alpha & \left[\frac{\exp(bt)}{b^2} \left\{ \sqrt{(M+b)} \left(\operatorname{erfc} \left(\sqrt{(M+a)t} \right) - 1 \right) - \frac{1}{\sqrt{\pi t}} \exp \left(-(M+b)t \right) \right\} \right. \\
 & \left. - \sqrt{\operatorname{Pr} \left(\frac{S}{\operatorname{Pr}} + b \right)} \left(\operatorname{erfc} \left(\sqrt{\left(\frac{S}{\operatorname{Pr}} + b \right) t} \right) - 1 \right) + \sqrt{\frac{\operatorname{Pr}}{\pi t}} \exp \left(- \left(\frac{S}{\operatorname{Pr}} + b \right) t \right) \right] + \\
 & \left[- \frac{1}{2b} \left(\frac{\operatorname{Pr}}{\sqrt{S}} \right) \left(1 - \operatorname{erfc} \left(\sqrt{\frac{St}{\operatorname{Pr}}} \right) \right) - \frac{1}{b} \left(t + \frac{1}{b} \right) \left\{ \sqrt{S} \left(1 - \operatorname{erfc} \left(\sqrt{\frac{St}{\operatorname{Pr}}} \right) \right) + \left(\sqrt{\frac{\operatorname{Pr}}{\pi t}} \right) \exp \left(- \frac{St}{\operatorname{Pr}} \right) \right\} \right]
 \end{aligned}$$





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$$-\psi = \left[\frac{\exp(dt)}{d^2} \left\{ (\sqrt{M+d}) \operatorname{erfc}(\sqrt{(M+d)t}) - 1 \right\} - \frac{1}{\sqrt{\pi t}} (\exp(-(M+d)t)) - \sqrt{Sc(\mu+d)} (\operatorname{erfc}(\sqrt{(\mu+d)t}) - 1) \right] + \left[\sqrt{\frac{Sc}{\pi t}} \exp(-(\mu+d)t) \right] + \frac{1}{2b\sqrt{M}} (1 - \operatorname{erf}(\sqrt{Mt})) + \frac{1}{d} \left(t + \frac{1}{d} \right) \left\{ \sqrt{M} (1 - \operatorname{erfc}\sqrt{Mt}) + \frac{1}{\sqrt{\pi t}} (\exp(-Mt)) \right\} - \frac{1}{2d} \sqrt{\frac{Sc}{\mu}} (1 - \operatorname{erfc}\sqrt{\mu t}) - \frac{1}{d} \left(t + \frac{1}{d} \right) \left\{ \sqrt{\mu Sc} (1 - \operatorname{erfc}\sqrt{\mu t}) + \sqrt{\frac{Sc}{\pi t}} (\exp(-\mu t)) \right\} \right] \tag{16}$$

From Eqs. (11) and (13), The rate of heat transfer coefficient or Nusselt number is as follows:

$$Nu = \left[t\sqrt{S} \operatorname{erf} \left(\sqrt{\frac{St}{Pr}} \right) + \sqrt{\frac{tPr}{\pi}} \exp \left(- \left(\frac{St}{Pr} \right) \right) + \frac{Pr}{2\sqrt{S}} \operatorname{erf} \left(\sqrt{\frac{St}{Pr}} \right) \right] \tag{17}$$

From Eqs. (12) and (14), The rate of mass transfer coefficient or Sherwood number is as follows:

$$Sh = \left[t(\sqrt{\mu Sc}) \operatorname{erf} (\sqrt{\mu t}) + \left(\sqrt{\frac{tSc}{\pi}} \right) \exp(-(\mu t)) + \left(\frac{\sqrt{Sc}}{2\sqrt{\mu}} \right) \operatorname{erf} (\sqrt{\mu t}) \right] \tag{18}$$

RESULTS AND DISCUSSIONS

Graphically in Figs. The expository findings reported in the past area and the arrangement of systemic outcome is accounted for 2 to 15. These analytical results are obtained to reflect the impact of M , Gr , Gc , Pr , S , Sc and time t on velocity, temperature, concentration profiles and Skin-friction, Nusselt and Sherwood number coefficients. For all calculations, the estimations of the Prandtl number are picked with the end goal that Mercury ($Pr = 0.025$), Air ($Pr = 0.71$), Water ($Pr = 7.0$), Water at 4°C ($Pr = 11.62$) and the estimations of the Schmidt number are picked to such an extent that Hydrogen ($Sc = 0.22$), Water-vapor ($Sc = 0.60$), Oxygen ($Sc = 0.66$) and Ammonia ($Sc = 0.78$). Every one of the profiles show the asymptotic conduct in the stream because of exponential movement of the plate. This is because of the actuated stream produced by the exponentially accelerated plate. In the present examination, the limit condition for $y \rightarrow \infty$ is supplanted by y_{max} which is an adequately substantial estimation of y where the velocity profiles approaches the important free stream speed and a range shrewd advance separation of 0.01 is utilized with $y_{max} = 15$. The impact of Grashof number (Gr) on velocity profiles is exhibited in Fig. 2. The Grashof number for heat transfer shows the overall impact of the heat lightness power to the viscous hydrodynamic power in the boundary layer. Not surprisingly, it is seen that there is an expansion in the velocity because of the improvement of heat buoyancy constrain. Likewise, as Gr rises, the peak estimations of the velocity increments quickly close to the permeable plate and afterward breaks down easily to the free stream velocity. The impact of Grashof number for mass exchange (Gc) on velocity profiles is exhibited in Fig. 3. The Grashof number for mass transfer describes the proportion of the buoyancy force to the viscous hydrodynamic force. Naturally, the fluid velocity increments and the peak value is progressively unmistakable because of an upgrade in the species buoyancy restrain. The velocity distribution achieves a particular most noteworthy incentive in the territory of the plate and afterward diminishes as it moves towards the free stream esteem. It is seen that the speed amplifies with expanding estimations of Grashof number for mass transfer.

In Fig. 4 the impact of the magnetic field quality on the force limit layer thickness is illustrated. It is currently a settled certainty that the magnetic field displays a damping impact on the velocity field by making drag drive that contradicts the smooth movement, making the velocity decline. Notwithstanding, for this situation an expansion in the M just somewhat backs off the movement of the fluid far from the moving vertical plate surface towards the free



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stream velocity, while the fluid velocity close to the moving vertical plate surface abatements. This wonder is in phenomenal concurrence with the physical reality that the Lorentz drive created in the present stream demonstrate because of connection of the transverse magnetic field and the fluid velocity goes about as a resistive force to the fluid stream which serves to decelerate the flow. Velocity for some practical estimations of Prandtl number $Pr = 0.025, 0.71, 7.0, 11.62$ which are critical as in they physically relate to mercury, air, water and water at 4°C are appeared in Fig. 5. From Fig. 5. It is discovered that the energy boundary layer thickness increments for the fluids with $Pr < 1$ and diminishes for $Pr > 1$. The Prandtl number really portrays the proportion between force diffusivity to heat diffusivity and thus controls the overall thickness of the energy and heat boundary layers. At the point when Pr is little, that is, $Pr = 0.025$ (Mercury), it is seen that the heat diffuses immediately contrasted with the velocity (energy). This implies for fluid metals the thickness of the heat boundary layer is a lot greater than the velocity boundary layer. As the Schmidt number expands, the velocity diminishes in Fig. 6. This causes the focus lightness impacts to diminish yielding a decrease in the fluid velocity. Decreases in the velocity circulations are joined by synchronous decreases in the velocity boundary layers.

Figs. 7 represent the impact of heat ingestion parameter on the velocity at $t = 1.0$. Physically, the velocity conveyance diminishes as S increments. It is additionally seen that the hydrodynamic (velocity) limit layers decline with the expansion in the heat absorption. Fig. 8 demonstrates the velocity for various estimations of substance chemical parameter λ . It is seen that the velocity marginally diminishes with the expansion of the chemical parameter. The influence of time t over velocity profile appeared with the assistance of Fig. 9. Unmistakably the velocity of the fluid ascending with increment of time. In Fig. 10, We saw that the temperature diminishes on expanding Pr , since lower Pr esteem has increasingly uniform temperature appropriation over the heat limit layer when contrasted with higher Pr esteem. This wonder happens when the lesser estimations of Prandtl number are comparable to expanding heat conductivity. Accordingly, heat is proficient to diffuse far from the heated surface all the more immediately contrasted with greater estimations of Prandtl number. Along these lines, the temperature of Water (7.0) falls all the more quickly contrasted with Air (0.71) and Mercury (0.025). Close to the plate, the temperature is most extreme and methodologies zero in the free stream locale asymptotically. The impact of heat absorption parameter on velocity and temperature profiles is appeared in the Fig. 11. It clear that, the nearness of heat assimilation tends to diminish the fluid temperature. Temperature appropriations decline as S increments. It is additionally seen that the heat (temperature) limit layers decline as the heat ingestion increment. The influence of time t on temperature profiles are appeared with the assistance of Fig. 12. Plainly temperature of the fluid ascends with increment of time t . Fig. 13 demonstrates the focus profile because of variety of Schmidt number for the gasses Hydrogen, Water-vapor, Oxygen and Ammonia. It is seen that the grouping of the fluid abatements with the expansion in Schmidt number. The focus falls bit by bit and continuously for hydrogen particular from different gases. Physically, it is valid, since increment of Sc implies decline of sub-atomic diffusivity, which results in decline of focus limit layer. Subsequently, the convergence of species is littler for higher estimations of Sc . Fig. 14 shows the impacts of the chemical parameter on the concentration profiles. The concentration diminishes with increment in the concoction chemical parameter. It is clear that the expansion in the compound chemical fundamentally adjusts the focus limit layer thickness yet does not change the energy limit layers. The influence of time t on focus profiles are represented in Fig. 15. Obviously the focus profiles of the fluid ascend with increment of time.

The numerical values of Skin-friction coefficient is presented in table-1 for variations of Magnetic field parameter, Prandtl number, Heat absorption parameter, Schmidt number and time. From this table, it is observed that, the Skin-friction coefficient is increasing values of time and the reverse effect if observed with increasing values of Magnetic field parameter, Prandtl number, Heat absorption parameter and Schmidt number. From table-2, it is observed that the Nusselt number coefficient is increasing with increasing values of time and decreasing with increasing values of Prandtl number and Heat absorption parameter. Similarly, From table-3, it is observed that the Sherwood number coefficient is increasing with increasing values of time and decreasing with increasing values of Schmidt number and Chemical reaction parameter.





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CONCLUSIONS

The logical arrangements of flimsy free convection, incompressible, viscous, electrically conducting fluid flow past an exponentially accelerated vertical plate with variable temperature in nearness of magnetic field, heat absorption and variable temperature by utilizing Laplace transform technique is examined and the accompanying ends are drawn: The fluid velocity increments with the expansion in Grashof number for heat transfer, Grashof number for mass transfer and time and is seen to diminishes with increment in magnetic field, Prandtl number, Heat Absorption and Schmidt number. The fluid temperature increments with the increase in time while it diminishes with the increase in Prandtl number and Heat Absorption parameter. The fluid focus increments with the expansion in time and diminishes with the increment in Schmidt number and chemical reaction parameter.

The coefficient of Skin-friction increments with the expansion in time while it diminishes with the increment in magnetic field, Prandtl number, Heat Absorption and Schmidt number. The rate of heat transfer diminishes with the increase in Prandtl number and Heat Absorption. The rate of mass transfer diminishes with the increase in Schmidt number and Chemical reaction parameter.

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Table-1.: Numerical values of Skin-friction coefficient

Cf	t	Sc	S	Pr	M
2.1032265849	1.0	0.22	1.0	0.71	1.0
1.8544329152	1.0	0.22	1.0	0.71	2.0
1.8744201559	1.0	0.22	1.0	7.00	1.0
1.9022314782	1.0	0.22	2.0	0.71	1.0
1.8840018426	1.0	0.30	1.0	0.71	1.0
2.2546113598	2.0	0.22	1.0	0.71	1.0

Table-2.: Numerical values of Nusselt number coefficients

Nu	t	S	Pr
0.8955214862	1.0	1.0	0.71
0.7511203698	1.0	1.0	7.00
0.7951247305	1.0	2.0	0.71
1.0562217892	2.0	1.0	0.71

Table-3.: Numerical values of Sherwood number coefficient

Sh	t	λ	Sc
0.8512236489	1.0	1.0	0.22
0.7532210497	1.0	1.0	0.30
0.8012446218	1.0	2.0	0.22
1.0233692154	2.0	1.0	0.22

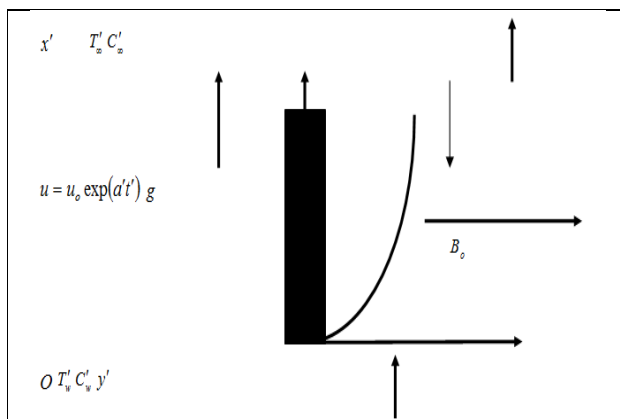


Fig. 1. Physical configuration and coordinate system

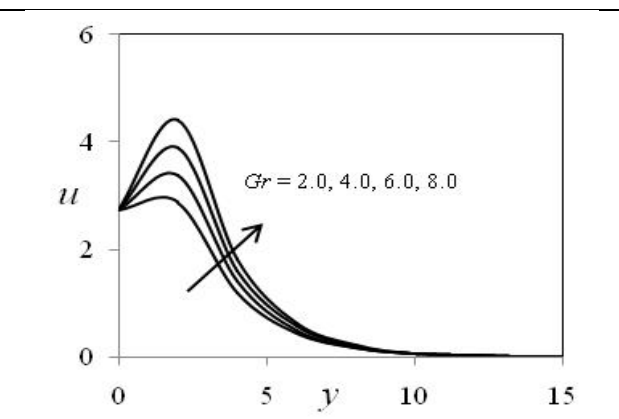


Fig. 2. Velocity profiles for various values of Gr





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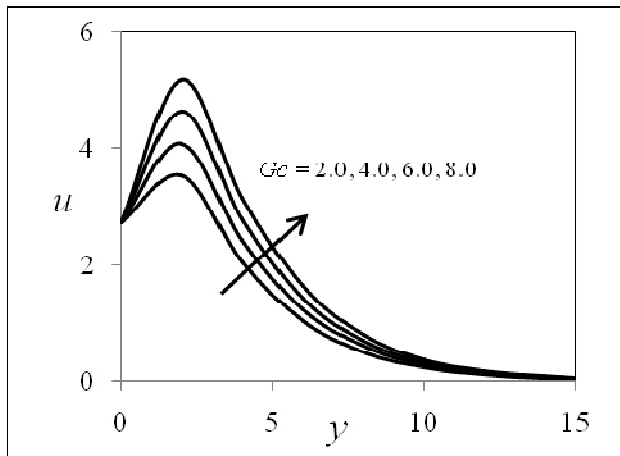


Fig. 3. Velocity profiles for various values of G_c

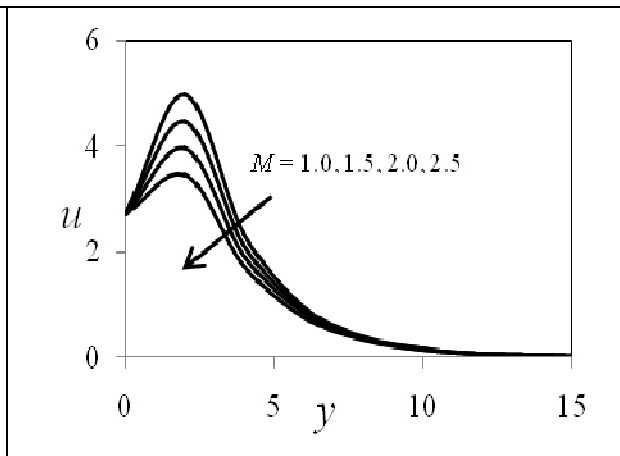


Fig. 4. Velocity profiles for various values of M

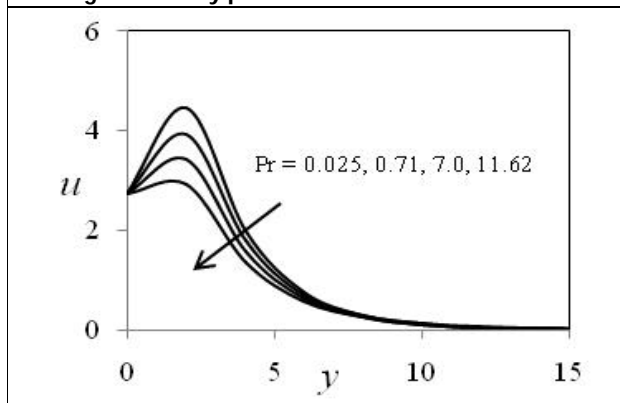


Fig. 5. Velocity profiles for various values of Pr

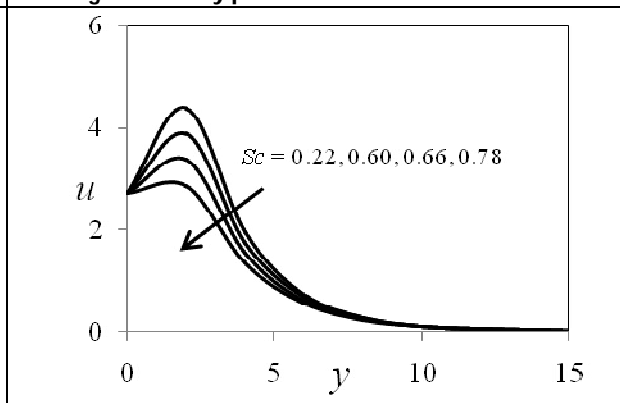


Fig. 6. Velocity profiles for various values of Sc

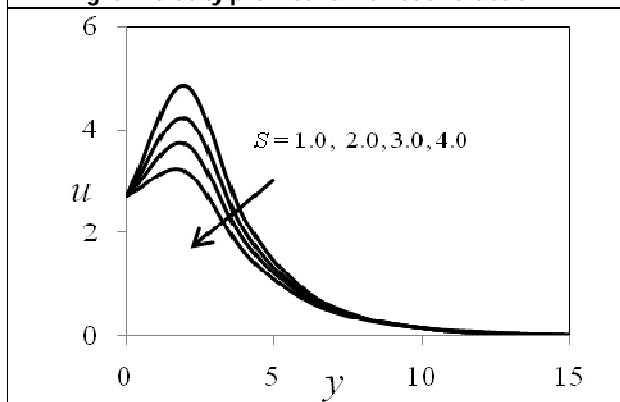


Fig. 7. Velocity profiles for various values of S

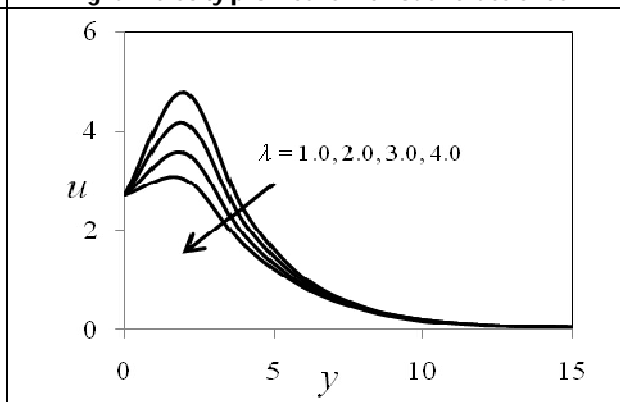


Fig. 8. Velocity profiles for various values of λ





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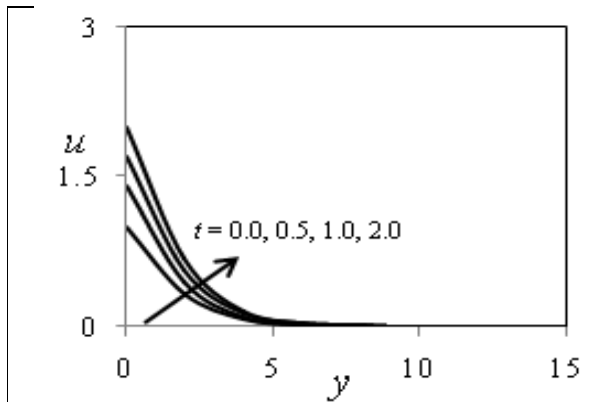


Fig. 9. Velocity profiles for various values of t

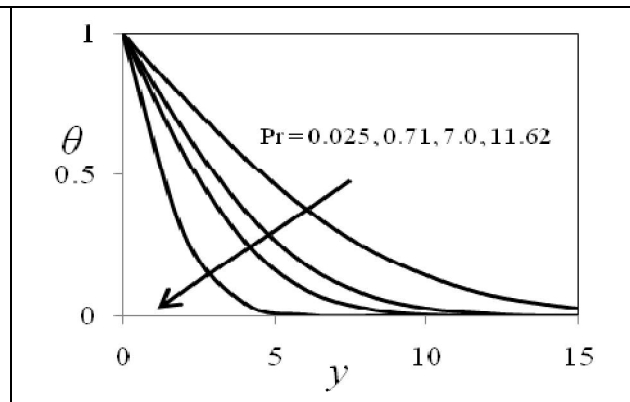


Fig. 10. Temperature profiles for various values of Pr

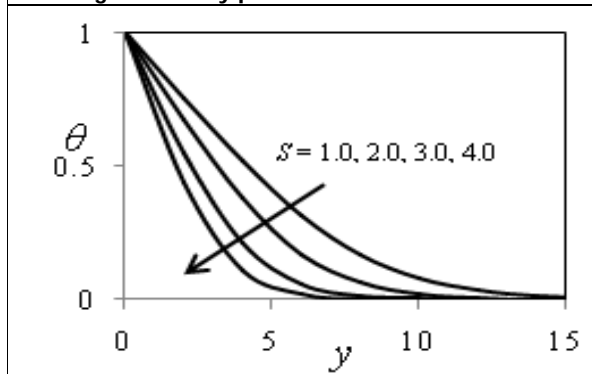


Fig. 11. Temperature profiles for various values of S

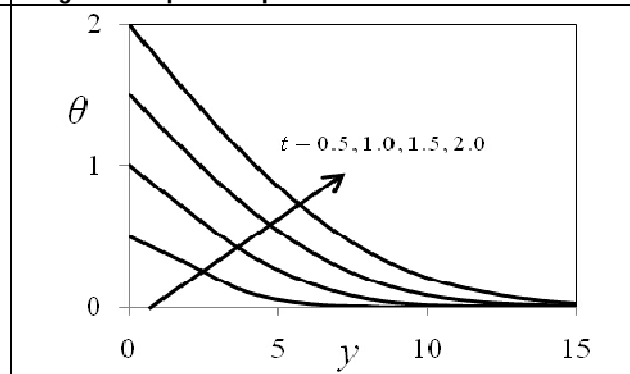


Fig. 12. Temperature profiles for various values of t

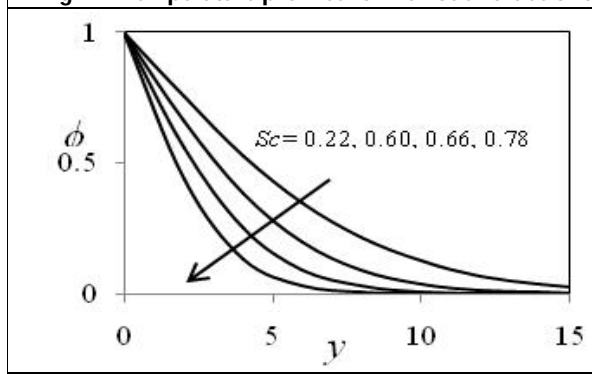


Fig. 13. Concentration profiles for various values of Sc

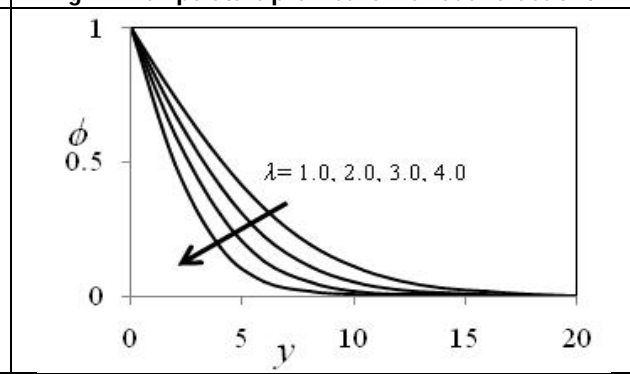


Fig. 14. Concentration profiles for various values of λ





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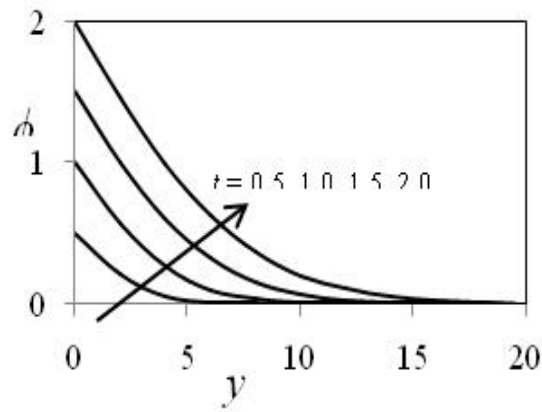


Fig. 15. Concentration profiles for various values of t





Vincamine Modulates the Activities of Carbohydrate Metabolizing Enzymes towards the Reduction of Blood Glucose in High Fat Diet and Streptozotocin Induced Type 2 Diabetic Rats

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ABSTRACT

Diabetes mellitus is a leading metabolic syndrome worldwide and affects the major metabolic organs of the body at chronic hyperglycemia. The modulating effect of vincamine on the carbohydrate metabolising enzyme activities in the liver and kidney of high fat diet/streptozotocin induced diabetic rats was studied by using specific colorimetric methods. Vincamine of (30 mg/kg b.w) orally restored the activities of carbohydrate metabolizing enzymes of liver and kidney of HFD/STZ diabetic rats. The antidiabetic effect of vincamine was found to be much closer to that of the standard reference drug, glibenclamide. Vincamine significantly ameliorated all the metabolizing enzymes in diabetic rats towards the normal range of glucose. The results thus concludes that the antihyperglycemic effect of vincamine could be due to its modulating effect on carbohydrate metabolizing enzymes towards blood glucose restoration in high fat diet and streptozotocin induced diabetic rats.

Keywords: High fat diet, streptozotocin, carbohydrate metabolizing enzymes, vincamine



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INTRODUCTION

Diabetes is a metabolic disorder characterised by impaired glucose metabolism and is associated either with low blood insulin levels or insulin resistance in target organs. Insulin sensitivity declines as a result of impaired postprandial insulin secretion caused by functional abnormalities and the death of surviving pancreatic beta cells [1]. The number of people living with diabetes is increasing day by day and is projected to increase 45 percent by 2030 from the current incidence rate [2]. India currently has 63 million diabetes patients and will become one of the world's leading diabetic country [3]. Defects in carbohydrate metabolic machinery, place an overburden on the endocrine system, and or endocrine dysfunction which intensifies abnormal carbohydrate metabolizing enzymes activities, resulting in hyperglycemia [4].

Chronic hyperglycemia could be the major cause of long-term diabetic complications, which could effect glucose protein glycation, auto-oxidation, and polyol metabolism [5]. Liver is the major metabolic organ that plays crucial role in blood glucose homeostasis. The defects in the activities involved in the glycogenolysis, gluconeogenesis, glycolysis, and glycogenesis could thus lead to hyperglycemia [6]. Normal blood glucose concentration is constantly maintained in the body via the regulation of several enzyme activities in the metabolic pathways such as glycogenolysis, gluconeogenesis, glycolysis, and glycogenesis [7]. The diabetic therapies available in the market, have a number of side effects, including gastrointestinal issues, diarrhoea, lactic acidosis and liver toxicity [8]. Though several antidiabetic medications are commercially available, intense reasearches are still in progress to find out the antidiabetic principles from traditional medicinal plants due to their less side effects, easy availability and affordable at low cost. Plants and plant-derived products are thus becoming more popular due to adverse side effects of synthetic antidiabetic drugs [9]. Vincamine is one such bioactive phytoconstituent from vinca minor possesses diverse pharmacological effects including anti-inflammatory and antioxidant properties [10]. It has also been reported that vincamine effectively suppressed cancer cell viability under in vitro conditions [11]. Research from our laboratory explored antihyperglycemic and antilipid peroxidative effect of vincamine in high fat diet/streptozotocin induced diabetic rats [12]. The status of liver and kidney carbohydrate metabolizing enzymes has been utilized to validate the antidiabetic efficacy of vincamine in HFD/STZ induced diabetic rats.

MATERIALS AND METHODS

Experimental animals

Adult wistar rats (160–180g) obtained from the Biogen Laboratory Animal Facility, Bengaluru, were maintained in an air-conditioned environment ($25\pm 10^{\circ}\text{C}$) with a 12h/12h cycle (light/dark) in the Central Animal House Annamalai university. The animals were allowed to access water and ad libitum diet. Experimental rats were acclimatised to laboratory atmosphere for around 10 days. Institutional Animal Ethical Committee (IAEC) proposal no. **AU-IAEC/1280/10/20**, Annamalai University approved the experimental design and allowed to maintain as per CPCSEA guidelines.

Chemicals

Vincamine and Streptozotocin were purchased from Sigma–Aldrich, (St. Louis, MO, USA). Other chemicals with high purity and analytical grade were obtained from E. Merck HiMedia (Mumbai) India.

High Fat Diet

The method of Muthalakshmi and Sarvanan was employed to prepare the high fat diet (figure 1).^[13] High fat diet was provided to the experimental animals for 4 weeks at the end a single dose of streptozotocin was intraperitoneally injected into the animal at a dose of (35 mg/kg b.w). After 72 hrs, fasting blood glucose concentration (FBG) was measured, and the animals with FBG levels above 250 mg/dl were considered as diabetic and used for further experimental work.



**Nasreena Shaban et al.,****Experimental Design**

The animals were divided into 4 groups (n=6 in each group). Group I rats served as control and received water and food ad libitum. Group II rats received dietary administration of HFD (40%) for 4 weeks which was followed by a single intraperitoneal injection of STZ (35mg/kg b.w). Group III rats received the administration of HFD-STZ as above and further treated with vincamine (30mg/kg b.w) for 30 days. Group IV rats received the HFD-STZ as above and then further treated with glibenclamide 0.6 mg/kg b.w for 30 days.

Biochemical analysis

Specific and standard colorimetric methods were used for the measurement of carbohydrate metabolizing enzyme activities. The methods of Brandstrup *et al* (Hexokinase),^[14] Gancedo and Gancedo (Fructose-1,6-bisphosphatase),^[15] Koide and Oda (Glucose-6-phosphatase),^[16] Ellis and Kirkman (Glucose-6-phosphate dehydrogenase),^[17] Leloir and Goldemberg (Glycogen synthase),^[18] Cornblath *et al* (Glycogen phosphorylase)^[19] and Morales *et al* (Glycogen)^[20] were employed to assess the activities of the above said enzymes.

Statistical analysis

The data obtained in the study are given mean±SD (n=6). SPSS software was used to verify the statistical significance between the groups, which was performed by one way analysis of variance (ANNOVA) followed by the Duncans's multiple range test (DMRT). The values were considered statistically significant if the p values were less than 0.05 between the groups.

RESULTS

Figure 2 and 3 shows the activities of hexokinase, glucose-6-phosphate dehydrogenase, glucose-6-phosphatase, and fructose-1,6-bisphosphatase in liver and kidney of control and experimental rats respectively. Decreased activities of hexokinase and glucose-6-phosphate dehydrogenase whereas the increased activities of glucose-6-phosphatase and fructose-1,6-bisphosphatase, were found in HFD/STZ induced diabetic rats. Administration of vincamine in diabetic rats retrieved the status of key enzymes to the near normal range. Figure 4 displays the glycogen content in the liver and muscle of control and experimental rats. In HFD/STZ induced diabetic rats significant decline was found in the glycogen content. Administration of Vincamine substantially elevated the levels of liver and muscle glycogen content to near normal range. Glycogen synthase and glycogen phosphorylase were determined in the liver of control and experimental rats. Significant decrease in glycogen synthase and increase in glycogen phosphorylase was found in the liver of control and experimental rats. However in HFD/STZ induced diabetic rats oral administration of vincamine restored the changes to near normal.

DISCUSSION

Liver plays a key role in glucose and lipid metabolism, and are highly affected in chronic hyperglycemia and the key enzymes involved in carbohydrate metabolism are significantly altered. The glycolytic pathway begins with the hexokinase (HK)-the core of cellular metabolism that phosphorylates glucose to glucose 6-phosphate. It is considered as one of the rate limiting enzyme of glycolysis and has a key role in glycogen synthesis as well as its utilisation, [21] and its activity is impaired in diabetes [22]. The decreased HK activity was noticed in the present study in the liver and kidney of HFD/STZ induced diabetic rats, could arise from reduced insulin levels and or secretion. Other investigations reported the same findings [23,24,25]. Administration of vincamine to HFD/STZ induced type 2 diabetic rats restored the status of hexokinase to near normal by improving insulin emulsion which in turn helps in improving glucose homeostasis and thus increases glucose utilization in tissues.

G6Pase an important enzyme involved in the metabolism of carbohydrate is responsible for maintaining glucose levels during starvation. It plays a vital role in both gluconeogenesis and glycogenolysis thereby liberating glucose into the circulation [26]. An elevated concentration of glucose causes an increase in the G6Pase in both liver and



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kidney [27,28]. Administration of vincamine to HFD/STZ diabetic rats might have increased the level of plasma insulin, as well as reduced the activities of gluconeogenic enzymes. G6Pase activity was restored to normal range in diabetic rats treated with vincamine, which could be due to glucose-6-phosphate dehydrogenase activity in HFD/STZ-induced diabetic rats by suppressing G6Pase activity. G6PDH catalyzes glucose-6-phosphate oxidation in the first step of the pentose phosphate pathway, that reduces NADP⁺ to NADPH. NADPH produced by G6PDH play a vital role in maintaining glutathione in a reduced state to protect the cell from oxidant injury [29]. In this investigation, G6PDH activity was shown to be significantly lower in the liver and kidneys of diabetic rats. This finding is in consistent with prior studies [30,31]. The decreased activity of G6PDH may potentially develop diabetic complications. Administration of vincamine in HFD/STZ rats significantly raised the G6PDH activity to near normal.

F1,6BP is involved in the hydrolysis of fructose-1,6-bisphosphate to fructose-6-phosphate [32]. It is usually prevalent in the liver and kidney, although it is also found in the cells of the pancreas. F1,6BP activity was found to be higher in HFD/STZ-induced diabetic rats. This finding is in line with previous findings from various authors [33,34]. Increased F1,6BP activity during diabetes could be a possible strategy to activate endogenous glucose production from glycerol via gluconeogenesis [35]. Vincamine treatment significantly decreased the activity of F1,6BP in diabetic rats, which could be due to its role in limiting gluconeogenesis via gluconeogenic substrates as well as by inhibiting glycolysis, gluconeogenesis, and the citric acid cycle, which could inturn help to maintain glucose homeostasis.

Accumulation of excess glucose in the liver is catalysed by glycogen synthase and the process is depends on insulin secretion and action. Glycogen metabolism is influenced by the activities of glycogen synthase and glycogen phosphorylase [36]. Insulin stimulates glycogen synthase and suppressing the action of glycogen phosphorylase [37]. Several authors utilizes the status of liver glycogen to assess the antidiabetic potential of phytoconstituents [38]. The decreased liver glycogen level in HFD/STZ-induced diabetic rats could be linked to decreased glycogen synthase activity and an increased glycogen phosphorylase activity. Diabetic individuals with poor insulin and insulin intolerance are reported to have lower glycogen levels [39]. The present findings revealed a substantial decrease in glycogen and glycogen synthase activity, as well as an increase in glycogen phosphorylase activity in the liver and kidney of HFD/STZ treated diabetic rats. Previous literature have shown similar results [40,41]. Changes in glycogen content, glycogen phosphorylase, and glycogen synthase activities might be ascribed to a fall in insulin levels. Vincamine administration restored the activities of glycogen content and glycogen phosphorylase and glycogen synthase in diabetic rats by stimulating insulin secretion from the remnant pancreatic beta-cells.

The efficacy of vincamine stimulated the activities of metabolic key enzymes and plays a pivotal role in maintaining glucose homeostasis. To conclude vincamine restored the glucose levels in HFD/STZ induced diabetic rats by modulating the key enzymes towards the reduction of blood glucose levels by enhancing secretion of insulin from the existing pancreatic β -cells. Vincamine therefore can be used as a good antidiabetic agent and further studies are in need to explore the effect of vincamine on various signalling pathways related to diabetes mellitus.

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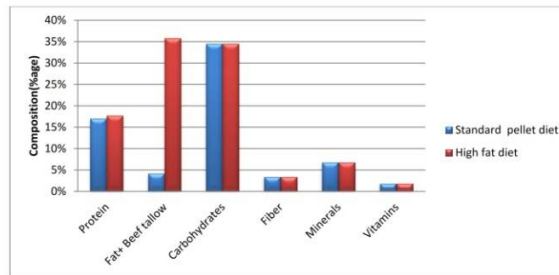


Figure 1

Fig.1: The composition of high fat diet (HFD) and standard diet

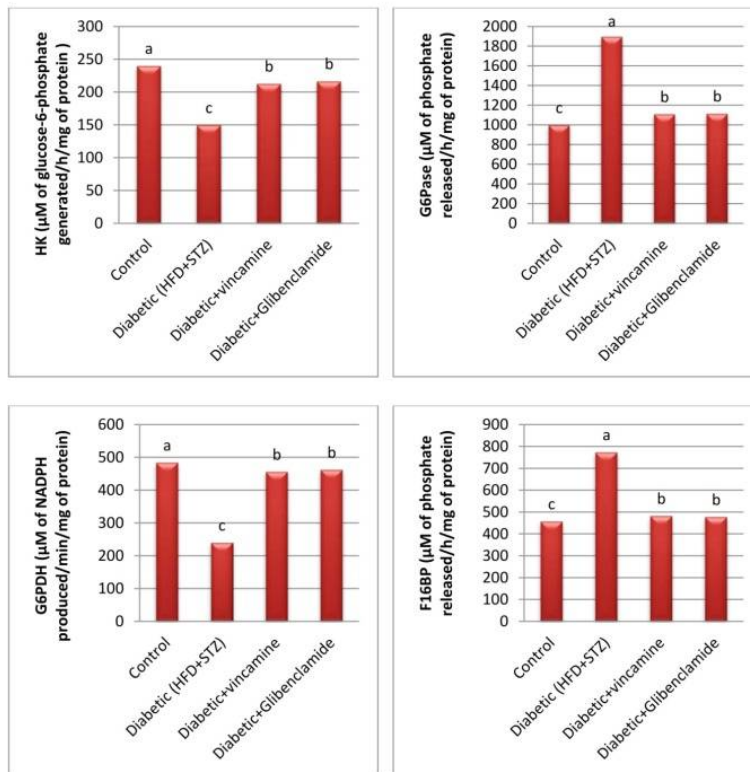


Fig. 2: Hexokinase (HK), Glucose-6-phosphatase (G6Pase), Glucose-6-phosphate dehydrogenase (G6PDH) and Fructose 1,6-bisphosphatase (F1,6BP) changes in the liver of experimental rats.

Values not sharing a common superscript differ significantly at $p \leq 0.05$ (DMRT)





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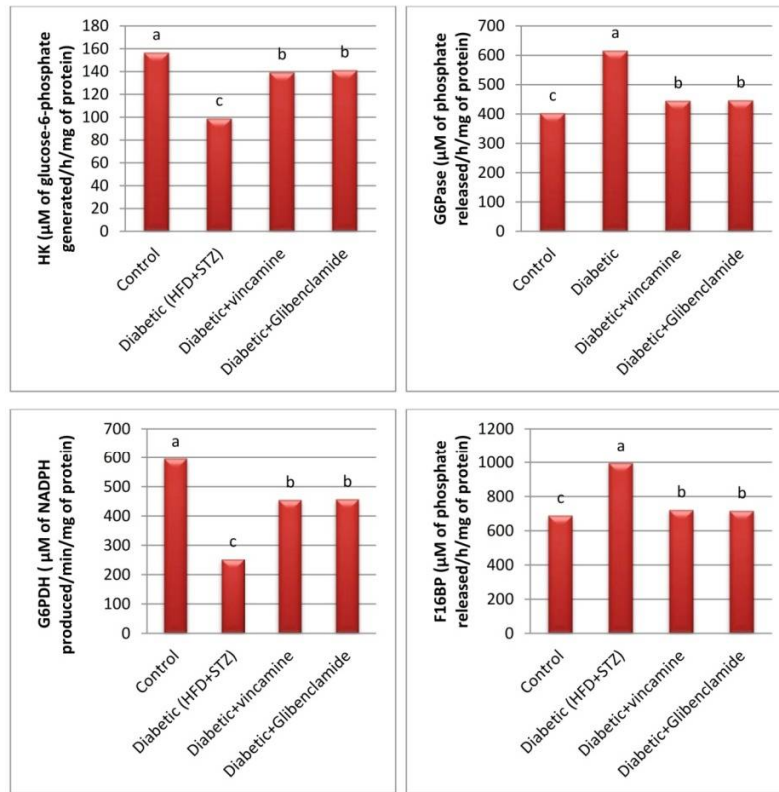


Fig. 3: Hexokinase (HK), Glucose-6-phosphatase (G6Pase), Glucose-6-phosphate dehydrogenase (G6PDH) and Fructose 1,6-bisphosphatse (F1,6BP) changes in the kidney of experimental rats. Values not sharing a common superscript differ significantly at $p \leq 0.05$ (DMRT)

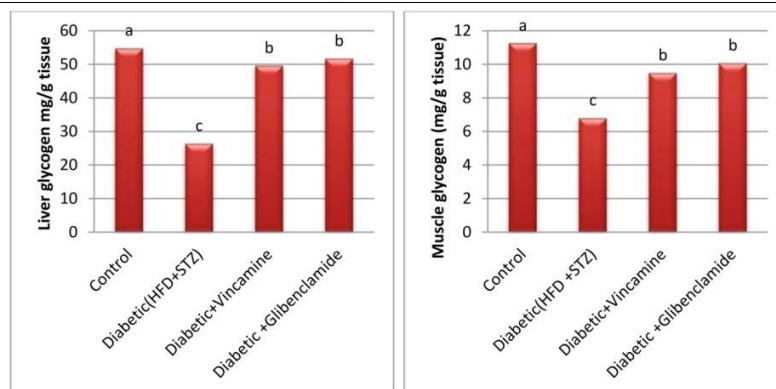


Fig.4: Level of glycogen content in the liver and muscle of control and experimental rats. Values not sharing a common superscript differ significantly at $p \leq 0.05$ (DMRT)





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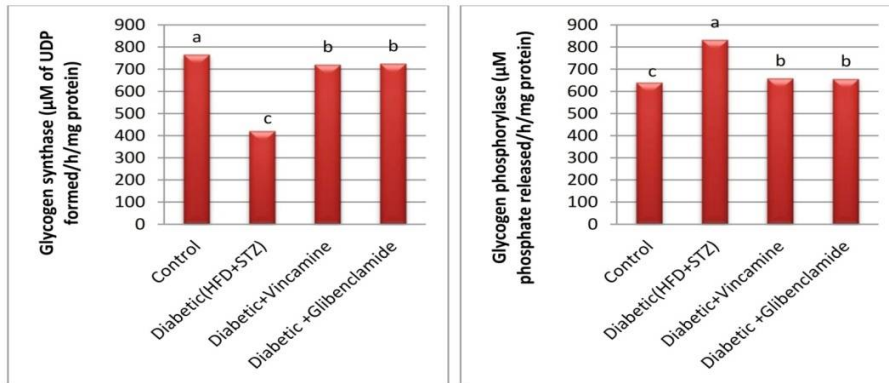


Fig.5: The level of glycogen synthase and glycogen phosphorylase in the liver of control and experimental rats

Values not sharing a common superscript differ significantly at $p \leq 0.05$ (DMRT)





Design and Analysis of Outer Rotor Radial Flux PMG for Small Scale Wind Turbines

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ABSTRACT

The design of radial flux permanent magnet generator for direct drive wind turbine applications is presented here. The characteristic geometry of radial flux machine is naturally more suitable than that of conventional topologies in certain application. The design of surface mounted permanent magnet generator with outer rotor structure is investigated. The analysis has been done using Finite Element Analysis (FEA). Finally, the analytical results obtained for the outer rotor RFPM are verified by FEM results for different geometries.

Keywords: Direct Drive, Radial flux, Permanent magnet generator, flux density, Torque

INTRODUCTION

The renewable energy sources play a vital role to generate the electricity. Especially sun and wind are the sources of energy is being utilized by human from long years. But wind has two important merits over solar in terms of high power density and less space for installations. The research on wind energy conversion system has been keep on increasing and development has been increased rapidly from 1985 onwards. Permanent magnet (PM) generator is more attractive since it provides high efficiency, simple construction and robust structure. The performance of the permanent magnet generator is further enhanced by choosing the high-energy permanent magnet materials such as Neodymium-Iron-Boron. It offers the high energy density, high magnetic field and high coercivity. The permanent magnet generators have been developed for wind turbine applications at various wind speed. The power extracted from the direct drive permanent magnet generator at different wind speed wind speed is maximum. The generated power is given to the utilities by using the power converters. Presently, direct drive [1-2] PMGs have been used for wind turbine applications due to the absence of gearbox arrangements which in turn simplify the construction and reduces the installation cost. The radial flux permanent magnet generator is suitable for low wind speed applications





when compared to the axial flux machine. The surface mounted radial flux machine magnets is suitable for large scale direct-drive wind generator. It is also desirable to operate for low speed operation even though they require many pole to obtain the low speed. The rotor of radial flux machine can be classified as inner rotor and outer rotor. The radial flux with inner rotor construction provides high torque and mechanical stability. There is an issue in generating the high output power due to its high material cost and it needs a gear box arrangement between turbine blade and generator to increase the speed at a low speed caused by the lack of a multi-pole structure. To overcome the above said drawbacks the outer rotor configuration of permanent magnet generator is used. This type of configuration generates the high output power even at low wind-speed since easy coupling between the generator surface and turbine blade and easy installation of the magnet on the rotor. This paper deals with radial flux permanent magnet generator with outer rotor configuration [3]. An innovative design of the machine has been proposed in order to make the machine suitable for direct drive application and Analytical equations are derived for permanent magnet radial flux concentrated coil machines [4-5]. With the preliminary design constraints, the design of the outer rotor structure is discussed and the analysis can be validated with the analytical calculations by using FEA methods.

Outer Rotor Radial Flux Permanent Magnet Generator

A. Outer rotor configuration

Easy installation of the permanent magnet on the rotor Because of the extended periphery of the out-rotor drum, multiple no of poles structure can be easily accommodated; Reduction in the rotor yoke causes the reduced total volume and weight. End winding length is shorter because of coil pitch is equal to slot pitch. Due to this copper is also reduced than longer pole pitch machine. More number of poles can be accommodated in the outer-rotor structure. In this paper, design for the outer rotor radial flux permanent magnet generator has been discussed to increase the efficiency and reduce the losses. To increase the efficiency, outer diameter and length is optimized. Secondly, permanent magnet rotor design and stator design is done. Finally, the simulation results were carried out by using Finite Element Analysis.

Design Procedure

Turbine Design Calculations

Initially the turbine design calculations are done by taking the number of blade is taken as 3. Generally, the number of blade is taken as 3 for low power generators. The nominal wind speed $V_{w \text{ nom}}$ is taken as wind speed. The generator produces the power at this wind speed. The wind speed range is usually set at 10 to 12 m/s for low speed applications. The turbine design starts from the turbine radius calculation, which is expressed in the equation (1),

$$r_{\text{turb}} = \sqrt{\frac{2 P_{\text{air}}}{\pi \rho C_p V_w^3}} \quad (1)$$

Where P_{air} is the aerodynamic power and C_p is the power coefficient, V_w is the nominal wind velocity, ρ is the air density at sea level and it is 1.225 kg/m³.

Power coefficient C_p [8] is calculated by using the below expression and it is also expressed in terms of tip speed ratio and pitch angle.

$$C_p = 0.5176 \left(\frac{116}{\lambda_i} - 0.4\beta - 5 \right) e^{\frac{-21}{\lambda_i}} + 0.0068\lambda \quad (2)$$

The wind turbine power can be obtained by using the relation in equation

$$P = \frac{1}{2} \rho v_w^3 A C_p \quad (3)$$

Main Dimension Parameters

Specific electric and magnetic loading is chosen for the rated machine. The desirable air gap length is chosen from 0.5 mm to 1.5 mm for better effective design and It must be as small as possible for low power machines. The main dimension is calculated using the below expression. [9].





$$D^2L = \frac{\varepsilon P_{gen}}{\frac{\pi^3}{2\sqrt{2}} \cdot SEL \cdot SML \cdot K_{w1} \frac{f}{p} \cos \phi} \quad (4)$$

$$\frac{L}{D} = \frac{\pi\sqrt{P}}{4P} \quad (5)$$

Where ε : ratio of excitation voltage / rated terminal voltage SML: Specific Magnetic Loading SEL: Specific Electric loading K_{w1} =Winding factor f :frequency $\cos \phi$: Power factor p = no of pairs

Geometrical Equations

The design parameters of the outer rotor RFPMG configurations are presented in this section

$$D = D_{arc} - 2l_m - 2\delta \quad (6)$$

$$b_{ss2} = \pi \frac{D - 2h_{ss}}{Q_s} - b_{ts} \quad (7)$$

$$b_{ss1} = \pi \frac{D - 2h_{sw}}{Q_s} - b_{ts} \quad (8)$$

$$h_{ys} = \frac{B_{\delta 0} b_m l_e}{2B_{ys} l_u} \quad (9)$$

Slot Dimensions

The factors are to be considered for the number of the stator slots is slots/pole/phase [13]

$$N_s = 2 m p q \quad (10)$$

Where q is the number of slots per pole per phase and m is the no of phase

Selection of Materials

The flux produced by the permanent magnet is responsible for the generating EMF in an armature and electromagnetic torque production [10-11]. So flux is the most important parameter to decide the performance of the machine. The permanent magnet is located as near as possible to the stator coil to reduce the leakage flux from N pole to south pole which in turn increases the permeability. From the permanent magnet material, Neodymium Iron Boron is chosen for design process. In this different NdFeB grading are available in the market in that NdFeB48 is chosen for design process having higher B_r and the remnant flux density when comparing to other magnetic material and their BH analysis of different magnetic material is shown in the figure 3.1.

Outer rotor PM Pole Dimensions

The airgap length and thickness of the magnet is main design parameter to affect the magnet dimension [3]. Airgap flux density equation is followed as

$$B_g = B_r \frac{h_m}{h_m + g} \quad (11)$$

Where h_m =height of the magnet, g =airgap length B_r =remanent flux density

Maximum flux can be calculated using equation (12)

$$\phi_{max} = B_{mg} A_m \quad (12)$$





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Stator Windings

Normally, Permanent magnet generators which are using wye-connected concentrated windings. Stator consists of two coil sides per slot [14] and double layer winding. A slot fill factor (λ_s) is used to determine the slot cross sectional areas given in equation

$$\lambda_s = \frac{\text{winding area}}{\text{Total slot area}} \quad (13)$$

Overall slot fill factor varies from 0.3-0.7.

FEM Analysis

FEM results [12-13] of the radial flux permanent magnet generator are discussed in this section. An outer rotor configuration RFPM generator is shown in Fig. 4.

Induced Phase Voltages external rotor PM generator

Fig. 4 illustrates the induced emf for the three –phase small scale RFOR under no load condition. In this figure, the Peak phase voltage appears as nearly 220V [7,8].

Flux linkage of the external rotor PM generator.

The flux linkage with the coil are shown in the fig 5. The air-gap is chosen as 1mm for higher flux linkage. The maximum flux linkage (Tesla) is obtained as 0.7 tesla [5] results in higher flux density in the air gap. The flux linkage waveform is shown in Figure 6 In Fig 7 the moving torque as a function of time is shown. It can be observed that the negative moving torque is developed in the machine and the moving torque value is nearly maintained constant as 176Nm. Therefore, in this outer rotor configuration torque developed is maximum. [15-16]. There is a high force across the air gap due to the high stress and strain in electrical machines. The stress and strain developed in the outer rotor machines is reduced using the optimized diameter and length of the machine. The stress developed in outer rotor radial flux permanent magnet generator is shown in figure 8.

CONCLUSIONS

The radial flux permanent magnet generator with outer rotor configuration is chosen and theoretical deign calculation is done by assuming the basic parameters. The simulation result of the radial flux permanent magnet generator is done [17] and this configuration compared with the analytical calculations. From this results, outer rotor configuration provides higher efficiency, high torque production and low material cost. Also, this configuration produces the maximum coil flux linkage to generate high output power. Hence the radial flux with external rotor arrangements is more suitable for wind turbine applications.

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Table 1Design parameters of the RFPMG

Parameters	Stator	Rotor
Outer diameter [mm]	220	249
Inner diameter [mm]	189	221
Length of stack [mm]	74	74
Number of slot	36	
Number of pole	-	24
Stator material grade	Steel-1008	
Magnet grade		NdFeb48
Airgap [mm]	1	1

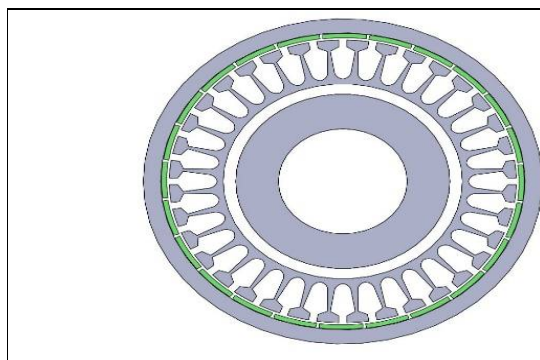


Fig 1 Structural view of outer rotor structure

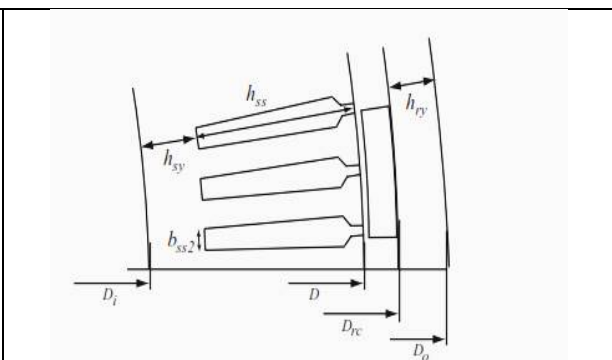


Fig 2 Geometrical parameters for the outer-rotor radial flux PMG





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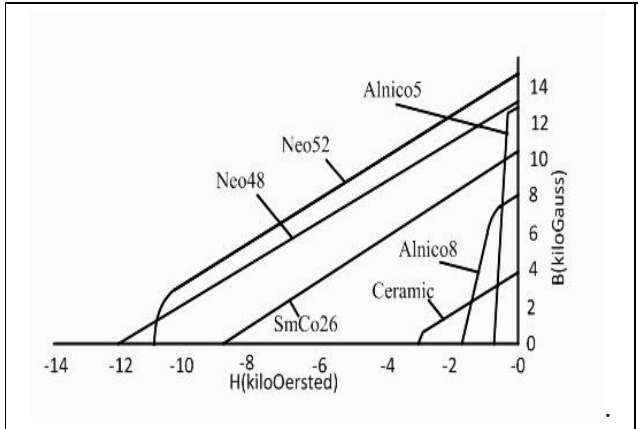


Fig 3 B-H Curve of Magnetic Material

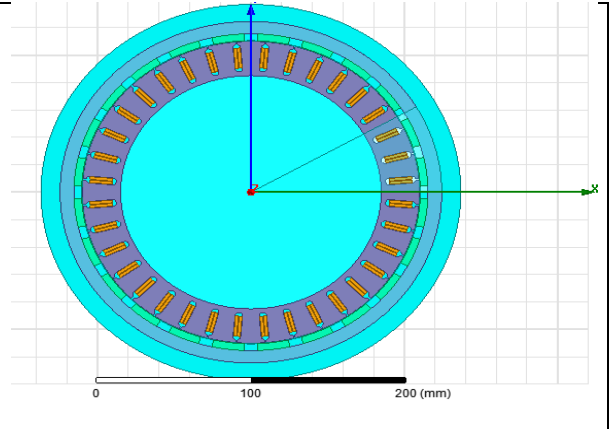


Fig 4 Radial flux outer rotor permanent magnet generator

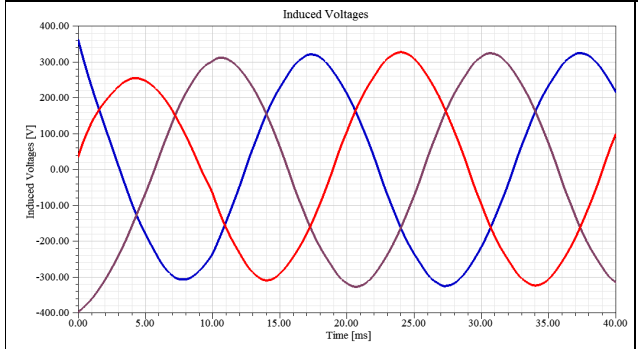


Fig 5 outer rotor PM induced voltage

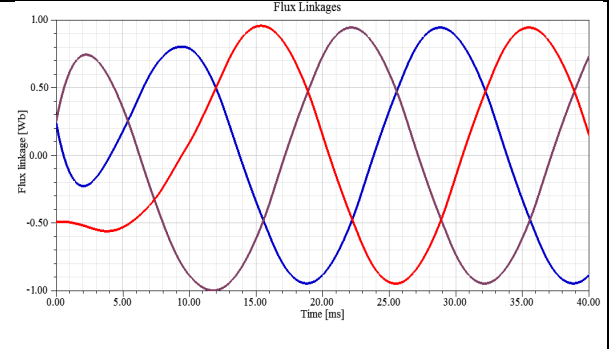


Fig 6 Outer rotor flux linkage

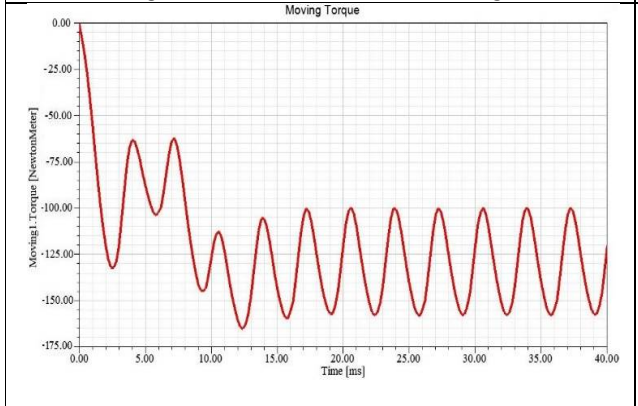


Fig 7 Moving Torque

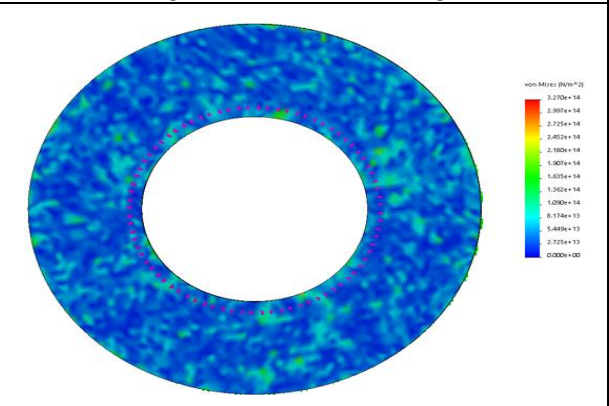


Figure 8. Stress in outer rotor radial flux permanent magnet generator





Hybrid Approach for Type 2 Diabetic Classification Model using PSO-GKFCM and PDF-RNN

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ABSTRACT

Diabetes is a metabolic condition characterized by persistently increased blood glucose (BG), which can lead to a variety of serious complications over time. To help diabetic patients maintain their health, continuous monitoring and prediction of BG concentration is required. Machine learning algorithms, such as CNN, RNN, and others, are common data-driven BG prediction solutions if insulin is minimized. To train the prediction model, they used BG data from numerous patients. However, given the same parameters, all of the training data cannot accurately describe BG fluctuation features. We propose PDF-RNN, a new BG prediction method based on recurrent neural networks (RNN) with probability density function (PDF) and incorporating a clustering pre-process using PSO-GKFCM, in response to the possibility that different subgroups of diabetic patients have different BG fluctuation trends. In terms of BG estimate precision, numerical results reveal that the proposed PDF-RNN for type II diabetes classification outperforms existing approaches such as Logistic regression (LR) and CNN.

Keywords: PDF, PSO, CNN, RNN, BG, Clustering, Classification, GKFCM

INTRODUCTION

Diabetes, often known as diabetes mellitus, is a chronic illness in which the body is unable to make or use insulin. The blood glucose/sugar level is extremely high [1]. According to the World Health Organization, the number of diabetics worldwide will rise to 333 million by 2025, up from 135 million in 1995 [3]. Diabetes that is inadequately controlled and maintained can cause issues in numerous parts of the human body, such as the skin, kidneys, heart,

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nerves, blood vessels, and foot [2]. Diabetes can cause coronary autonomic neuropathy as well as several other problems [1]. If the condition progresses, specific blood vessels that nourish the retina become blocked, preventing blood flow to select retinal regions [4]. The CAD (Coronary Artery Disease) screening of type II diabetes patients with two or more additional risk factors, comorbidities, or EKG changes indicating CAD and the existence of carotid or peripheral artery disease was advocated by the American Diabetes Association (ADA) in 1998 [6]. The EKG stress test was also said to be insensitive [8]. Changing the way we empower patients by continuously exporting and exchanging expertise and empowering people to handle their health awareness and aspirations in a customized and timely manner [11] is not difficult in our new world, where information and data are produced, stored, and accessible from everywhere while we talk. Deep learning's popularity has skyrocketed in recent years, and the notion has become intimidating. Deep learning algorithms are being used in a variety of sectors, including medical prognostics and optical character recognition [5]. Using modern computational techniques, including a deep neural learning network, this research provides a high-precision model for diabetes prediction [14]. Dropout is a regularization layer that addresses the issue of over-fitting induced by closely related columns.

In this proposed framework, we employed the GKFCM as the clustering and RNN classification result and compared it to Logistic Regression and CNN techniques. Type 2 diabetes develops when blood sugar levels are too high [7]. Blood glucose is the most common type of sugar, and it comes from the foods we eat. Insulin aids the movement of glucose from the bloodstream to our cells, where it is turned into electricity. On the other hand, glucose does not enter the cells of type 2 diabetes patients and hence remains in the bloodstream. Blood sugar levels rise as a result, and the pancreas generates more insulin. Insulin-producing cells eventually become damaged and unable to meet the body's needs. Type 2 diabetes is caused by a combination of factors including weight, fat density, inactivity, family history, and age. Patient concerns include nerve injury, organ damage, a heart attack, eyesight loss, and poor wound healing [16]. In this essay, we'll look at a data-driven approach. We propose DP-RNN, a new BG prediction approach based on recurrent neural networks (RNN) that includes a clustering pre-process into the classical RNN [13], motivated by [15] and the fact that distinct subgroups of diabetic patients exhibit different BG fluctuation tendencies. Section II comprises significant studies in the field, while Section III details the suggested technique, which involves dataset selection, processing, and classification using RNN. The findings and evaluations are presented in Section IV, which is followed by a general conclusion in Section V.

Background Study

Screening and diagnosis of diabetic retinopathy are typical study subjects, and various academics are interested in expanding their research in this area. For automated diabetic retinopathy screening, manual screening problem was presented, such as high cost, low sensitivity and specificity, time consumption, and insufficient human detecting capacity. The goal of automatic screening detection is to recognize the need for additional care. D. Bouallal et.al.[2], proposed the multimodel approach outperforms the thermal image-based method, particularly in complex instances. On the other hand, before ulceration became a problem, a 122-patient diabetes type II group participated in a cross-sectional clinical investigation. A diagnostic test identified three classifications of persons at risk of developing ulcers: the low-risk (R0) category, the medium-risk group, and the high-risk group (R2). With $p < 0.1$, the results show that the medium-risk (MR1) group had a higher average foot surface temperature than the low-risk (R0) group. With $p < 0.01$, the temperature difference measured during a cold stress test differs dramatically from R0 to R1 on one side and R1 to R2 on the other. Finally, R1 to R2 ($p < 0.1$) was the mean absolute deviation from the left to the right foot.

P. Choden et al. [3], the author successfully built and improved a manufacturing system for six chemiresistive gas sensors. The nose's gas sensors demonstrated their ability to distinguish diabetic patients from healthy people by discriminating against urine VOCs (volatile organic compounds). A. Chandran and colleagues [4], this paper established the hypothesized hybridized patch approach for diagnosing proliferative diabetic retinopathy. Specialists can save time and effort by using electronic ophthalmology systems to manage severe cases right away. S. Kumar and B. Kumar [9] by precisely assessing the volume and size of microaneurysms, the author devised a new method for detecting diabetic retinopathy. The sensitivity and accuracy results show that the suggested diagnostic technique





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is more effective at detecting non-proliferative diabetes. Y. Peng et al. [10] According to the author, FCM improves blood glucose levels, insulin tolerance, lipid metabolism illness, and oxidative tension in a type II diabetes mellitus rat model, which protects against hyperglycemia and diabetic nephropathy. FCM could be utilized as a medication to prevent diabetes and diabetic complications, according to all of the studies. Vahidi, O. et al. [15], the author employed a model for a diabetic community of Form II patients to diagnose cardiovascular deficits in a previous study. Using a particle filtering technique, the model settings and glucose metabolic rates in numerous organs, as well as a pancreatic insulin secretion rate, were examined. The euglycemic insulin clamp and hyperglycemic silicon clamp both revealed misbehavior in other organs. These techniques, as well as a nonlinear filtering system and mathematical model, could be used to diagnose hepatic abnormalities, pancreatic, and peripheral diabetes type II patients. J. Yang et al. [17] the effects of DOP (Dendrobium Officinale stem) on improving metabolic balance in type 2 diabetic rats have been researched, according to the author. DOP treatment improved hepatic metabolism while also protecting it from oxidative and inflammatory stress. DOP treatment also reduced the levels of bile acid and xanthine in the body. This study might be beneficial for implementing DOP cost-effectively and practically for diabetes treatment.

System Model

This section presents the suggested GKFCM with PSO and DP-RNN with PDF methods, which are extensively employed in natural language processing, speech recognition, and other time series-related problems because of their natural benefits for rapid capture. Because BG data is a time series, it can be processed with PDF-RNN.

Dataset

The Diabetes Dataset, which is available on the Kaggle platform, was used in this system. The major goal is to diagnose the patient and determine whether or not the patient has diabetes. This dataset contains a Type 2 Diabetes medical record. This medical record has a total of 17 features that can be used to predict disease.

System Architecture

The proposed system represents the architecture for type 2 diabetes prediction. This system consists of the standard dataset which is obtained from Kaggle. This dataset is further pre-processed to be used efficiently to predict the disease's outcomes.

Methods

We also covered advanced research approaches for diagnosing diabetes. In deep learning networks, the usual stages in the extraction, sorting, and classification of functions in traditional computer approaches do not need to be explained explicitly. In exchange, they are integrated into a larger learning network. The key mechanism is self-learning from data.

PSO-GKFCM

Particle swarm optimization is an inhabitant's optimization algorithm inspired by the behavior of flocks of birds and schooling fish. PSO and evolutionary computation approaches have a lot in common. The system starts with a population of random solutions, and the search for the best one is done via updating generations. PSO combines with Gaussian kernel-based fuzzy c-means algorithm to identify the best centroids.

By minimizing the following objective function, the GKFCM splits X into fuzzy subsets.

$$J_m(U, V) = \sum_{i=1}^c \sum_{k=1}^n U_{ik}^m \|x_k - v_i\|^2$$

Equation 1:

Consider the Gaussian kernel fuzzy c-means (GKFCM) algorithm that has been proposed. A nonlinear map is defined as





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$$\Phi : X \rightarrow \Phi(x) \in F$$

The data space is denoted by X, while the converted feature space is denoted by F, which has a greater, even infinite, dimension. The following objective function is minimized by GKFCM.

$$J_m(U, V) = \sum_{i=1}^c \sum_{k=1}^n U_{ik}^m \|\phi(x_k) - \phi(v_i)\|^2$$

Equation 2:

Where, $K(x, y) = \phi(x)^T \phi(y)$ is the product of the inner kernel, If the Gaussian function is used as a kernel function.

$$\|\phi(x_k) - \phi(v_i)\|^2 = K(x_k, x_k) + K(v_i, v_i) - 2K(x_k, v_i)$$

Equation 3:

$$J_m(U, V) = 2 \sum_{i=1}^c \sum_{k=1}^n U_{ik}^m (1 - k(x_k, v_i))$$

Equation 4:

$$u_{ik} = \frac{(1 / (1 - k(x_k, v_i)))^{\frac{1}{m-1}}}{\sum_{j=1}^c (1 / (1 - k(x_k, v_j)))^{\frac{1}{m-1}}}$$

Equation 5:

$$v_i = \frac{\sum_{k=1}^n U_{ik}^m K(x_k, v_i) x_k}{\sum_{k=1}^n U_{ik}^m K(x_k, v_i)}$$

Equation 6:

For the sake of simplicity, we'll merely utilize the Gaussian kernel function. If we employ other kernel functions, Eqs. (5) and (6) will be modified accordingly (6). In reality, Eqs. (3) can be seen as a kernel-induced new metric in the data space, with the following definition: Equation 7:

$$d(x, y) = \|\phi(x_k) - \phi(v_i)\| = \sqrt{2(1 - k(x, y))}$$

PDF- RNN

A recurrent neural network (RNN) is a variant of a traditional feed forward neural network that can accommodate variable-length sequence input. RNN can handle time series because it has a recurrent hidden state whose activation is dependent on the activation of the prior time. RNN is a sort of Neural Network in which the output from the previous step is used as input in the next phase. All of the inputs and outputs in standard neural networks are independent of one another, however in some circumstances, such as when predicting the next word of a phrase, the prior words are necessary, and so the previous words must be remembered. As a result, RNN was created, which used a Hidden Layer to overcome the problem. The Hidden state, which remembers certain information about a sequence, is the most essential element of RNN. Fig.1 shows the architecture of RNN, combined with the probability density function to produce a better result. The probability density function is defined as the integral of the variable density over a certain range. It is represented by the letter f. (x). At any point on the graph, this function is positive or non-negative, and the integral, more precisely the definite integral of PDF over the entire space, is always one. The likelihood of the outcomes is often below the curve on the graph of PDFs, which resembles a bell curve. The graph of a probability density function for a continuous random variable x with function f is shown below (x).





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As a result, the RNN forward pass can be represented by the equations below.

$$\begin{aligned} \mathbf{a}^{(t)} &= \mathbf{b} + \mathbf{W}\mathbf{h}^{(t-1)} + \mathbf{U}\mathbf{x}^{(t)} \\ \mathbf{h}^{(t)} &= \tanh(\mathbf{a}^{(t)}) \\ \mathbf{o}^{(t)} &= \mathbf{c} + \mathbf{V}\mathbf{h}^{(t)} \\ \hat{\mathbf{y}}^{(t)} &= \text{softmax}(\mathbf{o}^{(t)}) \end{aligned}$$

Experimental Results

This section presents numerical results on the efficacy and benefits of the suggested PDF-RNN model for BG prediction. This section presents numerical results on the efficacy and benefits of the suggested PSO-GKFCM and PDF-RNN model for BG prediction. A variety of clustering and classification algorithms and the results and working criteria for each methodology were slightly different. We were able to evaluate the results of the experiment through a visualized border using the WEKA tools and mat lab.

Data Pre-Processing

Improved decision tree and weighted k mean algorithm

Improved decision tree and weighted k means algorithm used for Pre-Processing and Missing values Analysis. The k-means algorithm organizes data by allocating all data points to the nearest clusters first, then calculating cluster means. These two phases are repeated until the algorithm converges. To improve clustering scalability, we suggest a version called weighted k-means. We create reservoir-biased sampling as an efficient data reduction strategy to speed up the clustering process because it performs a single scan through a data set. Our technique was created with the goal of grouping data from mixture models. W-k-mean may calculate variable weights automatically. The algorithm's variable weights indicate the importance of the variable in clustering. As a result, the technique can be utilized as a variable selection in data mining applications involving big and complex real data. For good clustering results, choose higher weighted factors and eliminate lower weighted variables.

The goal of W-k-Mean is to reduce:

$$P(U, Z, W) = \sum_{j=1}^m \sum_{i=1}^k \sum_{l=1}^n w^{\beta_j} u_{l,i} d(x_{l,j}, z_{l,j}).$$

The W-k -means algorithm is an extension of the k -means algorithm that adds a new step to calculate variable weights in the iterative process. It does not have a significant impact on the scalability of k-means type algorithms in clustering large data, so it is appropriate for data mining applications. The general rule for variable weighting is to provide a higher weight to a variable with a smaller total of within-cluster distances and a lower weight to a variable with a greater sum of within-cluster distances.

Weighted binary bat algorithm

Weighted binary bat algorithm used for feature selection. The Bat Algorithm (BA) was created based on bat echolocation behavior. An artificial bat in BA has location, velocity, and frequency vectors that are updated as iterations progress. The artificial bats use location and velocity vectors in the continuous real domain to navigate around the search space. There is a position (xi), frequency (fi), and velocity for each bat (bi) (vi). The bats advance to the next position with new velocities at each step t, as follows:

$$v_i(t+1) = v_i(t) + (x_i(t) - gbest)f_i \quad (1)$$

Where best denotes the best answer found thus far. The bat's position is now updated as follows:

$$x_i(t+1) = x_i(t) + v_i(t) \quad (2)$$





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At each iteration, the frequency of the i^{th} bat is calculated as follows:

$$f_i = f_{\min} + (f_{\max} - f_{\min})\beta \quad (3)$$

Where beta is a uniformly distributed random number in the range [0, 1]. A random walk approach, as shown below, improves BA's exploitation capability:

$$x_{\text{new}} = x_{\text{old}} + \varepsilon A^t \quad (4)$$

Where A is the loudness and is a random number between [-1, 1]. The loudness and pulse emission rate is changed as follows for each iteration:

$$A_i(t+1) = \alpha A_i(t) \quad (5)$$

$$r_i(t+1) = r_i(0) + [1 - \exp(-\gamma t)] \quad (6)$$

BA is straightforward and effective. For the standard parameters, other swarm intelligence algorithms employ a constant value. It can be seen from Equations (5) and (6) that the loudness and pulse rate are changed at each iteration.

Cluster Analysis

In the first phase of the experiment, the clustering algorithms K-means, Fuzzy C-means, and Gaussian kernel-based fuzzy c-means were used. Figure 3 depicts the input layers for member functions. The member functions are divided into six categories. Figure 4 depicts the algorithm's grouping output. Clusters are used in the proposed approach to obtain the best separation points and most accurate findings. Each of the separated clusters has several testers who may belong to the first class (diabetic-tested positive), the second class (diabetic-tested negative), or both classes (diabetic-tested positive). The proposed model was assessed and evaluated based on the following factors. Table 1 shows the experimental findings obtained by the proposed system. The proposed method's accuracy was compared to that of existing methods. The accuracy of the K-means approach is 80.025 percent, FCM is 89.3689 percent, and PSO-GKFCM is 97.7999 percent. When compared to existing approaches, our proposed PSO-GKFCM method performs better.

Classification Analysis

In the second phase of the experiment, the classification algorithms Binary Regression, Convolution Neural Network, and Recurrent Neural Network with Probability Density Function (PDF-RNN) were used. A ROC curve (receiver operating characteristic curve) is a graph that indicates how well a classification model performs across all categorization levels. The True Positive Rate and False Positive Rate are plotted on the receiver curve. Figure 7 depicts the simulation time for the proposed model's training model, testing data, and anticipated data. The total result table for Binary Regression, Convolution Neural Network, and PDF-Recurrent Neural Network is shown in Table 2. The Accuracy Predicted Binary Regression value for categorized learning is 89.6846, CNN is 94.9765, and PDF-RNN is 98.1245. When compared to existing approaches, our proposed method performs with better accuracy.

CONCLUSION

The suggested system aims to improve GKFCM by optimizing the cluster center's initialization procedure and incorporating PSO. Our modified model, on the other hand, is designed to predict DM2 and is compatible with the logistic regression PDF-RNN algorithm. It ensures that less time is spent and that the original data is retained to the maximum extent possible. Even though the revised model is not overly sophisticated, numerous trials have shown that it has a positive effect. The key issues we addressed were enhancing prediction model accuracy and allowing the



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model to adapt to different datasets. In this study, we show that our proposed model has a higher prediction accuracy (98.1245%) than the experimental results of previous researchers.

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Table 1: Clustering Result Comparison

Result	K-means	FCM	GKFCM
Accuracy	76.8	84.3396	92.9644
Sensitivity	82.75	88.3396	94.9644
Specificity	32	24.7799	22.5225
Precision	89.2271	94.8746	96.9644
Recall	10.7729	5.12537	3.03558
F-measure	7.2629	5.1254	2.4086
G-mean	68.7198	84.3396	86.5569





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Table 2: Classification Result Comparison

Method/ Measurement	BR	CNN	Proposed Method (PDF-RNN)
Accuracy	89.6846	94.9765	98.1245
Average Learning	60.1278	73.9874	88.2465
Classification with True data	85.3214	90.5213	94.5267
Sensitivity	86.2479	92.1236	97.8546
Specificity	40.3215	27.5645	12.5478
Precision	86.8566	94.3321	97.5499
Recall	12.6547	5.9874	2.8974
F Measure	8.6654	7.8846	3.5128

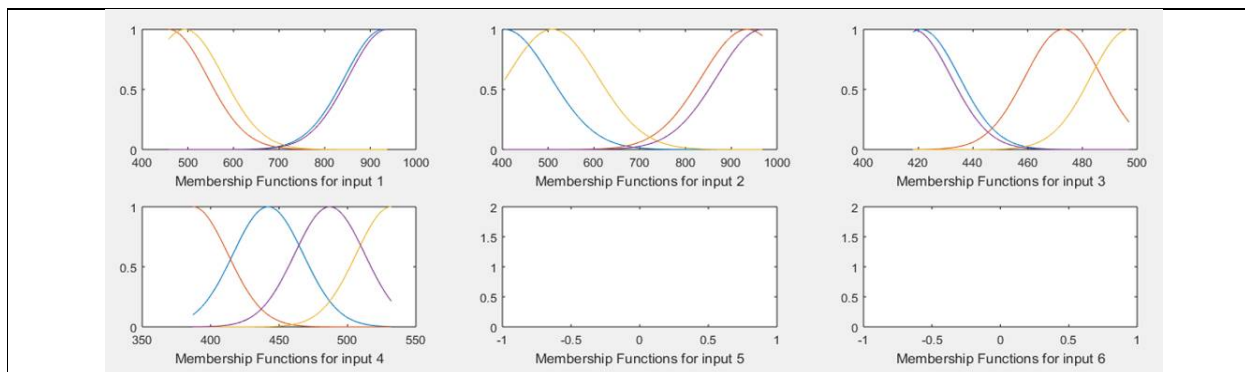


Figure 1: Member functions input charts

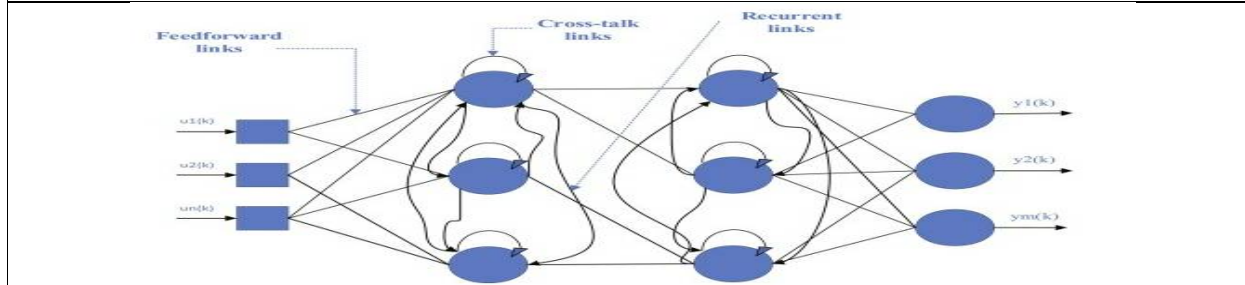


Fig 2: Architecture of RNN

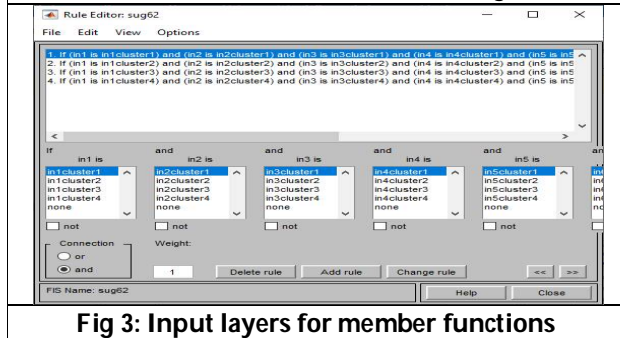


Fig 3: Input layers for member functions

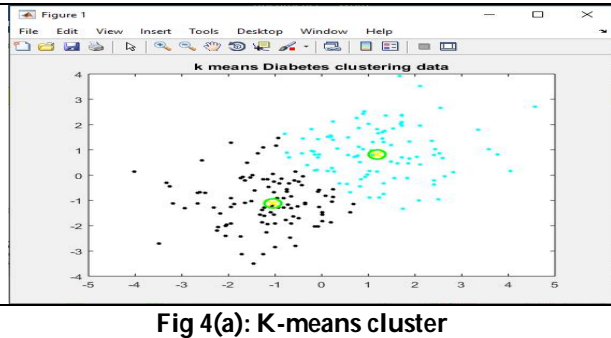


Fig 4(a): K-means cluster





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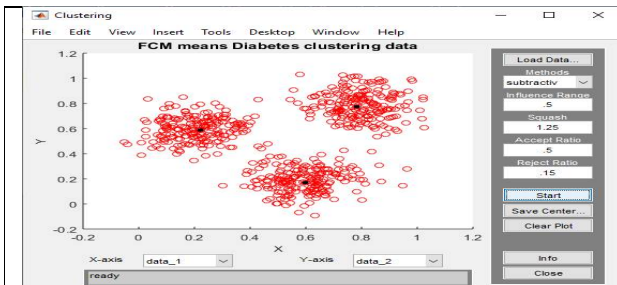


Fig 4(b): FCM

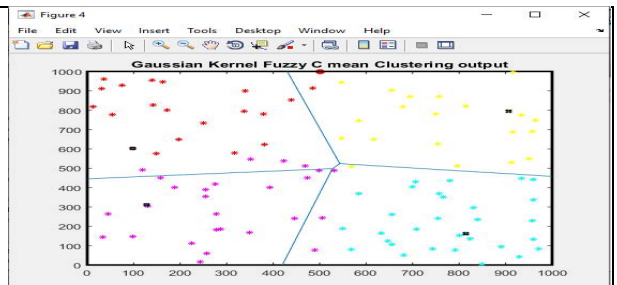


Fig 4(c): GKFCM

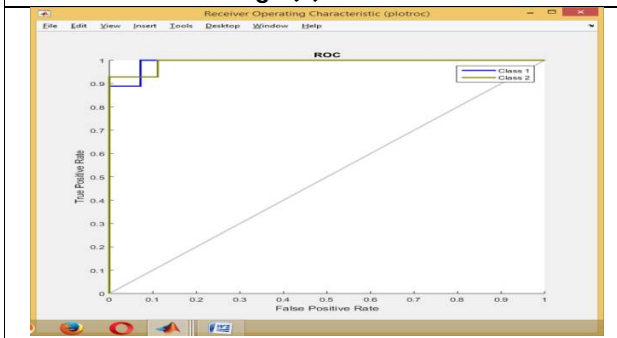


Fig 5: ROC Curve

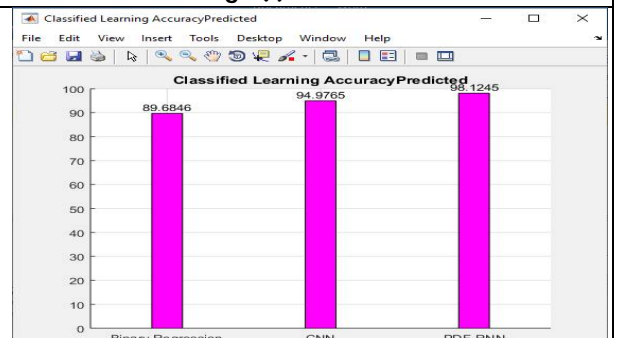


Fig 6: Classification accuracy

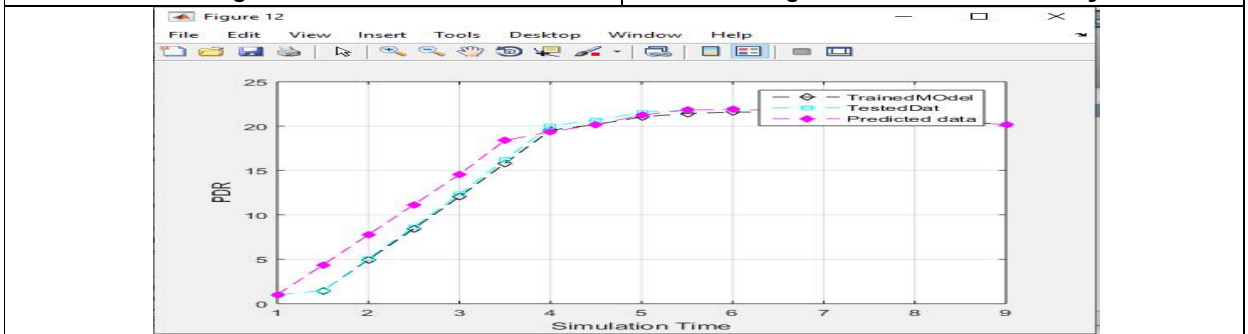


Fig 7: Predicted data





Viro-Periodontal approach Human Papilloma Virus- A Possible Periodontol Pathogen

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ABSTRACT

The purpose of this review is to analyse the role of viruses in causing Periodontitis and vice –versa. This is very important to know about the pathogenic role of viruses apart from bacteria in causing Periodontitis. In this review the main focus in on the weather the viruses play a key role in causing periodontal diseases or the patients having the periodontal problems are more prone to be affected by viruses. Human Papilloma Virus and its types are discussed in detail. The prevalence and severity of both Periodontitis and HPV infection are significantly higher in patients infected with HIV and herpes viruses. The role of various risk factor, diagnostic methods are also important to understand and in this review various risk factors and methods for detection are also discussed.

Keywords: Viruses, Periodontitis, Human Papilloma Virus, RT- PCR, Saliva.

INTRODUCTION

Periodontal disease is an infection that is identified by the progressive destruction of the structures supporting the teeth. Periodontitis has a vast etiology that involves the complex interaction between bacteria, host response, and various risk factors [1]. A specific group of pathogens present in the subgingival biofilm was shown to be the primary etiologic agents of periodontitis.[2,3] During the past 2 decades, many studies suggested that periodontal tissues may serve as a reservoir for the herpes simplex virus (HSV), Epstein-Barr virus (EBV), [4,5,6,7,8] and human cytomegalovirus (HCMV).[4,5,6,7,8]. Furthermore, some of these studies [4,5,6,7] showed that these viruses may be associated with the pathogenesis and severity of periodontal diseases. In oral squamous cell papilloma and

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condyloma acuminatum. HPV- 16, -18, -31, and -45 are the predominant high-risk types found in cervical squamous cell carcinoma, with HPV-16 alone accounting for 80% of cases. [9,10] HPV-16 seems to be the most frequent type associated with oral carcinomas. Findings and implications in the pathogenesis and severity of Cytomegalovirus (CMV), Epstein-Barr Virus type 1 (EBV-1), and Herpes Simplex Virus (HSV) in some of these diseases encouraged the search for other viral agents capable of residing in healthy and unhealthy oral tissues, but which have not been linked to periodontal pathologies. [11,12,13].

Human papillomaviruses (HPVs) that belong to the Papillomaviridae family consist of a group of epitheliotropic viruses associated with cell proliferative processes and may be benign (warts and condylomas) and/or pre-malign or malign (leukoplakia and carcinomas) in the stratified epithelia of the skin and mucosa. Infection of hosts by multiple microorganisms is the norm rather than the exception, yet much research has focused on single pathogens. Studies suggest that viruses and bacteria, mostly studied in isolation, may cooperate synergistically and should be considered a pathogenic consortium. The prevalence and severity of both Periodontitis and HPV infection are significantly higher in patients infected with HIV and herpesviruses. [14,15] This provides additional indirect evidence for Periodontitis-HPV association. It was shown that herpesvirus infections occurred more frequently in Periodontitis sites and that herpesvirus-associated periodontal pockets harbored higher levels of periodontal bacteria. In addition, periodontal disease severity was significantly associated with salivary viral load, and periodontal treatment reduced the viral load to undetectable levels. [16] It was suggested that Periodontitis sites are a source of salivary herpes viruses and that periodontal treatment may help control viral replication, transmission, and associated diseases. [17] Among the viral agents suggested, the human papilloma virus (HPV) has also been known to contribute to periodontal infection.[18,19] HPV causes characteristic cytopathic effects (koilocytosis) and proliferation of epithelial cells.[20,21] Since proliferation and migration of the Junctional epithelium are a major hallmark of periodontal breakdown, these known biological effects of HPV might provide a link between viral infection and periodontal disease.[22] Theoretically, the junctional epithelium attached to the tooth surface appears to fully serve the cellular functions required by HPV. Its phenotype is cell-like which does not differentiate and is exfoliated through the gingival crevice before differentiation occurs. [23]

HPV was selected because the association of HPV with periodontitis has been studied by various authors. [18,19] According to Hormia et al., the junctional and gingival sulcus epithelium in periodontitis could favor the replication of this virus and might be an important reservoir of HPV in the oral mucosa in case of chronic inflammation and continuous epithelial proliferation. HPV enters through micro-lesions or normal exposure of parabasal cells to the external environment. The Periodontal pocket serve as a reservoir for basal cells in the oral Mucosa. Marginal periodontium was selected under the study by Hormia et al., that maximum number of receptors for HPV is found in marginal Periodontal tissues. This was obtained through an internal bevel incision. The first step is attachment of virus to specific receptor to susceptible host cells in viral infection. [24] Integrin $\alpha 6\beta 4$, a cell surface receptor for laminins, was preliminarily suggested to be the receptor for HPV entry. HPV infection has been shown to require cell surface heparin sulfate, and especially syndecan-1 has been implied as to the candidate receptor of HPV.[25] Heparan sulfate proteoglycans have also been detected in the dental-epithelial junction.[26] Thus, the marginal periodontal epithelial cells express the implicated HPV receptors needed by the virus for its entry into the host cells, giving strong additional support to the concept of an HPV reservoir in the oral mucosa.

There are about more than 100 types of HPV and more than 30 are present in the oral cavity. [27] It was difficult to test for all these 30 strains and hence HPV-16 and HPV -18 were selected as they are one of the high-risk HPV types most prevalent in head and neck squamous cell carcinoma. A case-control study by Tezal et al. showed that in a chronic periodontitis patient for each millimeter of alveolar bone loss there is a fourfold increase in the risk for oral squamous cell carcinoma. In that study, 63% of patients were positive for HPV-16. Thus, the virus has increasing importance in the present scenario. Studies have shown that there is a positive association of HPV with periodontitis. Madinier et al. had shown a 16.6% prevalence of HPV in adult periodontitis and 50% prevalence in rapidly progressing periodontitis.[7] Another case-control study in Gingival Crevicular Fluid by Paras and Slots showed a prevalence of 17% in advanced periodontitis cases.[28]



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Inflammatory diseases such as periodontitis also enhance HIV viral load because increased inflammation attracts HIV-infected lymphocytes and monocytes. In vitro experiments show that HIV replication is finely regulated by various inflammatory cytokines acting in an autocrine and paracrine manner. Interleukins 1 and 6 and tumor necrosis factors have been demonstrated to induce HIV expression and replication in latently infected, resting CD4₊ T cells.[29] Increased inflammatory infiltrate carries HIV- and herpes virus-infected cells to the periodontitis sites, where cellular breakdown sheds viruses into the oral cavity. Saliva serves as a medium of interaction between the shed viruses, bacteria, inflammatory mediators and other carcinogens such as tobacco and alcohol metabolites. Saliva also acts as a mediator to transport from one surface to another. In this way it acts on the distant sites also.

Structure of HPV**Physical forms of HPV DNA**

The HPV genome consists of an upstream regulatory (URR), or long control, region (LCR), an early gene (E1, E2, E6, and E7) region, and a late gene (L1 and L2) region.[30] It should be noted, moreover, that adjacent regions overlap: e.g., E6, which is bigger than E7, overlaps a significant portion of E7. After infection of a cervical epithelial cell, the circular HPV DNA initially remains free inside the cell. HPV which are low risk causing like 6 and 11 mainly remain in this episomal form.[31,32] This also applies to high-risk types in cervical intraepithelial neoplasia 1 (CIN1), and frequently in CIN2 and CIN3. [33,34] However, in cervical carcinoma cell lines, the viral DNA is usually integrated into the cellular genome. HPV virions are composed of double-stranded circular chain which are 55nm in diameter composed of a of 8,000 pairs of DNA bases whose amino acid sequences classify them into more than 100 genotypes, which are present inside a naked icosahedral capsid shell. [35]

Viral Integration and Cancer

In HPV16-infected cancer cells, both episomal and integrated, head-to-tail arrays of HPV DNA have been seen. [36] For cervical carcinomas containing HPV16, one study found 44% had integrated, 44% had episomal and 11% had both forms of HPV DNA. [37] In another study, 8/34 invasive cancers had only the integrated form.[38] Yet another found 11/25 to have only integrated HPV. A heavy load of HPV16 DNA has been associated with the rapid progression of CIN lesions. In the case of HPV18, the HPV DNA was integrated and amplified in three cell lines, and in carcinomas, a mixture of integrated and episomal HPV16 was observed. In addition, increased levels of inflammatory cytokines, such as interleukins 1 and 6 and tumor necrosis factors, were shown to modulate HPV gene expression and proliferation.[39] In a recent study, a non-steroidal anti-inflammatory drug-induced specific degradation of the HPV oncoprotein E7 and caused growth arrest and apoptosis in cervical carcinoma cells. Periodontitis is a chronic inflammatory condition which is caused by gram negative anaerobic bacteria in the dental plaque. It leads to destruction of tissues around the teeth. Periodontitis results in a continuous release of bacterial toxins and inflammatory markers into the saliva and to a very less degree into the blood stream. [40] Human Papillomavirus infects exclusively the basal cells of the epithelium. It gains access through abrasions or normal exposure of parabasal cells, such as in the transformation zone of the uterine cervix. In addition, replication of the virus is closely associated with the proliferation of the basal and parabasal cells. The periodontal pocket provides a favourable environment for HPV infection because of the continuous epithelial proliferation, migration, rete ridge formation, and ulcerations. Integrin $\alpha_6\beta_4$ and syndecan-1, candidate receptors for HPV, are expressed during wound healing and are present in the periodontal pocket epithelium. It was also suggested that periodontal pockets may serve as a reservoir for latent HPV.[41] Latent state would require the presence of infected cells that fail to differentiate. The junctional epithelium serve the cellular functions required by HPV. The junctional epithelium is composed of basal and suprabasal cell layers only and has a very high turnover rate. The basal cells are exfoliated through the gingival crevice before differentiation occurs. Frequent occurrence of gingival papillomas and condylomas in human immunodeficiency virus (HIV) – positive participants and in patients with organ transplants receiving cyclosporine treatment could be explained by reactivation of latent HPV.

HPV and Cancer of the Oral Cavity

HPV is an important cause of Oropharyngeal Squamous Cell Carcinoma, it is currently unclear whether HPV has a role in other Head and neck cancer subsites, including oral squamous cell carcinoma. The generally accepted risk



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factors for cancers of the oral cavity including tumors of the tongue, the floor of the mouth, gingival, palate, lip mucosa, and other sites of the mouth are tobacco, smoking, betel quid chewing, and alcoholic beverage drinking. Prevalence is just 2 to 8% in the oral cavity, with HPV- 16 being the most commonly identified type. Most oral HPV infections are likely to be cleared within a year.[41]

Association of HPV with Risk Factors

The association between smoking and HPV prevalence in the literature is inconsistent. Although recent studies have shown that never-smokers tend to have HPV-positive tumors, most patients with HPV-positive tumors are still smokers.[42] Therefore, defining a relationship between the virus, smoking, and other host and environmental influences may be essential to understanding HPV-associated carcinogenesis. In a study it was found that smoking can't be the only predictor for HPV induced tumors. Even non-smokers showed a positive prevalence of HPV-tumors. This prediction was also adjunct with the fact that most patients with HPV -positive tumors and non-smokers had a severity of periodontitis. In cases of periodontitis who are non smokers are likely to have HPV positive tumors and not the vice-versa. Also the association with alcohol use and periodontitis have found positive cases of HPV tumors. Therefore, local factors, like chronic inflammation, bacterial infections can give a valuable access to the association of HPV with tobacco and alcohol abuse. Recent evidence supports the significant role of viruses in the initiation and progression of periodontitis. Poor oral hygiene leads to periodontitis. A possible link between poor oral hygiene developed periodontitis with HPVs have been advocated by previous research work which suggest that either both the disease are concurrent or HPV may have caused Periodontitis. However the link is yet to be decipher.

Mere detection of microbial virus is not a diagnostic criteria for cancer. Presence of biofilm protects HPV from host and chemicals defences which can enhance the fact that HPV is a synergistic microbe that effects the oral cavity. Detection of this infection can help clinician to prevent and treat cancer and periodontitis in a much effective manner by reducing the transmission, acquisition and persistence of HPV. Currently, there is no treatment for HPV infection. Studies have shown HPV -16 to cause more than 80% of squamous cell carcinomas of the uterine cervix and 30% of the oropharynx, and it also shows a strong association with tonsil cancer. HPV is biologically linked to the differentiation program of the host's basal keratinocytes. The basal cells of the junctional epithelium directly exfoliate the gingival sulcus and have a high capacity for proliferation and cell renewal. Syndecan-1 and heparan sulfate proteoglycans -specific cell surface receptors in susceptible individuals- be present in these marginal periodontium epithelial cells. These molecules are considered to cause adhesion of virus and subsequently is related to cell biology and survival. Non- keratinized thin and permeable gingival epithelial creates an ideal situation for virus to grow which is similar to the environment of the crevice in case of cervical cancer induced by HPV-16.

Oral transmission can occur by oral-genital or oral sex, or by autoinoculation which is suspected to facilitates intra-oral cancer by enabling horizontal and vertical microbial transmission among humans, which would justify the need to research other mucosal reservoirs. As the presence of HPV modifies the biological reactions of tissues, this study aimed to analyze the periodontal status of women with HPV genital lesions and detect whether there was also the presence of HPV in the periodontal sulcus and/or pocket and the tongue.

Evidence to Support the Association between Periodontitis and HPV Infection

Eight studies were found to support an association between periodontitis and oral HPV infection. The studies conducted in France and Finland were among the first few trials to demonstrate the link between periodontitis and oral HPV infection.[43,44] Similar results were obtained by them which showed 15% prevalence of HPV-16 and 10% of HPV-11. The highest prevalence of 25% was seen in HPV-6. Thus, they suggested that oral tissues exhibiting periodontitis perhaps acts as a preferred site for oral HPV infection. Similar studies were conducted to explore this possible link. A pilot study was conducted in India among chronic periodontitis patients and found a 50% prevalence of oral HPV in the marginal periodontium.[45] A case control Study in the U.S. among tongue cancer patients found a positive association between ABL and oral HPV-positive tumor status.[46]



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Meanwhile, a case-control study from India checked the periodontal pocket and gingival sulcus scrapings of patients with chronic periodontitis, and a group with no CAL which acted as the control for oral HPV and found 42.3% positive samples.[47] This possible link was further investigated by two studies which had a much larger sample size as compared to any other studies mentioned above. Across-sectional study was conducted 740 Hispanic adults where periodontitis was assessed using NHANES methodology and was classified as none/mild, moderate and severe as per CDC/AAP.[48] higher probability of oral HPV infection was found in adults with severe periodontitis as compared to those with no/mild periodontal disease. The other study with sample size of 3439 patients who self-reported with the possibility of gum disease showed higher presence of oral HPV infection in the self-collected oral rinse sample.[49]

Evidence to Support the Lack of Association between Periodontitis and HPV Infection

The largest cross-sectional study to evaluate this association was performed using data from NHANES 2009–2012 (n = 6004). Periodontitis was diagnosed using the CDC/AAP definition. Meanwhile, oral HPV infection was diagnosed through self-collected oral rinse using NHANES methodology [50]. This study did not find an association between periodontitis and oral HPV infection (OR 1.04, 95% CI 0.63 - 1.73) [50], although this analysis did not consider periodontitis severity. Null results regarding the association between periodontitis and oral HPV infection were seen in a pilot study in Australia (n = 223) among patients from a University dental clinic (OR 2.08, 95% CI 0.52 - 8.27). In this study, periodontitis was defined using a score between 0 and 4 at anatomical sextants in the mouth and a self-collected salivary oral rinse was used for oral HPV infection.[51]

Diagnosis

Virus diagnosis is a challenging task in periodontal cases; however, the revolution in the field of diagnostics made it easy now a day. The culture of virus in vitro (cell lines) and in vivo (animal) model was a gold standard but still a time-consuming method. Rapid diagnosis of viruses is essential by using molecular techniques like PCR, RT-PCR, real-time RT-PCR, and sequencing. Periodontal viruses may be identified successfully by using diagnostic DNA microarrays that can detect simultaneously HHV, EBV, and CMV. It uses multiplex real-time PCR techniques to quantify simultaneously the number of genome copies. HHV, HCMV, and EBV have been isolated from periodontal disease sites and were confirmed through molecular assays. Table [1]The presence of HHV was also confirmed through DNA probes, Flow cytometry, immunofluorescence staining, and culture. The human oral cavity is full of viral species yet to be identified in much detail using various metagenomics approaches. [54]

Assay sensitivity

Low –Immunoperoxidase detects viral capsid antigens indicating cell permissiveness for complete virus replication
Moderate – southern blot, dot blot, reverse blot hybridization can detect 1 to 10 copies of viral DNA per cell
High- Polymerase chain reaction –can detect < 1 copy of viral DNA per cell. Table [2]

Treatment

Conventional periodontal therapy can reduce the periodontal load of viruses. Mechanical debridement may be used to suppress subgingival viral load. Anti-HHV chemotherapy can also decrease the salivary viral load. A short course of Valacyclovir, 2g twice on the day of treatment and 1g twice the following day, resulted in a significant decrease in the salivary occurrence of EBV. Valacyclovir therapy, 3g per day for 14 days, resulted in a reduction, of more than 100- fold, of Epstein–Barr virus genome copies in oral wash fluid of patients with acute infectious mononucleosis. Chemotherapeutics are effective against viruses in the lytic phase, but not against viruses in the latent phase, limiting their potential use in disease-active infections. Acyclovir types of drugs are acyclic nucleoside analogs that inhibit HHV replication. Future management of periodontal diseases may benefit from anti-viral immunotherapy: either prophylactic vaccines, which harness the immune system of healthy subjects to prevent infection with disease-causing viruses; or therapeutic vaccines, which stimulate the immune system into combating existing viruses and disease. [54]



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CONCLUSION

A better understanding of the etiology of periodontitis is critical for developing detection systems and therapies that will enable us to ensure long-lasting disease control. This review article mainly focuses on the impact of virus-associated clinical outcomes in periodontal cases. Present clues of this pathogenic flora of periodontium have a futuristic vast area to research on diagnostic as well as therapeutics. Research during the past 15 years has implied that several viruses are involved in the etiopathogenic destructive periodontal disease. Published literature shows the presence of highly virulent viral species that may lead to severe infections in form of aggressive and chronic periodontitis. Co-infection of two viruses like EBV and CMV is also responsible for progressive periodontitis. HHV also cooperates with specific bacteria in periodontal tissue breakdown. A co-infection of active Herpes viruses and periodontopathic bacteria may constitute a major cause of periodontitis and explain a number of the clinical characteristics of the disease. The ability of an active virus infection to alter the periodontal immune responses may constitute a crucial pathogenetic feature of periodontitis. An active viral infection can exert direct cytopathogenic effects on key cells of the periodontium; induce the release of proinflammatory cytokines.

Ongoing research on viral infections of the periodontium has stream lighted towards prevention and treatment of virus-induced periodontitis. Studies in the field of virus-induced periodontal infections will help in understanding clinical and biological features involved in periodontitis, and also formulate new strategies for managing the disease. Detection or quantification of periodontal viruses may prove to have prognostic significance. To achieve the final goal to treat any patient up to the maintenance stage so that he/she would be able to get rid of infection truly is at far long. Assessment of the re-activation status of a periodontal infection may help to guide the treatment of patients with severe periodontitis. Development of new vaccines for viruses involved in periodontal disease is required in the future which can hope for low-cost prevention of periodontitis in large groups of individuals. A full understanding of the microbial factors, their pathogenicity as well as host factors is of essential importance for the pathogenesis of the periodontal disease. In this way, it would be possible to treat periodontal patients adequately. Therefore to make an effort toward a deep understanding of the etiopathogenesis of disease is required for the development of suitable preventive and therapeutic measures.

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Table 1: Different methods to detect the HPV [52]

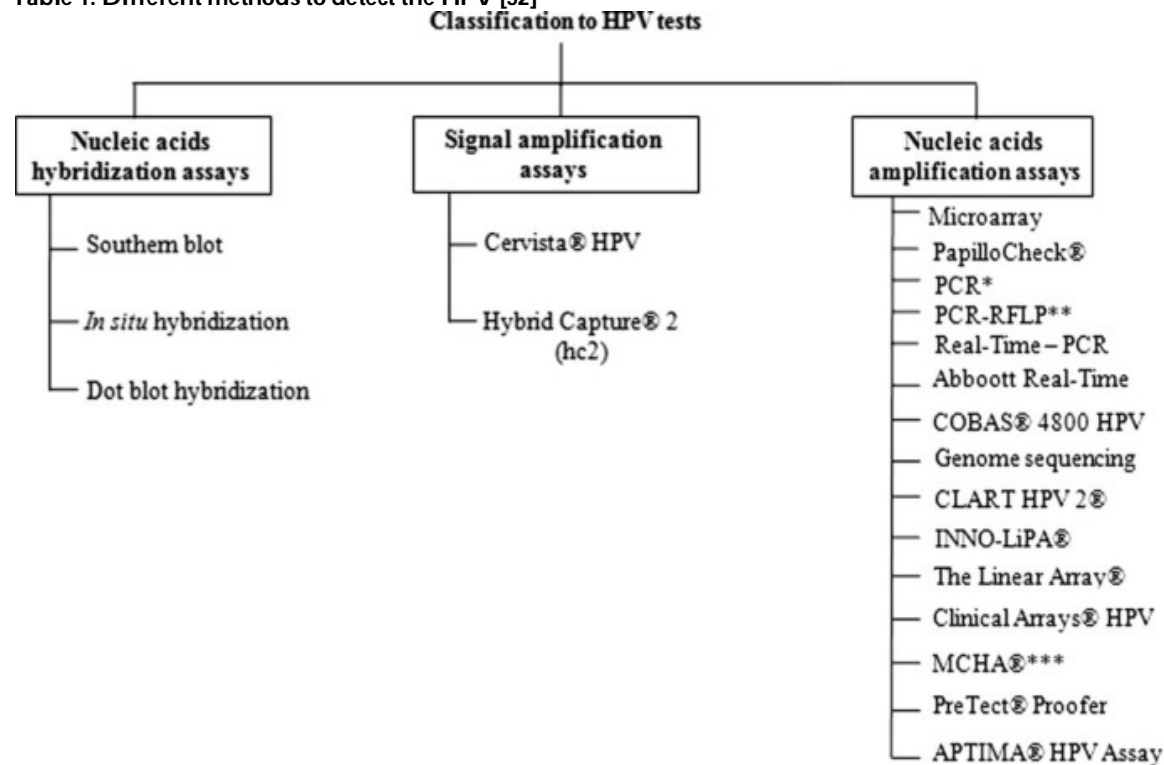


Table 2: Benefits and weaknesses of the molecular methods for HPV detection [53]

Method	Benefits	Weaknesses
Nucleic acids hybridization assays	Southern blot is the gold standard for HPV genomic analysis Presence of HPV in association with morphology	Low sensitivity, time-consuming, relatively large amounts of purified DNA
		Southern blot and hybridization cannot use degraded DNA
Signal amplification assays	Quantitative	Licensed and patented technologies
	FDA-approved test (hc2)	Wasn't designed to genotype individual
	Lower false-positive rate	
	High sensitivity to genotyping	
Nucleic acids amplification assays	Flexible technology (viral load and genotype)	Lower amplification signals of some HPV genotypes
	Very high sensitivity	Contamination with previously amplified material can lead to false positives
	Multiplex analysis	

HPV = Human *Papillomavirus*; FDA = Food and Drug Administration; hc2 = Hybrid Capture® 2; PCR = Polymerase Chain Reaction.





$\hat{\mu}\beta$ – Separation Axioms in Bi Č ECH Space"

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ABSTRACT

In this paper, we introduced the concepts of $\hat{\mu}\beta$ generalized closed sets in biČech closure space and investigate some of its properties and characterization.

Keywords: Bi Čech closure operator, Bi Čech closure spaces, Bi Čech $\hat{\mu}\beta$ generalized closed sets, Bi Čech $\hat{\mu}\beta$ generalized open sets.

INTRODUCTION

Čech closure spaces were introduced by Čech [1]. In Čech's approach the operator satisfies idempotent condition among Kuratowski axioms. This condition need not hold for every set A of X . When this condition is also true, the operator becomes topological closure operator. Thus, the concept of closure space is the generalization of a topological space. Closure functions that are more general than the topological ones have been studied already by Day [3]. A thorough discussion on closure functions is due to Hammer, see e.g. [6,7] and more recently Gnlika [4]. The notion of bitopological space were introduced by J.C.Kelly [8]. Such space are equipped with two arbitrary topologies. Furthermore, Kelly extended some of the standard results of separation axioms in a topological space to a bitopological space. Čech closure space were studied by Chandrasekhara Rao [2]. In this paper we introduced the $\hat{\mu}\beta$ closed sets in Bi Čech closure spaces.

PRELIMINARIES

Definition 2.1 : Two functions k_1 and k_2 from power set X to itself are called Čech closure operators (simply biclosure operator) of X if they satisfies the following properties





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- (i) $k_1(\phi) = \phi$ and $k_2(\phi) = \phi$
 (ii) $A \subset k_1(A)$ and $A \subset k_2(A)$ for any set $A \subset X$
 (iii) $k_1(A \cup B) = k_1(A) \cup k_1(B)$ and $k_2(A \cup B) = k_2(A) \cup k_2(B)$ for any $A, B \subset X$.
 (iv) (X, k_1, k_2) is called bi Čech closure space.

A subset A is closed in the closure space (X, k) if $k(A) = A$ and it is open if its complement is closed. The empty set and the whole space are both open and closed. A is a closed subset of a bi Čech closure space (X, k_1, k_2) if and only if A is a closed set of (X, k_1) and (X, k_2) . Also the following conditions are equivalent for a closed set A .

$$k_1 k_2(A) = A$$

$$k_1(A) = A, k_2(A) = A$$

Definition 2.2: [2] A subset A in a bi Čech closure space (X, k_1, k_2) is said to be

1. k_i regular open if $A = \text{int}_{k_i}(k_i(A))$, $i = 1, 2$.
2. $k_i - \alpha$ closed if $k_i[\text{int}_{k_i}(k_i(A))] \subseteq A$, $i = 1, 2$.

The smallest Čech $\hat{\mu}$ closed set containing A is called Čech $\hat{\mu}$ closure of A and it is denoted by $k_{\hat{\mu}}(A)$. The largest Čech $\hat{\mu}$ open set contained in A is called Čech $\hat{\mu}$ interior of A and is denoted by $\text{int}_{k_{\hat{\mu}}}(A)$. $k_{1\hat{\mu}}(A)$ and $k_{2\hat{\mu}}(A)$ is the intersection of all Čech $\hat{\mu}$ closed sets under the operator k_1 and k_2 .

Example 2.3: Let $X = \{a, b, c\}$ and let k_1 and k_2 be defined as:

$$k_1(\{a\}) = \{a\},$$

$$k_1(\{b\}) = k_1(\{c\}) = k_1(\{b, c\}) = \{b, c\},$$

$$k_1(\{a, b\}) = k_1(\{a, c\}) = k_1(\{X\}) = X \text{ and } k_1(\phi) = \phi.$$

$$k_2(\{a\}) = \{a\},$$

$$k_2(\{b\}) = \{b, c\},$$

$$k_2(\{c\}) = k_2(\{a, c\}) = \{a, c\},$$

$$k_2(\{a, b\}) = k_2(\{b, c\}) = k_2(X) = X \text{ and } k_2(\phi) = \phi.$$

Now, (X, k_1, k_2) is a bi Čech closure space.

$(k_1, k_2) - \hat{\mu}\beta$ closed sets

Definition 3.1: A subset A in a Čech closure space (X, k_1, k_2) is said to be $(k_1, k_2) - \hat{\mu}\beta$ closed if $k_{2\hat{\mu}}(A) \subseteq U$, whenever $A \subseteq U$ and U is $k_1\beta$ open set in X .

Example 3.2: In example 2.3, when $U = \{b, c\}$, $A = \{b\}$ is $(k_1, k_2) - \hat{\mu}\beta$ closed.

Theorem 3.3: If A and B are $(k_1, k_2) - \hat{\mu}\beta$ closed sets in a bi Čech closure space (X, k_1, k_2) and so is $A \cup B$.

Proof: Let A and B be two $(k_1, k_2) - \hat{\mu}\beta$ closed sets. Let U be a $k_1\beta$ open set in X . Let $(A \cup B) \subseteq U$. Since A and B are $(k_1, k_2) - \hat{\mu}\beta$ closed sets, $k_{2\hat{\mu}}(A) \subseteq U$ and $k_{2\hat{\mu}}(B) \subseteq U$. Hence $k_{2\hat{\mu}}(A \cup B) \subseteq U$. Thus $A \cup B$ is $(k_1, k_2) - \hat{\mu}\beta$ closed sets.

Theorem 3.4: If A is a $(k_1, k_2) - \hat{\mu}\beta$ closed sets in a bi Čech closure space (X, k_1, k_2) then $k_{2\hat{\mu}}(A) - A$ contains no non-empty $k_1\beta$ closed sets.

Proof. Let A be $(k_1, k_2) - \hat{\mu}\beta$ closed sets. Let U be $k_1\beta$ closed contained in $k_{2\hat{\mu}}(A) - A$. Now, $U \subseteq k_{2\hat{\mu}}(A)$ and $U \subseteq A^c$. Then $U \subseteq U^c$. Since U is $k_1\beta$ closed, U^c is $k_1\beta$ open. Thus, we have $k_{2\hat{\mu}}(A) \subseteq U^c$. Consequently, $U \subseteq [k_{2\hat{\mu}}(A)]^c$ and $U \subseteq k_{2\hat{\mu}}(A) \cap [k_{2\hat{\mu}}(A)]^c = \phi$. Therefore $U = \phi$. Hence $k_{2\hat{\mu}}(A) - A$ contains no non-empty $k_1\beta$ closed sets.

Theorem 3.5: Let (X, k_1, k_2) be a bi Čech closure space. For each x in X , $\{x\}$ is $k_1\beta$ closed or $\{x\}^c$ is $(k_1, k_2) - \hat{\mu}\beta$ closed sets.





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Proof. Let (X, k_1, k_2) be a bi \check{C} ech closure space. Suppose that $\{x\}$ is not $k_1\beta$ closed, $\{x\}^c$ is not $k_1\beta$ open. Therefore, the only $k_1\beta$ open set containing $\{x\}^c$ is X . Thus $\{x\}^c \subseteq X$. Also $k_{2\hat{\mu}}[\{x\}^c] \subseteq k_{2\hat{\mu}}(X)$. Hence $\{x\}^c$ is a $(k_1, k_2) - \hat{\mu}\beta$ closed sets.

Theorem 3.6: Let A be a $(k_1, k_2) - \hat{\mu}\beta$ closed sets in a bi \check{C} ech closure space (X, k_1, k_2) . If A is $k_1\beta$ open then $A = k_{2\hat{\mu}}(A)$.

Proof. Let A be $(k_1, k_2) - \hat{\mu}\beta$ closed subset of bi \check{C} ech closure space (X, k_1, k_2) and let A be $k_1\beta$ open set. Then $k_{2\hat{\mu}}(A) \subseteq U$ whenever $A \subseteq U$ and U is a $k_1\beta$ open set in X . Since A is $k_1\beta$ open and $A \subseteq A$, we have $k_{2\hat{\mu}}(A) \subseteq A$. But, always $A \subseteq k_{2\hat{\mu}}(A)$. Thus $A = k_{2\hat{\mu}}(A)$.

Theorem 3.7: Let $A \subseteq Y \subseteq X$ and suppose that A is $(k_1, k_2) - \hat{\mu}\beta$ closed set in (X, k_1, k_2) . Then A is $(k_1, k_2) - \hat{\mu}\beta$ closed relative to Y .

Proof. Let S be any $k_1\beta$ open set in Y such that $A \subseteq S$. Then $S = U \cap Y$ for some U is $k_1\beta$ open in X . Therefore $A \subseteq U \cap Y$ implies $A \subseteq U$. Since A is a $(k_1, k_2) - \hat{\mu}\beta$ closed set in X , we have $k_{2\hat{\mu}}(A) \subseteq U$. Hence $Y \cap k_{2\hat{\mu}}(A) \subseteq Y \cap U = S$. Thus A is a $(k_1, k_2) - \hat{\mu}\beta$ closed set relative to Y .

$(k_1, k_2) - \hat{\mu}\beta$ open sets

Definition 4.1: A subset A of a bi \check{C} ech closure space (X, k_1, k_2) is called $(k_1, k_2) - \hat{\mu}\beta$ open if A^c is $(k_1, k_2) - \hat{\mu}\beta$ closed in (X, k_1, k_2) .

Example 4.2: In Example 2.3, when $U = \{b, c\}$, $A = \{a, c\}$ is a $(k_1, k_2) - \hat{\mu}\beta$ open set.

Theorem 4.3: A subset A of a bi \check{C} ech closure space (X, k_1, k_2) is $(k_1, k_2) - \hat{\mu}\beta$ open if and only if $F \subseteq \text{int}k_{2\hat{\mu}}(A)$ whenever F is a $k_1\beta$ closed set and $F \subseteq A$.

Proof. Suppose that A is $(k_1, k_2) - \hat{\mu}\beta$ open in (X, k_1, k_2) . Let F be a $k_1\beta$ closed set and $F \subseteq A$. Then F^c is $k_1\beta$ open and $A^c \subseteq F^c$. This implies that $F \subseteq [k_{2\hat{\mu}}(A^c)]^c = \text{int}k_{2\hat{\mu}}(A)$. That is, $F \subseteq \text{int}k_{2\hat{\mu}}(A)$ whenever F is a $k_1\beta$ closed set and $F \subseteq A$. Let V be any $k_1\beta$ open set in X such that $A^c \subseteq V$. Thus $V^c \subseteq A$ and V^c is $k_1\beta$ closed. Therefore $V^c \subseteq \text{int}k_{2\hat{\mu}}(A)$. Then $[\text{int}k_{2\hat{\mu}}(A)]^c \subseteq V$. Hence $[k_{2\hat{\mu}}(A)]^c \subseteq V$ and A^c is a $(k_1, k_2) - \hat{\mu}\beta$ closed set. Thus A is $(k_1, k_2) - \hat{\mu}\beta$ open.

Corollary 4.4: If a subset A of a bi \check{C} ech closure space (X, k_1, k_2) is $(k_1, k_2) - \hat{\mu}\beta$ closed set, then $k_{2\hat{\mu}}(A) - A$ is $(k_1, k_2) - \hat{\mu}\beta$ open set.

Proof. Let F be a $k_1\beta$ closed set such that $F \subseteq k_{2\hat{\mu}}(A) - A$. Then, $F = \phi$ by Theorem 3.4. Therefore $F \subseteq \text{int}k_{2\hat{\mu}}\{k_{2\hat{\mu}}(A) - A\}$. Hence, by Theorem 4.3, $k_{2\hat{\mu}}(A) - A$ is a $(k_1, k_2) - \hat{\mu}\beta$ open set.

Theorem 4.5: If A and B be $(k_1, k_2) - \hat{\mu}\beta$ open sets in a bi \check{C} ech closure space (X, k_1, k_2) , then so is $A \cap B$.

Proof. Let $(A^c \cup B^c) \subseteq U$ where U is $k_1\beta$ open. This implies that $A^c \subseteq U$ and $B^c \subseteq U$ gives $k_{2\hat{\mu}}(A^c) \subseteq U$ and $k_{2\hat{\mu}}(B^c) \subseteq U$. Thus $k_{2\hat{\mu}}(A^c) \cup k_{2\hat{\mu}}(B^c) \subseteq U$. Thus $k_{2\hat{\mu}}(A^c \cup B^c) \subseteq U$. Therefore $A \cap B$ is a $(k_1, k_2) - \hat{\mu}\beta$ open set.

$\hat{\mu}\beta$ - SEPARATION AXIOMS IN BICLOSURE SPACE

In this section we introduce the concept of generalized $\hat{\mu}\beta$ Hausdorff biclosure spaces, $\hat{\mu}\beta$ regular biclosure spaces and study some of the separation axioms.

Definition 5.1: A biclosure space (X, k_1, k_2) is said to be

1. $(k_1, k_2) - \hat{\mu}\beta$ Hausdorff space whenever x and y are distinct points of X there exist a $k_1\hat{\mu}\beta$ - open subset U and $k_2\hat{\mu}\beta$ open subset V of X such that $x \in U, y \in V$ and $U \cap V = \phi$.





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2. $(k_1, k_2) - \hat{\mu}\beta$ regular space if for any closed subset F of X and any point $x \in X - F$, there exist $k_2 \hat{\mu}\beta$ open subsets U and V of X such that $x \in U, F \subseteq V$ and $U \cap V = \emptyset$.

Definition 5.2: Let (X, u_1, u_2) and (Y, v_1, v_2) be closure spaces. A map $f : X \rightarrow Y$ is called $\hat{\mu}\beta$ irresolute, if $f^{-1}(F)$ is a $\hat{\mu}\beta$ closed subset of X for every $\hat{\mu}\beta$ closed subset F of Y . Clearly, a map $f : X \rightarrow Y$ is $\hat{\mu}\beta$ irresolute if and only if $f^{-1}(G)$ is a $\hat{\mu}\beta$ open subset of (X, u) for every $\hat{\mu}\beta$ open subset G of (Y, v) .

Definition 5.3: Let (X, u_1, u_2) and (Y, v_1, v_2) be biclosure spaces and let $i \in \{1, 2\}$. A map $f : (X, u_1, u_2) \rightarrow (Y, v_1, v_2)$ is called $i - \hat{\mu}\beta$ irresolute if the map $f : (X, u_i) \rightarrow (Y, v_i)$ is $\hat{\mu}\beta$ irresolute. A map f is called $\hat{\mu}\beta$ irresolute if f is $i - \hat{\mu}\beta$ irresolute for each $i \in \{1, 2\}$.

Proposition 5.4: Let (X, u_1, u_2) and (Y, v_1, v_2) be biclosure spaces. Let $f : (X, u_1, u_2) \rightarrow (Y, v_1, v_2)$ be injective and $\hat{\mu}\beta$ irresolute. If (Y, v_1, v_2) is a $(v_1, v_2) \hat{\mu}\beta$ Hausdorff biclosure space, then (X, u_1, u_2) is a $(u_1, u_2) \hat{\mu}\beta$ Hausdorff space.

Proof. Let x and y be any two distinct points of X . Then $f(x)$ and $f(y)$ are distinct points of Y . Since (Y, v_1, v_2) is a $(v_1, v_2) \hat{\mu}\beta$ Hausdorff biclosure space, there exists a disjoint $v_1 \hat{\mu}\beta$ open subset U of (Y, v_1) and $v_2 \hat{\mu}\beta$ open subset V of (Y, v_2) containing $f(x) \in U$ and $f(y) \in V$ respectively. Since f is $\hat{\mu}\beta$ irresolute and $U \cap V = \emptyset, f^{-1}(U)$ is a $u_1 \hat{\mu}\beta$ open subset of X and $f^{-1}(V)$ is a $u_2 \hat{\mu}\beta$ open subset of X such that $f^{-1}(U) \cap f^{-1}(V) = \emptyset$ and (X, u_1, u_2) is a $\hat{\mu}\beta$ Hausdorff biclosure space.

Proposition 5.5: Let (X, u_1, u_2) and (Y, v_1, v_2) be biclosure spaces. Let $f : (X, u_1, u_2) \rightarrow (Y, v_1, v_2)$ be injective, closed and $\hat{\mu}\beta$ irresolute. If (Y, v_1, v_2) is a $\hat{\mu}\beta$ regular biclosure space, then (X, u_1, u_2) is a $\hat{\mu}\beta$ regular biclosure space.

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Development of Thermal Tolerant *Spirulina* (SCP) Mutant

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ABSTRACT

The thermal tolerant *Spirulina* mutant was created by using of chemical mutagen ethyl methanesulfonat (EMS) and selected for outdoor cultivation and named as MS3-1 and MS3-2. This thermal mutant stain was tolerate the temperature above 45°C during the summer period than the wild stain. The result concluded that thermal tolerant mutant strain MS3-2 of *Spirulina platensis* was selected based on higher growth among the two mutant strains for mass production in RME liquid medium in outdoor experimental studies. The mass outdoor cultivation was carried out in cement tank at summer (April and May) and winter seasons (November and December), 2019. In summer season the growth parameters increased with increase in growth period till 60th day. The biomass recorded on 60th day was 13.10 g DW/m² day⁻¹ and the chlorophyll content was recorded at 1.54 mg/l/d. The recorded lipid, protein, carbohydrates and phycocyanin content were 0.297 mg/l, 66.80%, 19.50% and 115 mg/g respectively. In the winter season the growth parameters increased with increase in growth period till 60th day. The biomass recorded on 60th day was 9.25 g DW/m² day⁻¹ and the chlorophyll content was recorded at 1.12 mg/l/d. The recorded lipid, protein, carbohydrates and phycocyanin content were 0.244 mg/l, 61.00%, 13.00% and 101.0 mg/g respectively. The thermal tolerant *Spirulina platensis* mutant strain MS3-2 was found best suited for outdoor mass cultivation during summer period in RME in tropical and subtropical region.



**Amala et al.,****Keywords:** *Spirulina*, Microalgae, Mutant strain MS3-2, EMS, Thermal tolerant.

INTRODUCTION

Spirulina is blue green microalgae. It has rich in protein content in the range 62% there is no cholesterol. *Spirulina* was the one of oldest inhabitant of the earth. 1940, the French phycologist Dangeard reported that the *Spirulina*, gave protein contents that ranged from 62 to 68% of the dry weight. It fulfill the hunger of protein research studies. It is the best innovative protein food for the malnutrition children and adults in throughout the world. Mainly, Protein is an essential component for human diet management. For the recent centuries, the global food protein storage is the biggest challenge in the world.

In many countries, protein malnutrition may cause serious health disorder or infection in human. 'Kwashiorkor' is the protein deficiency infection occur in all over the world. It leads to cause increased mortality rate throughout the world. So researchers highly concern the need for new protein rich food. *Spirulina* is the best single cell protein (SCP). The *Spirulina* was cultivated in all over the world and using for protein food consumption in the form of powder or tablets. It is best protein food supplement in developing countries. *Spirulina platensis* is a blue green, single celled microalgae with spherical shaped and called as *Spirulina*. It has all the essential nutrients and developed as high nutritional rice food for future. It has antimicrobial activity against different bacterial pathogens like *E. coli* and *Staphylococcus aureus* and proofed by inoculated with muller hinton agar and the antifungal activity against *Aspergillus niger* using potato dextrose agar (Ravikumar *et al.*, 2010).

The cyanobacteria *Spirulina* which has been used as a dietary food and feed for humans and other animals. It carry many nutrients which has powerful effects on the human and animals body metabolism. It contains all essential good quality proteins, vitamins and minerals and helps to reduce liver fat and protect heart, improve brain health and it has anti-inflammatory, ant diabetic, antioxidant properties (Sohara Parveen, 2016). The antibacterial properties like as steroids, alkaloids, flavonoids, terpenoids, tannins, saponins, quinines and cardiac glycosides, protein and sugars of *Spirulina* was screened by agar well and paper disc diffusion method against the following wound causing pathogen such as *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Streptococcus pyogenes* and *Enterococci*. It shows good zone of inhibition against those bacterial pathogens (Vanmathi Selvi *et al.*, 2017).

Spirulina can able to produce essential components such as phycocyanine, poly unsaturated fatty acid such as linoleic and linolenic acids and carotenoids which carry out important role in human metabolic pathway. Those components were analyzed using GC-MS study and identified it can produced 15 more components like alkaloids, flavonoids, steroids, Saponins (Ravikumar *et al.*, 2010). The in-vitro antihelmenthic activity of *Spirulina* Powder (150 mg/ml) was evaluated against Indian earthworm *Pheretima posthuma*, finally the *Pheretima posthuma* was gone paralysis and death (Ramanjaneyulu *et al.*, 2017)

Supratim Ray (2011) reported that free radical scavenging activity of water extract of *Spirulina platensis* on flutamide-induced lipid peroxidation was evaluated and concluded that the *Spirulina platensis* can able to suppress the flutamide-induced toxicity. The microalgae nanoparticles polymer drugs were formulated and used as modern medicine and healthcare and treated different diseases. The silver nanoparticles were produced from cold tolerant mutant *Spirulina* and evaluated against tumor and cancer. The in vitro anticancer activity of *Spirulina* nanoparticles were screened human Hep 2 cell lines by means of MTT assay. The silver nanoparticles synthesized from the cold tolerant stains of *Spirulina platensis* can able to use as potential anti-bacterial against *Pseudomonas aeruginosa* and *Staphylococcus aureus* and anti-cancerous agent (Karthick Raja Namasivayam *et al.*, 2014).

The microalge helps to produce Biofuel with less emission of green-house effects, biodegradable and non-polluting. The algal oil were produced from different microalgae serves to be the improved one as it is easily available and



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renewable and reduce and control the pollution and exploitation of natural resources (Rajakumari *et al.*, 2019). The optimum temperature for *Spirulina* cultivation is 30°C. India is one of the developing countries and tropical region. In India, the pre-monsoon season the average temperature around 32°C to 40°C, it has highly challenges to cultivate *Spirulina* during summer season.

In this work, the *Spirulina* was changed into the mutant stain for temperature tolerant by using of chemical mutagens and mass outdoor cultivation was carried out in cement tank at Summer (April and May) and Winter seasons (November and December) and produce more protein rich *Spirulina*.

MATERIALS AND METHODS

Sample collection

The microalgal samples were collected from aquatic habitats like ponds, tanks and lakes in twenty different locations in Tamilnadu, India. The two *Spirulina* strains were isolated from those twenty algal samples and named as S1 and S2 and identified as *Spirulina platensis* based on comparison with *Spirulina platensis* S5 reference strain obtained from Microbiology laboratory, Annamalai University.

Culture maintenance

The isolated strains of *Spirulina platensis* S1, S2 and the reference strain S5 were grown in Zarrouk's medium under laboratory condition at 30°C in the light chamber for 30 days.

Characterization

The predominant algal genera in the 20 samples were identified based on their morphological characters such as colour of scum, mucilaginous (or) fibrous nature, floating (or) deposited filaments, heterocyst and shape and identified using low and high power objectives of the compound microscope. These *Spirulina* strains were characterized based on habitat, average no. of spirals, direction of the helix, distance between the spirals, the diameter of the spirals, the width of the spirals, filaments, shape of the spirals, pH tolerance and temperature tolerance. Morphological characters were observed under low power and high power objectives of the compound microscope and measured by micrometry method.

Mutant development

In the mutation procedure, the ethyl methane sulfonate (EMS) solution was used as a chemical mutagenic agent. The EMS ($\text{CH}_2\text{SO}_2\text{OC}_2\text{H}_5$) is a colorless liquid with a peppermint odour and it was obtained from HI-MEDIA laboratories, Mumbai. It has a dosimetry/ half-life period of 30 hours. the mutation procedure was carried out by (Ruengjitchawalya *et al.*, 2001) that the *Spirulina* stains were treated with different concentration of EMS ranges from 25, 50, 75 and 100 $\mu\text{L mL}^{-1}$ under various time durations 10, 20 and 40 min obtained.

Effect of temperature on mutant cells of *Spirulina platensis*

After mutation process, the mutant strains (1×10^4 cells per ml) were inoculated on Zarrouk's medium and incubated at various temperature (40, 45 and 50°C) in BOD incubator fitted with fluorescent light.

Outdoor cultivation

Mass production of *Spirulina platensis* mutant in RME medium

Mass cultivation of *Spirulina platensis* in the outdoors is possible under optimal conditions of nutrients, light, agitation, pH and temperature. The production unit has to be located in areas with suitable climatic conditions and places where all culture conditions are optimum.



**Amala et al.,****Maintenance of seeded culture**

The pure culture of *Spirulina platensis* strain MS3-2 was grown in 1000 ml of RME liquid medium (Amala and Ramanathan, 2013) for 30 days under laboratory condition for maintaining stock cultures for outdoor cultivation. The *Spirulina platensis* growth was evidenced by thickening of the culture marked by the development of an intense green colour and they are shaken a few times every day. After 30 days, the inoculum was ready for outdoor cultivation.

The parameters involved in the mass cultivation of *Spirulina platensis*

The technological factors like cultivation system, nutrient, light, agitation, pH temperature are involved in the mass cultivation *Spirulina platensis*.

Cultivation system

The *Spirulina platensis* cultivation requires effective pond management for outdoor production. Mass cultivation of *Spirulina platensis* was carried out in 200cm x200cm x30cm surface areas of 4m² (1000L) cement pond and culture depth is maintained at 15 cm.

Nutrient

A cost effective RME medium composed of nitrogen (2 g L⁻¹ NaNO₃), phosphorus (0.3 g L⁻¹ K₂HPO₄), carbon (10 g L⁻¹ NaHCO₃), 0.01 g L⁻¹ FeSO₄ and 0.08 g L⁻¹ EDTA in RME, pH adjusted to 9.5 was prepared and used.

Light

The outdoor cultivation of *Spirulina platensis* the light source was Sunlight.

Temperature

The cultivation area is one of the sunniest in India. Average daytime temperatures normally exceed 42°C in summer and in the winter season are above 28°C.

Agitation

The growth medium was mixed by manual stirring with a plastic stick (30 min/day) to prevent algal accumulation at the surface and to ensure uniform algal growth and distribution of nutrients.

Cultivation period

The *Spirulina platensis* cultivation was carried out in 1000L cement tank, during the period of summer (April and May, 2019) and winter season (November and December, 2019).

Mass cultivation of *Spirulina platensis*

The *Spirulina platensis* cultivation was carried out in 1000L shallow cement tank during the summer (April and May, 2019) and winter season (November and December, 2019). The stock culture (0.25g L⁻¹) of *Spirulina platensis* (MS3-2) was inoculated in RME medium. The growth medium was mixed by manual stirring with a plastic stick to prevent algal accumulation at the surface and to ensure uniform distribution of nutrients. After 60 days of cultivation period the growth parameters such as specific growth rate, doubling time, dry biomass, protein content, chlorophyll content, lipid content, total carbohydrate and phycocyanin were estimated by various methods.

RESULT AND DISCUSSION**Characterization of microalgae**

The *Spirulina platensis* consist of multicellular, filamentous, unbranched and helicoidal trichomes, motile cell structures like flagella and heterocysts were absent. The filaments called trichomes were formed by a single spiral



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twisted cell, when viewed through microscope green spiral coiled structure can be seen. The isolated strains of *Spirulina platensis* (S1 and S2) were characterized based on various parameters.

Mutation

The cell survival population of healthy and unhealthy *Spirulina platensis* (wild type) S1 and S2 strains were treated with various concentrations of EMS (25, 50, 75 and 100 μ l) was carried out at various time durations (10, 20 and 40 min) and the results were furnished in Table – 2. Similarly, Soundarapandian (2008) reported that the *S. platensis* SM-2, S-10 and S-20 strains were isolated from field soils of the paddy breeding station lands of TNAU, Coimbatore. He compared them with standard reference strains of *S. platensis* CS-1 and Sp obtained from algal laboratory, Madurai.

The initial population of wild type S1 and S2 *Spirulina platensis* strains were calculated (healthy colonies - approximately 80×10^4 cells per ml). The viable mutant colonies were higher in strain S1 than S2 strain. The population of the mutant healthy colonies were maximum in 50 μ l EMS concentration for 20 mins (38×10^4 cells, 47.5%) followed by 10 min and 40 min time duration. In contrast, the unhealthy cell population was maximum at 40 min followed by 10 min and the unhealthy cells were very low in 20 min exposure to the chemical mutagen. The present study lend support to the findings of Chih-Sheng *et al.* (2010) who reported that the two thermal tolerant mutant strains of *Chlorella* sp. were developed by treating *Chlorella* sp. (1×10^7 cells) with 100 mM ethyl methane sulfonate (EMS) for 1 h, and each approximate 1×10^3 cells were plated on agar plates and were incubated at 40°C. The bigger colonies were selected for outdoor cultivation.

Effect of thermal mutant cells of *Spirulina platensis*

The effect of temperature (30, 35, 40, 45 and 50°C) on the growth of the mutant cells of *Spirulina platensis* was investigated. Among those different temperature was showing higher numbers of healthy mutant colonies as 41×10^4 in MS1 mutant cells at 50°C and. The lowest numbers of healthy mutant cells were recorded as (1×10^4) at 50°C in Wild strain S2 (Table-3). Multiple stress tolerant (Metronidazole and DCMU) mutant cells of *Spirulina platensis* isolated after chemical mutagenesis (NTG treatment), pinhead-like mutant colonies were observed in Zarrouk's medium, under microscopic field, look like the circular shape of mutant colonies was obviously due to the typical coiling pattern (Singh *et al.*, 1997). Chih-Sheng *et al.* 2010 reported that the two thermal tolerant mutant strains of *Chlorella* sp were developed by treating *Chlorella* sp (1×10^7 cells) with 100 mM ethyl methane sulfonate (EMS) for 1 h, and each approximate 1×10^3 cells were plated on agar plates and were incubated at 40°C. The bigger colonies were selected for outdoor cultivation. In outdoor cultivation, the thermal tolerant mutant strain (MT-7 and MT-15) tolerated high temperature 40°C and obtained lipid content was 12.4 and 11.8% and the biomass obtained was 0.9 g L⁻¹ and 1.2 g L⁻¹ at first day and third day respectively.

Selection of thermal tolerant mutant strains for outdoor cultivation.

The mutant strains were developed were compared with wild type strains for their morphological characters like presence of filaments, direction of the helix, average number of spirals and the shape of spirals. The two thermal tolerant mutant strains of *Spirulina platensis* were selected from wild type and named as MS1-1, MS1-2 for outdoor cultivation (Table-4). Two mutant microalgae LARB-202-2 and LARB-202-3 were isolated after mutation treatment with 50 μ l mL⁻¹ EMS for 20 mins. The LARB-202-3 strain a produced highest biomass (0.9 g L⁻¹ d⁻¹) and parent wild type produced lowest biomass (0.72 g L⁻¹ d⁻¹) at 6th days. The lipid content of the strains (LARB-202-2 and LARB-202-3) was observed 273 and 297 mg L⁻¹ d⁻¹ and the wild type lipid content was 24 mg L⁻¹ d⁻¹ at 12th days. Under high light condition total biomass of LARB-202-2, LARB-202-3 and wild type was 5.62, 6.37 and 5.32 g L⁻¹ respectively. The chlorophyll content 45.6 mg chlorophyll a L⁻¹ was observed for LARB-202-3 on day 2 under high light conditions (Mahendrapurumal *et al.*, 2012).

The effect of different temperature (40°C and 50°C) on growth parameters of wild and mutant strains was studied and the results are presented in Table-5, 6. The mutant strain MS1-2 has showed highest specific growth rate (0.036), dry weight (2.50 g L⁻¹), chlorophyll content (0.106 mg ml⁻¹), lipid content (0.185 mg ml⁻¹) and protein content (1.530 mg ml⁻¹) followed by a mutant strain MS1-1 and wild strain S2 at the temperature 40°C.



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The mutant strain MS1-2 has a high specific growth rate (0.038), dry weight (2.63g L⁻¹), chlorophyll content (0.123 mg ml⁻¹), lipid content (0.198 mg ml⁻¹) and protein content (1.615 mg ml⁻¹) followed by mutant strain MS1-1 and wild strain S2 at the temperature 50°C. The present studies lend support to the previous findings of Chih-Sheng Lin *et al.*, (2010) who reported that two thermal-tolerant mutants of *Chlorella* sp. MT-7 and MT-15 were isolated. In indoor cultivation, specific growth rate (l, d⁻¹) of the mutants were 1.4 to 1.8-fold at 25°C and 3.3 to 6.7-fold at 40°C higher than those of wild type. Whereas, the growth of wild type was inhibited in the outdoor cultivation. Singh *et al.* (1997) reported that the specific growth rate of multi stress tolerant strain of *Spirulina platensis* was observed that 0.026 μ (h⁻¹) and chlorophyll a (20 mg g⁻¹) in 35°C at 12th day.

Microalgae are the predominant cultured in India, most of the algal species can survive themselves and efficient bio accumulators of inorganic nutrients. Microalgae can grow abundantly in medium having minor nutrients. The high nutritive value of microalgae like *Spirulina platensis* and adaptability to various environment like different pH, nutrients and other physiological conditions. The microalgae an ideal feed in marine aquaculture, animals and also a supplement food for human and animal nutrition (Betsy Bai *et al.*, 2015).

CONCLUSION

The thermal tolerant mutant strain *Spirulina platensis* MS3-2 was selected based on higher growth among the two mutant strains for mass production in RME liquid medium in outdoor experimental studies. The mass outdoor cultivation was carried out in cement tank at summer (April and May) and winter seasons (November and December), 2019. In summer season the growth parameters increased with increase in growth period till 60th day. The biomass recorded on 60th days was 13.10 g DW/m².day⁻¹ and the chlorophyll content was at 1.54 mg/l/d. The recorded lipid, protein, carbohydrates and phycocyanin content were 0.297 mg/l, 66.80%, 19.50% and 115 mg/g respectively. In the winter season the growth parameters were increased with increase in growth period till 60th day. During 60th day, the biomass recorded was 9.25 g DW/m².day⁻¹. The chlorophyll content was recorded as 1.12 mg/l/d. The recorded lipid, protein, carbohydrates and phycocyanin content were 0.244 mg/l, 61.00%, 13.00% and 101.0 mg/g respectively. The thermal tolerant *Spirulina platensis* mutant strain MS3-2 was found best suited for outdoor mass cultivation during summer period in RME.

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Table.1. Characterization of microalgae

Characters	S1	S2
Habitat	Brackish water	Fresh Water
Average number of spirals	5 – 8	3 – 8
Direction of helix	Right	Right
Distance between spirals (µm)	0.5	0.3
Diameter of spirals (mm)	1 – 5	0.5 - 0.7
Width of spirals (µm)	18.2	44.0
Filaments	Very long	Short
Shape of spiral	Loosely coiled	Slightly coiled
pH tolerance	Alkaline	Alkaline
Temperature tolerance	Mesophile	Mesophile

Table.2. Survival of *Spirulina platensis* strains treated with various concentrations of EMS at various time duration

EMS (µl)	Survival count colonies (X 10 ⁴)											
	S1						S2					
	10mins		20mins		40mins		10mins		20mins		40mins	
	HC	UHC	HC	UHC	HC	UHC	HC	UHC	HC	UHC	HC	UHC
25	32	20	32	15	20	45	28	15	26	18	12	32
50	45	27	38	12	33	20	34	21	34	15	30	16
75	29	32	28	15	15	38	26	41	25	19	13	41
100	15	52	10	35	9	50	10	44	7	22	8	42

HC/Healthy colonies - (green colonies), **UHC/Unhealthy colonies** - (pale green colonies)

Initial population = 80 x 10⁴





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Table 3. Effect of temperature tolerant mutant cells of *Spirulina platensis* on RME medium

Mutant strains	Survival count colonies (X 10 ⁴) after 45 days					
	Different temperature (°C)					
	25	30	35	40	45	50
MS1-1	3	18	9	33	35	41
MS1-2	8	13	6	28	19	32
S2 -Wild	2	9	10	3	7	1

Table.4. Morphological comparison of wild type Vs mutant type strains

<i>Spirulina platensis</i> Strains	Name of strains	Macroscopic view on solid medium	Microscopic view			
			Filaments	Direction of helix	Avg.of spirals	Shape of spirals
S1	S1	Lawn	Short	Right	3-12	Tightly coiled
	MS1-1	Filamentous	Too short	Right	8-10	Tightly coiled
	MS1-2	Big cell	Too long	Right	10-21	Spirally coiled
S2	S2	Lawn	Very short	Right	3-8	Normally coiled
	MS2-1	Single cell	Too short	Nil	Nil	Straight
	MS2-2	Big cell	Too long	Nil	Nil	Straight

Table.5. Effect of temperature (40°C) on growth of wild and mutant types of *Spirulina platensis*

Growth parameters	<i>Spirulina platensis</i> strains		
	MS1-1	MS1-2	S2- wild
μ_{max} (h ⁻¹)	0.035	0.036	0.027
Doubling time (h)	19.80	19.25	25.66
Dry weight (g L ⁻¹)	2.44	2.50	1.45
Chlorophyll content (mgml ⁻¹)	0.102	0.106	0.061
Lipid Content (mgml ⁻¹)	0.180	0.185	0.107
Protein content (mgml ⁻¹)	1.475	1.513	0.825

Table.6. Effect of temperature (50°C) on growth of wild and mutant types of *Spirulina platensis*

Growth parameters	<i>Spirulina platensis</i> strains		
	MS1-1	MS1-2	S2- wild
μ_{max} (h ⁻¹)	0.034	0.038	0.017
Doubling time (h)	20.38	18.23	40.76
Dry weight (g L ⁻¹)	2.35	2.63	1.28
Chlorophyll content (mgml ⁻¹)	0.104	0.123	0.050
Lipid Content (mgml ⁻¹)	0.180	0.198	0.101
Protein content(mgml ⁻¹)	1.596	1.615	1.512





Anthropometric Parameters and its Correlation with Peak Expiratory Flow Rate in Upper Abdominal Patients

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ABSTRACT

The purpose of the study is to find the correlation of anthropometric parameters with peak expiratory flow rate in upper abdominal surgery patients. Pulmonary functions are evaluated by peak expiratory flow rate. The expiratory effort is declined due to surgery in the upper abdominal area in spite of anesthesia and drugs. There is an association between the anthropometric parameters and the peak expiratory flow rate in normal people. Therefore the study is aimed to analyse the correlation of peak expiratory flow rate with various anthropometric parameters in participants subjected to upper abdominal surgery on performing incentive spirometry and breathing exercises in the post-operative period. 40 subjects between the age of 20 to 65 years who have undergone urgent and elective abdominal surgery were included in the study. The subjects were given incentive spirometry and breathing exercises. The exercises were given for a period of 6 days, and the outcome measure of PEFR are measured on the first day and 6th day for the comparison. Statistical analysis were done using students "t" test, and Pearson's correlation coefficient. The subjects who had performed incentive spirometry and breathing exercises for a period of 6 days shown significant improvement in PEFR. The PEFR on the Day 6(110.5±15.35) had significant difference than Day 1 (240.5±45.68). The correlation between PEFR and age in male patients are moderate positive correlation (day1 : day 6; $r = 0.09$: $r = 0.68$) and in females ($r = -0.20$)





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: $r = 0.24$), in height and body surface area, the correlation with PEFR shows negative correlation (Height; males : female; $r = -0.24 : -0.75$, Weight; males : female; $r = 0.11 : -0.34$, BSA; males : female; $r = -0.10 : -0.59$) whereas the correlation of PEFR with weight shows positive correlation in male ($r = 0.11$). BMI shows positive correlation more in in female ($r = 0.30$) than male ($r = 0.26$). The above study had proved that there is a correlation exists between the PEFR and anthropometric parameters following upper abdominal surgery which helps to reduce the post-operative pulmonary complications in participants who have undergone upper abdominal surgery. It is concluded that PEFR increases and shows improvement in lung function following incentive spirometry and breathing exercises and also shows improved positive correlation with anthropometric parameters like age, height, weight BMI and body surface area. The correlation is better in males compared to that of female.

Keywords: Peak expiratory flow rate, Correlation, Anthropometric parameters, Upper abdominal surgery, Incentive spirometry, Breathing exercises.

INTRODUCTION

Major abdominal surgery is defined as the surgeries that are included as Upper gastrointestinal surgery, Hepato-pancreato-biliary surgery and Colorectal surgery that is done with either an anastomosis or stoma. Upper abdominal surgery is the incision that is made above the level of umbilicus with an open surgery as laparotomy of more than 5 centimeters. Annually more than 230 major surgeries are done worldwide [1], out of which around 23% incidence of postoperative pulmonary complications occur [2]. The pulmonary dysfunction or abnormality that the patient possess with the clinical symptoms following surgery are due to the anaesthesia and altered thoracoabdominal mechanics, and the risk of pulmonary complications are high following upper abdominal surgery [3]. Following abdominal surgery the pulmonary impairments are greater due to the effect of anaesthesia and immobilization which leads to a major problem of developing postoperative pulmonary complications which can be reduced by early postoperative physiotherapy.

The early physiotherapy interventions to increase lung volume includes deep breathing exercises, incentive spirometry, forced expiratory technique, continuous positive airway pressure (CPAP) and early ambulation [4]. In this study the physiotherapy interventions included are Deep breathing exercises, Incentive spirometry used for the clearance of secretions from the lungs that helps to improve the lung function and capacities, also assist in the expiratory maneuver that the patient themselves could perform for clearing the secretions. Pulmonary functions are evaluated by peak expiratory flow rate. The strength of the abdominals which are the expiratory muscle has an influence on the peak expiratory flow rate in healthy lungs. PEFR is the measurement of ventilatory function introduced by Hadorn in 1942. The maximum flow rate during a forced expiration from a maximal inspiration is known as the peak expiratory flow rate (PEFR). During the initial 200 millisecond of expiratory phase the peak flow rate occurs. It is highly effort dependent of the person who performs maximum airflow. Measured in litres/minute. The respiratory airway calibre and the respiratory muscle strength along with the voluntary effort of the person is reflected with the performance of peak expiratory flow rate. PEFR monitoring is used not only for the diagnosis of respiratory disease and also for assessing the response to the treatment given to the person who has respiratory dysfunction. Various factors search as age, height, weight, body mass index and body surface area influences the changes in peak expiratory flow rate. There is an association between the anthropometric parameters and the peak expiratory flow rate in normal people [5].

Anthropometry meaning " Human measurements". They are used to evaluate the body size, proportions and composition of the human body. It is a non-invasive, simple and low cost reliable technique, easily administered in all the population with no use of expensive equipment. The centers for disease control and prevention have declared

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that anthropometry becomes a valuable tool in assessing the nutritional status in both the population of children and adults. This body measurements of variable parameters helps in determining the health status and disease risk [6]. But the correlation of PEFr in abdominal subjects were not studied. This study was aimed to measure the peak expiratory flow rate in upper abdominal surgery patients and to find the correlation between peak expiratory flow rate and various anthropometric variables between male and female patients following the intervention of incentive spirometry and breathing exercises for 6 post-operative period.

Statement of the problem

Incentive spirometry and breathing exercises are very safe and beneficial in improving peak expiratory flow rate in subjects who have undergone upper abdominal surgery and has a correlation with the anthropometric parameters.

Objective

To evaluate the correlation of anthropometric parameters with peak expiratory flow rate following Incentive spirometry and breathing exercises in improving the peak expiratory flow rate in upper abdominal surgery patients.

Hypothesis**Null hypothesis**

There is no significant correlation of anthropometric parameters with peak expiratory flow rate following Incentive spirometry and breathing exercises in subjects following upper abdominal surgery.

Alternate hypothesis

There is significant correlation of anthropometric parameters with peak expiratory flow rate following Incentive spirometry and breathing exercises in subjects following upper abdominal surgery.

Need of the study

Variations of ventilatory parameters with anthropometric determinants are reported by many authors. The correlation of PEFr with anthropometric parameters are studied in normal people in recent years. Subjects who performs Incentive spirometry and breathing exercises following upper abdominal surgery has significant benefits in improving lung function, the quality of life, reduce the length of hospital stay and prevention of post-operative pulmonary complications. They have a correlation between PEFr and anthropometric parameters. This analysis can be used in designing the respiratory care and rehabilitation following upper abdominal surgery.

MATERIALS AND METHODOLOGY**Study Design**

Experimental study design

Study Setting

The study was conducted in Parulsevashram hospital Vadodara, Zydus medical college and hospital, Dahod, Shailesh diagnostic and laparoscopic hospital, Dahod.

Sampling Method

Simple Random sampling

Study Population

Upper abdominal surgery patients

Sample Size

40 participants who have undergone upper abdominal surgery (Male = 26, Female = 14)



**Mani Arasi et al.,****Study Period**

The study was from January 2021 - August 2021

Criteria**Inclusion criteria**

- ✓ Male and female patients with age between 20 – 65 years of upper abdominal surgery who were willing to participate in this study.
- ✓ Individuals who underwent both elective and emergency upper abdominal surgery.

EXCLUSION CRITERIA

- ✓ Unstable and complicated abdominal surgical patients.
- ✓ Age more than 65 years.
- ✓ Case of chronic respiratory diseases, cardiovascular diseases, neurological conditions and musculoskeletal problems.

MEASUREMENT TOOL

Incentive spirometry unit.
Computerized PFT machine
Portable weighing machine

METHODOLOGY

Following the ethical approval from the institutional ethical committee, the study was undertaken over 40 upper abdominal surgery patients. Once the inclusion and exclusion criteria were fulfilled, Informed consent were taken. The procedure of the study were explained in detail to all the participants. The patient assessment sheet were filled. The participants were given Incentive spirometry and breathing exercises, for 6 days post operatively. Incentive Spirometry (10 times with 3 secs hold every 4 waking hours) for 6 days post operatively. The demographic data were assessed and recorded in day 1 which includes Age, Sex, Height, Weight, BMI and BSA. The outcome measure of PEFr were recorded on the day 1 and at the end of sixth day. The collected data were tabulated and analysed using students "t" test that will compare between the two groups by Unpaired "t" test and within the groups by Paired "t" test.

BMI (Body Mass Index) [7] was calculated using the formula

$$\text{BMI} = \text{Weight in kilogram} / \text{Height in meter}^2$$

BSA (Body Surface Area) was calculated using DuBois formula [8]

$$\text{BSA} = 0.007184 \times (\text{Weight in kilogram})^{0.425} \times (\text{Height in cm})^{0.725}$$

Peak expiratory flow rate (PEFR)

A computerized Spirometry machine- Spirotech was used. All the subjects were encouraged to produce maximal effort and the procedure was demonstrated. Subjects were asked to inhale completely, quickly place the mouthpiece and with a seal around the mouthpiece with the lips. It was made sure that the mouthpiece was passed through the participants teeth and not occluded by the tongue. Instructed to exhale completely with maximal force. The reading of PEFr was noted. This measurement was repeated for two more times. The best one was taken for the record. Two PEFr readings were collected as an outcome measure - Day 1 and Day 6.

Statistical Analysis

The collected data were tabulated and analysed using statistical analysis.

Descriptive statistics. - Demographic data of age(years), sex (Male / Female), height(cm), weight(kg), BMI (Body Mass Index), BSA (Body Surface Area), Peak expiratory flow rate (l/min). The data collected were presented in the



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form of tables, graphs, mean, standard deviation and standard error were also calculated. Analytical statistics (Gender)- the collected data were analysed by adopting proper statistical test as well as percentage of results. To compare the means within the group Paired "t" test were used. To compare the means between the groups UnPaired "t" test were used. To find the correlation between the variables Pearson coefficient correlation test were used. Level of significance was 95% and p-value < 0.05 was considered as statistically significant. Data collected were analysed using SPSS statistical software package.

RESULTS

The Below table shows that there is no significant difference of age, height, BMI, Body surface area exists within both the gender as the "p" value > 0.05. Even the comparison of PEFR between gender in day 1 and day 6 shows no significant difference as the "t" value is 0.7081 and 0.8459 with "p" value > 0.05. The weight of male and female shows significant difference with "t" value 2.2467 > 2.021 table value for 38 degrees of freedom table value. The table 6 shows the correlation of PEFR with anthropometric parameters between male and female. There is a weak positive correlation between PEFR and age group of 20 to 45 years. ($r = 0.05$). There is also a positive correlation exists between PEFR and age group ($r = 0.09$), weight ($r = 0.03$), and BMI ($r = 0.08$) in male patients.

There is a positive correlation between PEFR and age group ($r = 0.50$) and BMI. ($r = 0.29$) in all the subjects. There is also a positive correlation exists between PEFR and age group ($r = 0.61$), weight ($r = 0.11$), and BMI ($r = 0.26$) in male patients. In female also there is a positive correlation exists in age group ($r = 0.24$) and BMI ($r = 0.30$) with PEFR.

DISCUSSION

In the present study the subjects of various age group who have undergone upper abdominal surgery were involved. They were divided into 2 study groups based on genders. Peak expiratory flow rate which has direct relationship with the anthropometric parameters were studied. Variations of ventilatory parameters with anthropometric determinants are reported by many authors. The correlation of PEFR with anthropometric parameters are studied in normal people in recent years [9]. The present study of correlation between PEFR and anthropometric studies helps to assess the health status of the patients in accordance with the intervention program. The study of normal healthy adults and medical students by Behera (2014) [10] and Ranjith (2015) [11] found a variations of PEFR and vital capacity between genders. This supports the present study of variations among the genders : male with mean age of 41.46 have improved PEFR of 109.23 from day 1 to 245 in day 6, likewise female with mean age group of 38 also shown improvement of PEFR from 112.86 in day 1 to 232.14 in day 6. Male shows more improvement in all the parameters of (i) mean height of male is 156.5 cm and female is 155.5 cm, (ii) mean weight is 58.81kg in male and 55.5 in female patients. The body surface area of male and female patients are 1.58 m² and 1.53 m². The reduction of reduced pulmonary function in female compared with male may be due to the sex hormones, increased fat mass and low stature.

When comparing the correlation between the PEFR and anthropometric parameters it was observed that there is a positive correlation exists between PEFR (Day 1) and age group of 20 -45 years ($r = 0.05$), and body surface area of 1.3 – 1.6 m²($r = 0.02$) in all the subjects, but the correlation is very weak. Similarly in day 6, there is also a positive correlation between age group and PEFR ($r = 0.51$) and BMI ($r = 0.29$). Here the correlation is moderate. On comparing the correlation of PEFR and other parameters it was found that, age wise correlation has increased from negligible negative correlation($r = -0.01$) to moderate positive correlation ($r = 0.51$) in all the subjects. In the case of gender the correlation changed from very weak positive correlation ($r = 0.09$) to moderate positive correlation ($r = 0.61$) in male patients of upper abdominal surgery. In female patients after 6th post-operative day, the correlation improvement was observed from negligible negative correlation ($r = -0.20$) to weak positive correlation ($r = 0.24$). this is supported by CK Gupta (1982) [12] who have correlated the PEFR with various age group have positive correlation of increase in PEFR as the age increases.



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The correlation between body surface area from day 1 to day 6 was observed as negligible negative correlation ($r = -0.09$ to -0.22) with PEFR. Though BSA has a linear increase in PEFR, the reduction in his study are due to the reduced weight in spite of surgery and nutritional status of patients. Vimala J (1996) [13] have shown the weak positive correlation in BSA in both the genders of healthy persons. Bandyopadhyay (2011) [14] in his study have correlated the height and PEFR in young healthy Malaysians and observed a strong correlation between height and PEFR. This supports the current study of correlation from negligible negative correlation ($r = -0.05$) to less negative correlation ($r = -0.36$) from day 1 to day 6 showing improved correlation. Comparing the correlation of height in male and female with PEFR, the male ($r = -0.07$ to -0.24) shows more improved association than female ($r = 0.01$ to -0.75) in day 6. Similar results was observed by Doctor (2010) [15]. A study by Azah in Nigerian population have also concluded that PEFR increases with height [16].

The correlation of weight with PEFR in the present study have concluded that in male patients from day 1 to 6 have improved from ($r = 0.01$ to 0.03) they are weak positive correlation whereas in females it is less negative correlation ($r = -0.34$). the reason for the less correlation in the patients groups are the nutritional status which affects the weight reflecting the anthropometric variation. This goes in the agreement with Banerjee where his correlation of PEFR and weight in normal medical students of male is $r = -0.08$ and female is $r = 0.14$ [17]. when the correlation of BMI and PEFR were analysed the correlation shows a weak positive correlation in male and female in the day 6 ($r = 0.26$; $r = 0.30$). This contradicts the previous study by Ghobain, who had the negative correlation between BMI and PEFR in healthy non-smoking adults [18]. Taksande have evaluated the PEFR in rural school children as weak positive correlation [19]. Though the PEFR is reduced comparing to normal range of PEFR in healthy adults, the increased value from day 1 to day 6 shows the improvement following physiotherapy intervention. If the treatment session is continued for more period the patients who have undergone upper abdominal surgery will have better correlation with the anthropometric parameters as normal adults.

CONCLUSION

The above study had proved that there is a correlation exists between the PEFR and anthropometric parameters following upper abdominal surgery which helps to reduce the post-operative pulmonary complications in participants who have undergone upper abdominal surgery. It is concluded that PEFR increases and shows improvement in lung function following incentive spirometry and breathing exercises and also shows improved positive correlation with anthropometric parameters like age, height, weight BMI and body surface area. The correlation is better in males compared to that of female.

Limitation of the study

The present study was conducted for a shorter duration, hence short term effects are studied, so lacking long term effects.

Sample size is less.

The correlation of PEFR with anthropometric parameters in age group wise and various height and weight can be studied more in detail in large samples.

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Table 1: Demographic data (n=40)

Characteristics	Mean	Std. Dev	Std. Error
Age (years)	40.3	9.4901	1.5005
Height (cm)	155.9	7.4586	1.1793
Weight (kg)	57.65	4.666	0.7378
BMI	23.83	2.6044	0.4118
BSA(m ²)	1.56	0.0837	0.0132

Table 2: Gender distribution (n=40)

Sex	Percentage
Male	26 (65 %)
Female	14 (35 %)





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Table 3: Age group distribution (n=40)

Age group (years)	Percentage	Mean	Std. Dev	Std. Error
20 - 45	26 (65 %)	34.73	6.4409	1.2631
45 - 65	14 (35 %)	50.64	3.6291	0.9699

Table 4: Body Surface Area distribution (n=40)

Body Surface Area (m ²)	Mean	Std. Dev	Std. Error
1.3 – 1.6	1.51	0.5538	0.0111
1.6 – 1.9	1.65	0.4460	0.1157

Table 5: PEFR among all subjects in Day 1 and Day 6

PEFR (L/min)	Mean	Std. Dev	Std. Error
Day 1	110.5	15.3506	2.4271
Day 6	240.5	45.6829	7.2231

Table 6: Comparison of Anthropometric parameters and PEFR between male and female subjects

Parameters	Gender		t value	P value	Statistical significance
	Male (n=26)	Female (n=14)			
Age (years)	41.46 ± 10.01	38.14 ± 8.35	1.0565	0.2874	No Significant difference
Height (cm)	156.5 ± 8.36	155.5 ± 5.91	0.3865	0.694	No Significant difference
Weight (kg)	58.81 ± 4.16	55.5 ± 4.94	2.2467	0.0306	Significant difference
BMI	24.29 ± 2.78	22.99 ± 2.08	1.5353	0.133	No Significant difference
BSA (m ²)	1.58 ± 0.08	1.53 ± 0.08	1.6096	0.1158	No Significant difference
PEFR Day 1	109.23 ± 16.23	112.86 ± 13.83	0.7081	0.4822	No Significant difference
PEFR Day 6	245 ± 46.58	232.14 ± 44.41	0.8459	0.4029	No Significant difference

Table 7: Correlation of PEFR Day 1 with Anthropometric parameters between gender

Anthropometric parameters	All subjects (n= 40)		Male (n = 26)		Female (n = 14)	
	r	P value	r	P value	r	P value
Age (years)	-0.0099	0.9560	0.0860	0.6762	-0.1971	0.4996
20 – 45 Years	0.0479	0.8163				
45 – 65 Years	-0.0764	0.7962				
Height (cm)	-0.0511	0.7546	-0.0648	0.7561	0.0094	0.9746
Weight (kg)	-0.1013	0.5352	0.0274	0.8943	-0.2476	0.3946
BMI	-0.0353	0.8302	0.0779	0.7052	-0.2665	0.3580
BSA (m ²)	-0.0869	0.5977	-0.0224	0.9151	-0.1447	0.6233
1.3 – 1.6	0.0161	0.9391				
1.6 – 1.9	-0.0926	0.7444				

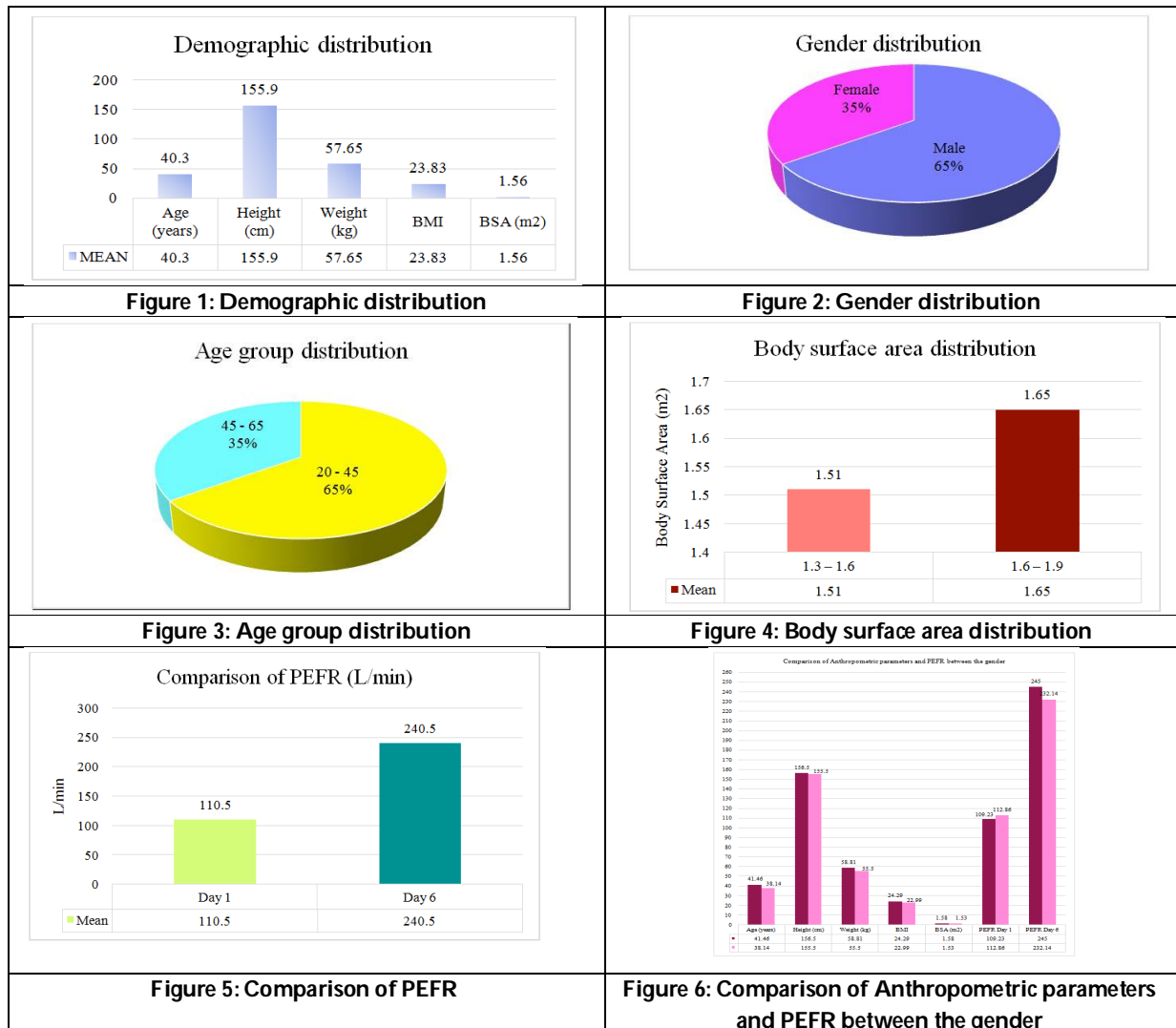




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Table 8: Correlation of PEFR Day 6 with Anthropometric parameters between gender

Anthropometric parameters	All subjects (n= 40)		Male (n = 26)		Female (n = 14)	
	r	P value	r	P value	r	P value
Age (years)	0.5089	0.0008	0.6072	0.0010	0.2357	0.4172
20 – 45 Years	-0.0157	0.9420				
45 – 65 Years	0.2578	0.3735				
Height (cm)	-0.3573	0.0237	-0.236	0.2458	-0.7464	0.0018
Weight (kg)	-0.0088	0.9609	0.1064	0.6049	-0.3418	0.2324
BMI	0.2927	0.0668	0.26	0.1996	0.3035	0.2915
BSA (m ²)	-0.2223	0.1686	-0.104	0.6131	-0.5901	0.2635
1.3 – 1.6	0.0229	0.9135				
1.6 – 1.9	-0.0915	0.7470				





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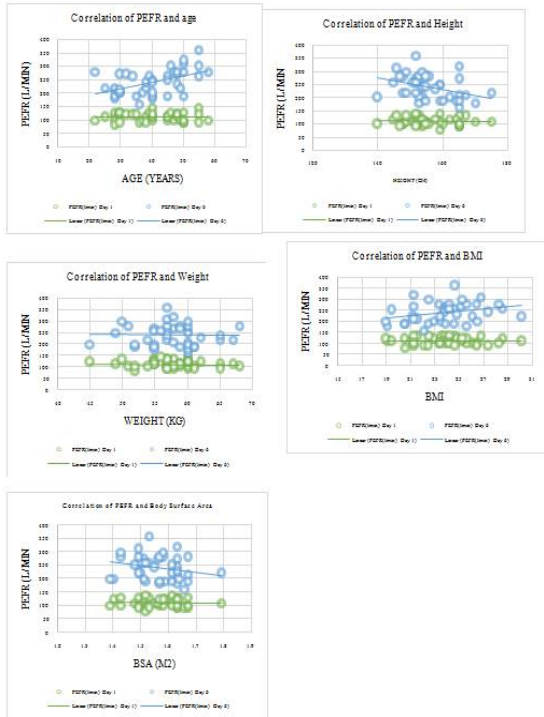


Figure 7: Correlation of Anthropometric parameters and PEFR in day 1 and day 6



Figure 8: Correlation of Anthropometric parameters and PEFR in female gender

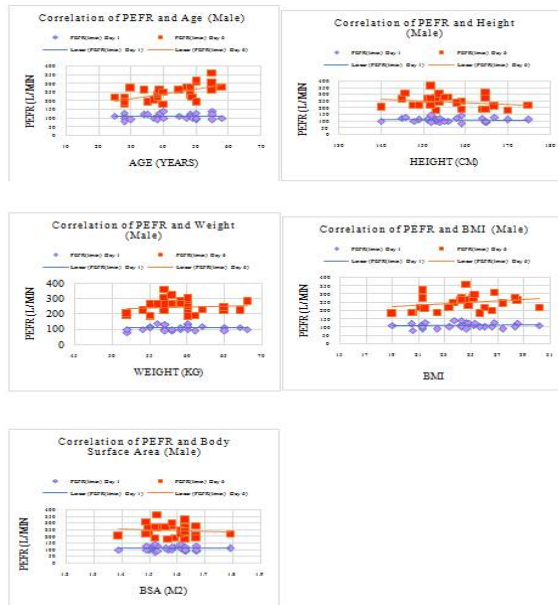


Figure 9: Correlation of Anthropometric parameters and PEFR in male gender





Drought Induced Modifications of Proline Metabolizing Enzymes in Landraces of Foxtail Millet [*Setaria italica* L. P. Beauv.]

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ABSTRACT

Landraces have been there since the beginnings of agriculture, and they have played an important role in crop improvement and agricultural production around the world. Drought is a major abiotic stress, adversely affects food productivity by limiting plant growth and development. The present study was aimed to evaluate the drought induced changes in proline metabolizing enzymes such as γ -Glutamyl kinase activity and Proline oxidase activity of *S. italica* landraces under drought stress condition. The *S. italica* landraces collected from Kolli hills (S1) and Velli hills (S2), Tamil Nadu and India. 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 drought stress significantly increased γ -Glutamyl kinase activity and decreased Proline oxidase activity. These results are indicating that plants are altering their proline metabolism under water deficit conditions.

Keywords: Foxtail millet, landraces, drought stress, γ -Glutamyl kinase activity and Proline oxidase activity.



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INTRODUCTION

Landraces are a source of genetic variation that may be used in future breeding efforts, as well as the creation of novel agricultural systems and products that can adapt to certain agro-climatic environments [1]. Landraces are prospective reservoirs of desirable allelic forms of important traits, which could aid in the development of biodiversity and, as a result, agricultural production sustainability in the case of climatic change [2]. Millets are annual cereals with small seeds that are used for food, forage, and fuel [3]. Such crops are grown on marginal soils and under low-input agricultural circumstances, where main cereal crops frequently fail to thrive or generate low yields [4]. Foxtail millet (*Setaria italica*) is an old crop plant that is grown in dry places around the world. Because of the tiny size of the diploid genome, the species is regarded as a model crop plant for decoding plant drought-tolerance processes [5, 6].

Agricultural crops cultivated under open fields affect by abiotic stresses throughout their morphological and physiological development [7]. Around 70% of the freshwater is used for agrarian purposes worldwide. The global climate change scenarios emphasize the need to implement some sustainable resolutions to address the issue of drought for providing food safety and security [8]. Especially, drought stress is one of the most limiting factors for plant growth and productivity [3, 9]. The Food and Agricultural Organization (FAO) reported that due to drought, 34% of crop and livestock production suffered in the least developed countries and lower-middle-income countries [10].

Sustained radial drought events have a substantial impact on plant development, delaying growth, disrupting physiology, and harming reproduction [11, 12]. Due to the increase in global greenhouse gases and ozone layer depletion over the last few years, extreme weather conditions such as continuous seasonal drought have brought severe challenges for the cultivation and management of crops worldwide. Drought stress limits plant growth, water content, and cell membrane stability, and it also has a negative impact on a variety of physiological metabolisms, including polyamine [13, 14], -aminobutyric acid metabolism, nitrogen metabolism, and proline metabolism in plants [15]. Proline oxidase and -glutamyl kinase are vital in managing proline levels; proline oxidase catalyses the conversion of proline to glutamate, and -glutamyl kinase is involved in proline synthesis [16, 17]. However, H₂O₂ can be further eliminated by catalase (CAT), ascorbate peroxidase (APX) and Proline oxidase (POX) present in the cell organelles [4]. Proline oxidase, commonly known as proline dehydrogenase, is a flavin-dependent enzyme found in the inner mitochondrial membrane. Proline is converted into 1-pyrroline-5-carboxylate by the enzyme (P5C). This reaction is critical for maintaining cellular redox balance by providing a mechanism for utilizing and diminishing the prospective of free proline. Free proline, on the other hand, is used in scar formation [18]. The objectives of this study were to determine the to estimate the changes that occurred in the proline metabolism such as γ -Glutamyl kinase activity and Proline oxidase activity under water stress, which is an important strategy to abiotic stress resistance and identify the tolerant variety of landraces of *Setaria italica* for water deficit.

MATERIALS AND METHODS

Seed collection and Experimental work

The landraces of *Setaria italica* seeds namely S1 were collected from of Kolli hills (Namakkal District) and S2 collected from Valli Hills (Villupuram District) Tamil Nadu, India. The experimental part of this work was 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 20 days with regular water irrigation. After 20 days, well established plants were selected for treatments (Figure 1). The drought stress given on 2 DID (Days Interval



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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.

PROLINE METABOLIZING ENZYMES **γ - Glutamylkinase activity [ATP: L. Glutamate 5- phosphotransferase]**

γ -Glutamyl kinase activity was assayed by the method of Hayzer and Leisinger (1980) [19].

Extraction

One gram of plant tissue was ground with 10 ml of 50 mM Tris-HCl buffer (pH 7.2) in a vortex homogenizer for 3 min. Then centrifuged at 10,000 rpm for 20 min, washed again with 50 mM Tris-HCl buffer (pH 7.2) and stored at -20°C . A frozen sample was suspended in 7 ml of 50 mM Tris-HCl buffer (pH 7.2), containing 1 mM 1, 4-dithiothreitol. Cellular disruption was affected by a double passage through a French press at 38.5 MPa and the cell debris were removed by centrifugation at 20,000 rpm for 30 min. The crude extract was saved and used for the estimation of γ -glutamyl kinase. All operations were carried out at 4°C .

Enzyme assay

Crude enzyme extract (2.5 ml) was desalted with a Pharmacia PD-10 (SephadaxG-25) column equilibrated with 50 mM Tris-HCl buffer (pH 7.2), containing 1mM 1, 4-dithiothreitol. The enzyme assay mixture contained, in a final volume of 0.25 ml; L-glutamate, 50 mM; ATP, 10 mM; MgCl_2 , 20 mM; Hydroxylamine HCl, 100 mM; Tris base 50 mM (pH 7.0) and 100 μl of desalted extract containing approximately 3.0 mg enzyme protein in a final volume of 2 ml. The reaction was started by the addition of enzyme extract. After 30 min of incubation at 37°C , the reaction was stopped by the addition of 1 ml of a solution containing $\text{FeCl}_3 \cdot 3\text{H}_2\text{O}$ (2.5% w/v) and trichloroacetic acid (6% w/v) in 2.5 M HCl. Precipitated protein was removed by centrifugation at 10,000 rpm (0°C) and the absorbance was measured at 535 nm in Spectrophotometer against a water blank. One unit of γ -glutamyl kinase activity can be defined as μg of γ -glutamyl hydroxamate formed per minute per mg protein. γ -Glutamyl hydroxamate was used as standard.

Proline oxidase activity (L- Proline: O_2 Oxidoreductase)

Proline oxidase activity was determined according to the method outlined by Huang and Cavellieri (1979) [20].

Extraction

One gram of plant tissues was taken in a pre-chilled mortar and pestle and homogenized with 5 ml of homogenizing medium and the homogenate was filtered through two layers of muslin cloth. The filtrate was centrifuged at 10,000 rpm for 10 min in a refrigerated centrifuge at 4°C . The supernatant was again recentrifuged at 20,000 rpm for 25 min. After completion of fractionation a pellet was obtained. This pellet was mixed with 1 ml of 5 mM Tricine – KOH buffer (pH 7.5) containing 6 M sucrose. This extract was used for assaying the enzyme activity. The extraction was carried out at 4°C .

Enzyme assay

The enzyme was assayed spectrophotometrically. 3 ml of assay mixture contained 0.1ml of enzyme extract, 1.2 ml of 50 mM Tris-HCl buffer at pH 8.5, 1.2 ml of 5 mM MgCl_2 , 0.1 ml of 0.5 mM NADP, 0.1 ml of 1 mM potassium cyanide (KCN), 0.1 ml of 1 mM phenazine methosulfate (PMS), 0.1 ml of 0.06 mM 2, 6-dichlorophenol indophenol (DCPIP) and 0.1 ml of 0.1 M proline. The reaction was monitored at 600 nm at 25°C using proline to initiate the reaction. The increase in optical density was recorded. The rate of reduction of DCPIP was used to determine the enzyme activity. The enzyme activity was expressed as milli moles of DCPIP reduced per minute per mg protein.



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RESULT AND DISCUSSION

The activity of γ -Glutamyl kinase increased in the root and shoot of *Setaria italica* landraces (S1 & S2). The rate of γ -Glutamyl kinase activity was high in 8 DID when compared to other treatments. During the drought stress condition S1 recorded the highest activity and it was 4.55, 4.742, 5.158, 5.711 and 6.312 $\mu\text{g}/\text{min}/\text{mg}^{-1}$ protein then followed by 4.306, 4.539, 4.874, 5.218 and 5.776 $\mu\text{g}/\text{min}/\text{mg}^{-1}$ protein in root. In shoot of S1 have the highest activity and it was 3.411, 3.506, 3.957, 4.538 and 4.953 $\mu\text{g}/\text{min}/\text{mg}^{-1}$ protein and then followed by 2.937, 3.193, 3.338, 3.668 and 4.128 $\mu\text{g}/\text{min}/\text{mg}^{-1}$ protein in S2 shoot was observed in 75 DAS under 2, 4, 6 and 8 DID stress respectively (Figure 2). The γ -Glutamyl kinase is an important regulating enzyme in the synthesis of proline. The induction of proline accumulation may be due to an activation of proline synthesis through glutamate pathway involving γ -Glutamyl kinase, glutamyl phosphate reductase and Δ^1 -proline-5-carboxylate reductase activities in peanut [16] and tomato [21]. Similar results were reported in drought stressed plant such as *A. esculentus* [22], *C. roseus* [23] and *H. annuus*[24].

Increasing drought stress reduced the proline oxidase activity in the root and shoot of *Setaria italica* landraces (S1 & S2) and it was 0.436, 0.417, 0.391, 0.365 and 0.328 $\mu\text{g}/\text{min}/\text{mg}^{-1}$ protein and then followed by 0.389, 0.367, 0.349, 0.328 and 0.295 $\mu\text{g}/\text{min}/\text{mg}^{-1}$ protein in S2 (Figure 3). In shoot S1 was 0.613, 0.599, 0.573, 0.546 and 0.505 $\mu\text{g}/\text{min}/\text{mg}^{-1}$ protein and then followed by 0.512, 0.503, 0.484, 0.461 and 0.423 $\mu\text{g}/\text{min}/\text{mg}^{-1}$ protein in S2 shoot was observed in 75 DAS under 2, 4, 6 and 8 DID stress respectively (Figure 4). The level of proline degrading enzyme proline oxidase activity was inhibited in landraces of *Setaria italica* under water deficit condition. Proline oxidase converts proline to glutamate. Thus, this enzyme also influences the level of free proline. The Δ^1 -pyrroline-5-carboxylate synthetase is the rate limiting enzyme in proline biosynthesis in plants and is subjected to feedback inhibition by proline. It has been suggested that the feedback regulation of P5CS is lost in plants under stress conditions [25]. The proline content also increased with increasing water stress tolerance in *Curcuma allismatifolia* [26].

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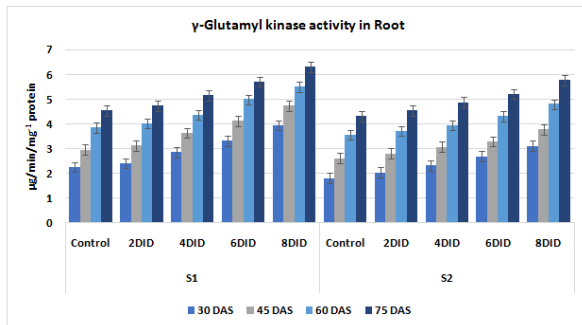


Figure 1: Drought stress induced changes in γ -Glutamyl kinase activity in root of *Setaria italica* landraces S1 and S2 (Values are expressed in $\mu\text{g}/\text{min}/\text{mg}^{-1}$ protein)

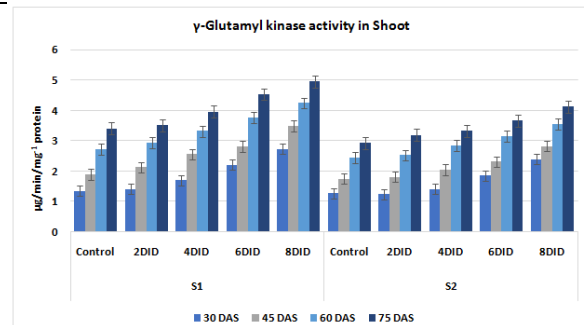


Figure 2: Drought stress induced changes in γ -Glutamyl kinase activity in shoot of *Setaria italica* landraces S1 and S2 (Values are expressed in $\mu\text{g}/\text{min}/\text{mg}^{-1}$ protein)

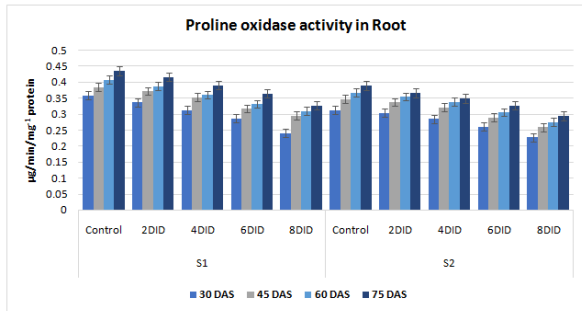


Figure 3: Drought stress induced changes in Proline oxidase activity in root of *Setaria italica* landraces S1 and S2 (Values are expressed in $\mu\text{g}/\text{min}/\text{mg}^{-1}$ protein)

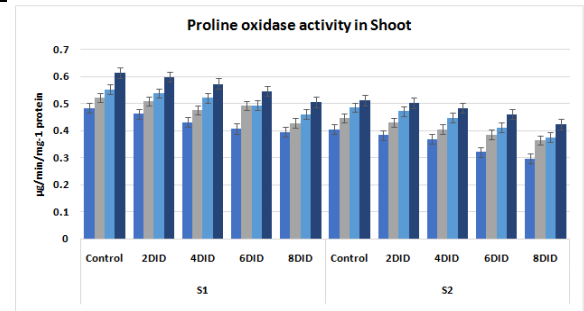


Figure 4: Drought stress induced changes in Proline oxidase activity in shoot of *Setaria italica* landraces S1 and S2 (Values are expressed in $\mu\text{g}/\text{min}/\text{mg}^{-1}$ protein)





Efficacy of Different Training Capsules on Selected Cardio Respiratory Parameters and Performance Variables in Adolescent Female Basketball Players

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ABSTRACT

The purpose of the study was to investigate the efficacy of different training capsules on selected cardio respiratory parameters and specific game skills in adolescent female basketball players. The subjects were selected from school level adolescent girls basketball players. According to the school records, the average age of the subjects was ranging between thirteen to seventeen years. The subjects were assigned at random to one control group and two experimental group, each consisting of twenty (20) subjects. The experimental group was asked to take part in selected different physical activities for ten weeks. After consulting experts in the field and also going through the available literature on the subject, the following cardio respiratory parameters and game skills variables were selected for this study. Cardio respiratory variables: Resting Heart rate specific game skill variables are basketball dribbling. The analysis of data revealed that the training programme showed significant changes in some selected variables in Resting heart rate and basketball dribbling due to ten weeks of training programme for selected different physical activities. The type of training and methods used depends on factors such as the type of movement, skill requirements and specific demands of the activity in question. Coaches and athletes need to understand there are different types of training specifically designed to develop the fitness components, and each is closely linked to the energy systems and principles of training. All components of his body are intern dependent upon movement for their continued vigor, health and development. Physical activity is one of numerous factors, which influence the growth and development by children and adolescents. It is of the utmost importance to know the physiological mechanism that





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sustains and acts as the, basis of everybody response to exercise. In the course of physical exertion a number of co-ordinates and compensatory adjustments take place throughout the body. It is the general consensus that enduring benefits to health in respect of desirable body composition require the incorporation of habituate physical activity from an early age. In short, plyometric training improved the jumping performance of basketball players and it is recommended to be used as a training strategy in improving jumping performance not only in basketball but in other sport as well.

Keywords: Resting heart rate, Cardio respiratory, Basketball dribbling, performance variables and Physical training.

INTRODUCTION

Success in basketball is based upon training and strength conditioning programmes that encompass a broad variety of physical requirements which includes jumping ability, quickness, lateral mobility, agility and balance, coordination, physical strength, and a combination of aerobic and anaerobic fitness. Jumping ability is developed through specific drills based upon plyometric principles. Plyometrics are exercises that enable a muscle to reach maximum strength in as short a time as possible, which contribute to improve the vertical jump performance. Power is an essential component and crucial for success in most sport performance including basketball. Explosive leg power is a critical component for successful performance in basketball. The ability to jump high and reach maximum height quickly helps to create successful basketball player at any age. There are two factors that are key to enhancing vertical jump ability firstly is by refining jump mechanics, and secondly by developing explosive strength in the lower extremity muscles responsible for jumping .Plyometric training took place twice weekly for 6 weeks including three sets of 15 repetitions of depth jump (from 45-cm box height), vertical jump, and standing long jump, in addition to regular basketball practice of the team. Vertical jump (VJ), standing long jump (SLJ), 4 × 9-m shuttle run, agility t test (ATT), and Illinois Agility Test (IAT) were measured at pre- and post-training. The PL group showed significant improvement. It consists of performing exercises that usually involve the work of a large number of muscle groups, so that intervals of great intensity are alternated with intervals of medium and low intensity. Following this dynamic, it is possible that a complete recovery between the high intensity intervals will not occur.

Training procedure

The programmes of different physical activities were prepared with great care. Exercise were chosen primarily to warm-up the complete body. The following selected different physical activities for the study . Plyometric training and different modern ball training methods was applied the training programme. The experimental subjects took training under the supervision of the investigator who was assisted by trained Physical Education Teachers. The training programme was conducted thrice a week for ten weeks with 45 minutes duration i.e. from 7.00 to 7.45 a.m. The time-table for training schedule was prepared by the investigator in consultation with the University authorities.

MATERIALS AND METHODS

The subjects were selected from school level adolescent girls basketball players According to the school Records, the average age of the subjects was ranging between thirteen to seventeen years. The subjects were assigned at random to one control group and two experimental group, each consisting of twenty (20) subjects. To achieve the purpose of the study, the subjects were selected from school level adolescent girls basketball players. According to the school Records, the average age of the subjects was ranging between thirteen to seventeen years. Data were collected on the selected variables before and after the training period of ten weeks. The differences between the initial and final scores in selected variables were subjected to statistical treatment using 't' ratio to find out whether the mean differences were significant or not and analysis of covariance was applied to find out the significant mean differences among the group. The subjects were divided in to three equal groups randomly 15 subjects each. Experimental group

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I participated in specific training , Experimental group II participated in different physical training participated for a period of 10 weeks. Control group did not participate any specific game training. The subjects were tested on selected criterion variables. Analysis of Co-Variance (ANCOVA) was applied to find out the significant differences in each criterion variables among the experimental groups and control group. The process through which the pretest means differences between the groups can be adjusted to adjusted post hoc test means. 'F' ratio were computed to access the variation, interaction from the group. If the 'F' ratio for interaction was significant and to determine which of the paired mean of experimental and control group differ significantly was applied

Required table value at 0.05 level of significant with degrees of freedom 2 and 57 is 2.77 and degrees of freedom 2 and 56 is 2.77. Table I shows the obtained 'F' values on pre test, post test and adjusted post test means on heart rate of specific training ,different physical training and control group. The pre test means on heart rate were 74.80, 75.67 and 74.60 respectively. The 'F' value observed for the pre test on heart rate was 0.95. It fails to reach the table value of 2.77 for degree of freedom 2 and 57 at 0.05 level of confidence. Based on the results it was confirmed that the mean differences among the groups specific training, different physical training and control group on heart rate before the start of the respective treatments were found to be not significant. The post test means on heart rate of specific training , different physical training and control group were 72.93, 73.67 and 74.53 respectively. The 'F' value observed for the post test on heart rate was 2.96. It was greater than the table value of 2.77 for degree of freedom 2 and 56 at 0.05 level of confidence. Since the observed F- value on post test means among the groups namely specific training, different physical training and control group on heart rate was significant as the F value was greater than required table value of 2.77.Thus the results obtained proved that the respective experimental training produced significant improvements on heart rate among the experimental groups.

The adjusted post test means on heart rate of specific training, different physical training and control group were 73.03, 73.02 and 74.80 respectively. The 'F' value observed for the adjusted post test means on heart rate was 17.14. It was greater than the table value of 2.77 for degree of freedom 2 and 56 at 0.05 level of confidence. Since the observed F- value on adjusted post test means among the groups on heart rate was highly significant as the F value was higher than required table value of 2.77. Thus the results obtained proved that the training on heart rate produced significant improvements among the experimental group. Required table value at 0.05 level of significant with degrees of freedom 2 and 57 is 2.77 and degrees of freedom 2 and 56 is 2.77. Table II shows the obtained 'F' values on pre test, post test and adjusted post test means on dribbling of specific training ,different physical and control group. The pre test means on dribbling were 0.10, 0.10 and 0.09 respectively. The 'F' value observed for the pre test on dribbling was 0.13. It fails to reach the table value of 2.77 for degree of freedom 2 and 57 at 0.05 level of confidence. Based on the results it was confirmed that the mean differences among the groups specific training ,different physical and control group on dribbling before the start of the respective treatments were found to be not significant.

The post test means on dribbling of specific training different physical training and control group were 0.08, 0.08 and 0.10 respectively. The 'F' value observed for the post test on dribbling was 7.82. It was greater than the table value of 2.77 for degree of freedom 2 and 57 at 0.05 level of confidence. Since the observed F- value on post test means among the groups namely specific training ,different physical training and control group on dribbling was significant as the F value was greater than required table value of 2.77.Thus the results obtained proved that the training on dribbling produced significant improvements among the experimental groups. The adjusted post test means on dribbling of specific training , different physical training and control group were 0.079, 0.082 and 0.098 respectively. The 'F' value observed for the adjusted post test means on dribbling was 31.70. It was greater than the table value of 2.77 for degree of freedom 2 and 56 at 0.05 level of confidence. Since the observed F- value on adjusted post test means among the groups on dribbling was highly significant as the F value was higher than required table value of 2.77. Thus the results obtained proved that the training on dribbling produced significant improvements among the experimental groups.



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RESULTS AND DISCUSSION

Heart Rate

In the present study the effect of specific training different physical training on selected physiological and skill performance variables of school level adolescent girls basketball players differences were found in comparison between base line and post test. The results of the study indicate there was significant improvement in heart rate due to the influence of specific training different physical training and also there were no statistically significant changes in heart rate of control group. The result of the study proved that there was significant change due to Heart rate response during basket singles match-play and selected physical fitness components of experienced female basket players on heart rate and the findings of this study are in agreement with the studies of Rousanoglou et.al (2008) who found that heart rate can be beneficially altered with specific training different physical training.

Dribbling

In the present study the effect of specific training different physical training on selected physiological and skill performance variables of school level adolescent girls basketball players differences were found in comparison between base line and post test. The results of the study indicate there was significant improvement in dribbling due to the influence of specific training different physical training and also there were no statistically significant changes in dribbling of control group. The result of the study proved that there was significant change due to effects specific training and different physical training durations on physical performance in basketball players on Dribbling and the findings of this study are in agreement with the studies of Abbas Asadi (2013) who found that Dribbling can be beneficially altered with specific training and different physical training.

CONCLUSIONS

The following conclusions are drawn based on the findings of the study.

1. The result of the study shows that the experimental group I that had undergone specific training had improved Physiological variables heart rate and Skill performance variables dribbling of school level adolescent basketball players.
2. From the result of the present study, it is concluded that the specific training group improved physiological and skill performance variables of school level adolescent basketball players.
3. From the finding of the study it was concluded that specific training group had better than the different physical training in heart rate and dribbling.
4. From the finding of the study it was concluded that specific training group had better than the control group in heart rate and dribbling.

Recommendations for Implication

1. It is recommended that coaches and physical educators in the game of basket ball should give due importance to specific training , different physical training in their training schedules.
2. In the physical exercise, while designing the training programme the effect of varied training modalities is explained positively on physical fitness parameters and skill performance variables of basket ball players, the physical education teachers, trainers and coaches can prefer this type of training so as to achieve their aim in time.
3. It was also recommended that a basket ball team to reach any level should have knowledge about specific training, different physical training to train the players for enhancing their performance.

RESULTS

The results of the study indicate there was significant improvement in heart rate due to the influence of specific training different physical training and also there were no statistically significant changes in heart rate of control

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group. The results of the study indicate there was significant improvement in dribbling due to the influence of specific training different physical training and also there were no statistically significant changes in dribbling of control group.

CONCLUSIONS

This study proved that there was significant improvement in physical training for the basket players . Hence it was recommended that physical educationists, special education teachers and physiotherapists to include variety of physical activities to improve the heart rate and specific game skill .

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Table 1: Analysis of covariance among skill training group different physical training group and control group on heart rate

	Specific Training Group	Different Training Group	Control Group	Source of Variance	Sum of square	Df	Mean square	F-value
Pre test mean	74.80	75.67	74.60	Between	14.98	2	4.99	0.95
				Within	294.67	57	5.26	
Post test mean	72.93	73.67	74.53	Between	20.85	2	6.95	2.96*
				Within	273.33	57	4.88	
Adjusted post mean	73.03	73.02	74.80	Between	31.278	2	10.426	17.14*
				Within	33.440	56	0.608	

*Significant at 0.05 level of confidence

Table 2: Analysis of covariance among skill training group different physical training group and control group on dribbling

	Skill training Group	Different Physical Training Group	Control Group	Source of Variance	Sum of square	Df	Mean square	F-value
Pre test mean	0.10	0.10	0.09	Between	0.00	2	0.00	0.13
				Within	0.02	57	0.00	
Post test mean	0.08	0.08	0.10	Between	0.01	2	0.00	7.82*
				Within	0.02	57	0.00	
Adjusted post mean	0.079	0.082	0.098	Between	0.006	2	0.002	31.70*
				Within	0.003	56	6.16	

*Significant at 0.05 level of confidence

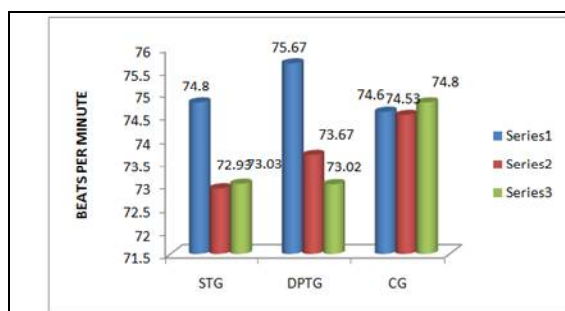


Figure 1: Analysis of pre test , post test and adjusted post test mean values of heart rate of specific training group different physical training group and control group

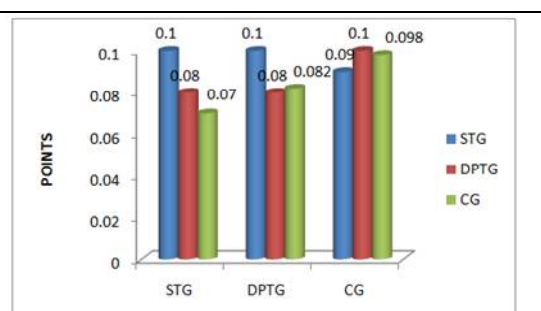


Figure 2: Analysis of pre test , post test and adjusted post test mean values of dribbling of specific training group different physical training group and control group





Impact of Mental Health Related Factors on Job Satisfaction during Covid-19 Pandemic

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ABSTRACT

In the COVID-19 era, Employees are facing many problems in their jobs. The present study concerned about the mental aspects of health which they were facing & affecting their Job Satisfaction while working at their work stations and post-work. To determine the relationship between job satisfaction and mental aspects of the health during COVID 19 pandemic. Cross-Sectional Observational study in nature in which a Self-made questionnaire was developed by adopting 7 questions from our previous study & other questions were formed on 5-Point Likert Scale to assess the mental aspects of health. Data were analyzed using IBM-SPSS-26.0 from which the Cronbach Alpha(α), Correlation between the factors and Job satisfaction & Significance (p-value) was calculated. The level of acceptable significance was set at $p < 0.01$. Cronbach alpha (α) came out to be 0.76 for 176 respondents. A Statistically Significant Negative Correlation was observed between Job Satisfaction with Negativity, feeling of being depressed, Anxiety at -0.50, -0.26 & -0.24 whereas a positive correlation with sleep quality was found to be 0.24 respectively. All of them were significant at $p < 0.01$. Present study concluded Negativity, Anxiety, Depression & Poor Sleep Quality have negative consequences on Job Satisfaction among employees during the COVID-19 Pandemic. Frequent mental examination, positivity, and job optimism can help in employee satisfaction in Jobs which can help in their better mental state, and if any mental ailments diagnosed earlier, can be rectified sooner and will be less time consuming than usual. This will also encourage employees to raise their concerns regarding the job.

Keywords: Psychological health, negativity, anxiety, work contentment



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INTRODUCTION

In March 2020, when the World Health Organization (WHO) declared CoViD-19 a global pandemic, India had around 400 confirmed cases throughout the country [1]. But by starting of October 4, 2020, Cases has risen to more than 6.4 million & more than 100,000 deaths [2]. In between, several measures were taken place by State & Central Governments to prevent the spread of the virus. The offices were closed to prevent the gathering of people in one place wherever possible due to multiple lockdowns throughout the country.[3,4] Many companies, due to this, saw a decline in their growth during this period, like Uber [5]. In offices where closure or work from home was not possible, alternate shifts and different timings were arranged to maintain social distancing. Masks, sanitization, thermal scanning, temperature checks, and non-contact operations became a norm since reopening & all this has led to new normal across the globe [5-8]. However, all these factors have impacted the employees & jobs associated with it. In the Philippines, nurses, who were doing their jobs reported being feared of COVID-19, which affected their job satisfaction [9]. And this is not just confined to COVID-19, it's the mental health which is related to job satisfaction eg, increased anxiety has led to being less satisfied with the job that a person is doing [10]. There were 8 sources of anxiety which was discussed during COVID-19 by medical healthcare professionals which were ranging from access to PPE kits to lack of access to up-to-date information & communication respectively [11]. All these factors lead to negativity about the job, affects sleep quality & ultimately make the employee depressed about their job [12]. As seen in the previous studies, all these factors including availability of PPE kits, gears, proper medical checking at their workplace, salary, etc had a greater impact on job satisfaction [11,13]. But apart from these factors, there are some personal mental health aspects which need to be considered as all these factors together contribute towards the job dissatisfaction. Thus, this study was conducted to determine those mental aspects of health that are affecting the job satisfaction of the employees during this COVID 19 pandemic.

MATERIALS & METHODS

Self-made questionnaire on 5 points Likert scale was utilized for assessing job satisfaction and mental health. The study was cross-sectional & observational in nature. Ethical approval has been received on 29 May, 2020 from Physioheal Physiotherapy Human Research Ethics Committee. With the help of the Snowball Sampling method, 176 responses were taken into consideration from 1st August to 31st August 2020 through various social media platforms along with Informed Consent. Only people working outside from home were considered for the selection of samples. 14 Questions were asked in the questionnaire which was divided into two sections. Section A consisted of 7 questions which were adopted from our previous study [13] and it included questions regarding general views on the job during COVID, while other section focused upon mental aspects of job satisfaction. In which, Questions were related to negativity, anxiety, depression etc. were asked.

Data Analysis

The data of this study was compiled in the MS Excel sheet and was analyzed on descriptive statistics of SPSS version 26.0. Cronbach alpha (α) was used to determine the reliability of the questionnaire. Spearman correlation was used to find the correlation between job satisfaction and various psychological parameters (depression, anxiety, sleep quality, negativity) during COVID 19. The level of acceptable significance was set at $p < 0.01$.

RESULTS

Cronbach's alpha value came out to be 0.76 which shows that the questionnaire is reliable.

Demographics

176 individuals filled the questionnaire which included 100 males, comprising 56.8% of the total sample size, and 76 females which comprises rest 43.1% of the total sample size respectively.



**Anush Shukla et al.,****Job Satisfaction**

One question asked about the job satisfaction of the participants. Most of them i.e. 39.77 % (70 individuals) of the respondents were neither satisfied nor dissatisfied with their jobs. While 21.5 % (38 respondents) were dissatisfied. On the contrary, the respondents who were satisfied with their jobs comprise 25.5 % i.e. 45 respondents as depicted in fig. 1.

General Views Regarding Job during COVID

This section focused upon the views of the respondents related to their job which includes optimism about new job opportunities, safety while working, family at risk of infected due to their jobs etc. On starting with, they were asked "how often they go outside for their work", for which 32.9 % responded that they go twice or thrice a week outside for their work. When asked about the optimism for new job opportunities, majority of them (53.4 %) were slightly optimistic. Similarly, when asked about the funds are they getting was enough for their family during this pandemic, 23.2% of them responded most of the times. When asked about risk to their family due to their job, 26.7% responded they felt their family is at risk of getting infected everytime. Other question was on the conversation with their co workers, 24.43% reported that they felt their conversation has been reduced most of the times. On asking about the safety at their workplace, 55.6% responded that they didn't felt safe. However, 42.6% didn't felt like they should change their job post COVID. The responses of the questions are given well in table 1.

Mental Aspects Affecting Job Satisfaction

This section focuses on the different psychological factors which could affect the job satisfaction of the population. They were asked whether they feel depressed post job, 30.1% of them didn't felt depressed while 17.6% felt depressed post job most of the times. On asking about the anxiety, 33.5% responded that they felt anxious most of the times. Other question stating whether they are afraid of getting infected while working outside, 38% responded they were afraid of it most of the times. Similarly question was asked on feeling of negativity post job, 30.1 % didn't felt like this at all, while 20.4% reported that they felt negative most of the times post job. Another factor which was considered in this section was sleep quality, 34% responded that their sleep quality was mildly affected. Responses of the questions are given in table 2. There was statistical significant negative correlation found between job satisfaction with depression ($r = -0.26$), anxiety ($r = -0.24$), negativity (-0.5) which suggests that there is inverse relation between job satisfaction and these parameters i.e. as job satisfaction increases, these parameters will decrease. Whereas statistical significant positive correlation was found between job satisfaction and sleep quality ($r = 0.24$), indicating direct relationship between these two variables (Table 3)

Mental Health and Job Satisfaction

The last question of this questionnaire asks about the mental health of the respondents in general now as compared to pre COVID times. Majority of them (37.5 %) responded their mental health to be the same as pre COVID times, whereas 30.6% responded somewhat worse now than before COVID 19. All the responses of this question are depicted in figure 2.

DISCUSSION

The present study aimed to evaluate the mental aspects of health which affects the job satisfaction during this COVID-19 Pandemic. The results depicted that multiple aspects related to mental health were affecting their job. Negativity while coming back to their homes post job was the biggest factor in their job dissatisfaction. The present study found a statistical significant moderate negative correlation of 0.50 between the two. The reason could be that the Employees felt that they were paid less in comparison to the effort given [13]. Another reason of developing negativity in human beings was when they felt restricted in doing their jobs, and further due to new normal because of CoViD-19 pandemic, feeling of isolation can be seen due to reduced conversation with co workers which is also seen in this study and moreover physical wellbeing also can get affected [14-16]. Even after all these things, changing job is not the option for employee which has been found in this study as it can create a financial threat to the





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employee's family, which can further degrade their mental state [17]. On the contrary, feeling of positivity does enable them to feel empowered & do handle their jobs well with sense of comfortability. [15,18,19]

Anxiety while working was another key factor in employees being not satisfied with their jobs. Results depict statistically significant mild negative correlation between them. This result is in line with studies done among healthcare workers of Philippines, Bolivia & United Kingdom respectively [9,20,21]. It was found that Healthcare workers were anxious due to lack of PPE's given to them, long duration of workload, were not trained properly to treat patients, making them more prone to infections. All of these points were discussed in the previous studies and were considered as source of anxiety during COVID-19 Pandemic [11,13]. Negativity & Anxiety are usually a precursor to affected sleep & sleep quality. The present study found out statistically significant positive correlation between job satisfaction & sleep quality. In this regard, incidence of insomnia among general population has been increased during COVID times [12,22]. Sleep quality is usually a good measure for satisfactory life as it is considered to be one of the biological urge of Human Being. Increased Stress & anxiety due to job can led to overthinking & improper sleep in night which can lead to Job dissatisfaction.

All the components ultimately lead to feeling of being depressed [22]. The present study justifies this with statistically significant negative correlation on Nurses of Iran were found to be anxious & depressed, which affected their job satisfaction [23,24] Meanwhile, Canadian Emergency Physicians were found to be depressed because of burnout or running out of energy which is common during COVID times due to longer shifts than normal. [25] The sense of depression was not confined to healthcare workers only, in teachers as well, it has been seen feeling of being depressed because of Workload & students behaviour [26]. Apart from this, the study has shown that around 52.8 % felt that their family are at greater risk of getting infected majority of times due to their job. Moreover, 55.6% of the employees in this study didn't felt safe at their workplace. So all these factors could have led to the feeling of being depressed. In the present study, the results depicted Job satisfaction is dependent on multiple aspects of mental health. Feeling of anxiety, negativity about the job, poor sleep quality and feeling of being depressed ultimately affects the overall mental health of the person which is also seen in this study as 30.7 % of employees reported their mental health to be somewhat worse in general now as compare to the pre COVID times. So, all these aspects of mental health will hinder their performance and does affect them not only personally but professionally as well. So in order to improve their situation, companies can consider giving them sessions which can improve their mental health in their office premises regularly as well as regular mental health check-ups in order to prevent them from burnout and to maintain their optimum mental health. These slight measures can help in growth in companies in longer run, and all these things becomes much more essential during this COVID-19 Pandemic. [14]

LIMITATIONS & FUTURE RECOMMENDATIONS

The present study did not consider the work experience of employees which may impact the result in future studies. The age groups were not considered in the present study, which can be considered for future studies. Similarly, the study only focused upon the employees going outside for work. Future study can be done with work from home ones taken into consideration. Job profiles were not taken into consideration in the present study as it was generalized, and can be done with more reliable and valid questionnaire or by the use of multiple questionnaire focusing upon the mental aspects of health affecting employees Job Satisfaction.

CONCLUSION AND IMPLICATIONS

Mental Health is a key element in attaining Job Satisfaction. The present study enlightened the mental aspects of Job which affects the Job Satisfaction during COVID-19 pandemic. The present study concluded that negativity, anxiety, poor sleep quality & depression affect Job Satisfaction significantly which ultimately impact the employee's performance while working. Nowadays, mental health as taken over the center stage not specifically regarding job but in general health as well. Large scale implications will provide employees with much better mental state & being



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more involved in work rather than things which may cause hindrance in their performances. Examining and assessing employees regularly will help employees & companies in the longer run.

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Conflict of interest

There is no conflict of interest.

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Table 1: General Views regarding Job

Variables	Everytime	Most of the times	Quite often	Rarely	Not at all
Did you felt you had sufficient funds to run your family during lockdown?					
N (%)	30 (17.04)	41 (23.29)	40 (22.72)	30 (17.04)	35 (19.88)
How often do you feel you should change your job post COVID-19 because of problems occurring during Lockdown?					
N (%)	15 (8.52)	27 (15.34)	31 (17.61)	28 (15.90)	75 (42.61)
How often do you feel because of your job, your family is at risk of getting infected to COVID-19?					
N (%)	47 (26.70)	46 (26.13)	31 (17.61)	22 (12.5)	30 (17.04)
How often do you feel due to social distancing, your conversation with your co-workers is reduced?					
N (%)	28 (15.9)	43 (24.43)	39 (22.15)	32 (18.18)	34 (19.31)
Variables	Not at all	Slightly optimistic	Highly optimistic		
Are you optimistic about the job opportunities post COVID-19?					
N (%)	57 (29.08)	94 (53.40)	25 (14.20)		
Variables	Yes	No			
Do you feel you are safe at your workplace?					
N (%)	78 (44.31)	98 (55.68)			
Variables	Not at all	Rarely	Once a week	Twice or thrice a week	Daily
How often you go outside for work or for household things?					
N (%)	9 (5.11)	30 (17.04)	28 (15.90)	58 (32.95)	51 (28.97)





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Table 2: Mental aspects affecting Job Satisfaction

Variables	Everytime	Most of the times	Quite often	Rarely	Not at all
Do you feel depressed post Job during COVID?					
N (%)	11 (6.25)	31 (17.61)	39(22.15)	42(23.86)	53 (30.11)
Do you feel anxious while dealing with client in close contact?					
N (%)	39 (22.15)	59 (33.52)	37 (21.02)	19(10.79)	22 (12.5)
Are you afraid of getting infected while working outside?					
N (%)	63 (35.79)	67 (38.06)	29(16.47)	15 (8.52)	2(1.13)
Do you feel negative about yourself post job during this COVID-19 pandemic?					
N (%)	16 (9.09)	36 (20.45)	38(21.59)	33(18.75)	53 (30.11)
Variables	Yes, Severely Affected	Yes, mildly Affected	Same	Improved	Significantly improved
Do you think your sleep quality is getting affected due to COVID-19?					
N (%)	31 (17.61)	60 (34.09)	56 (31.81)	25 (14.20)	4 (2.27)

Table 3: Correlation between Job satisfaction with mental health factors

PARAMETERS	CORRELATION (r)	p – value
Job satisfaction with sleep quality	0.24	p<0.01*
Job satisfaction with depression	-0.26	p<0.01*
Job satisfaction with anxiety	-0.24	p<0.01*
Job satisfaction with feeling of negativity post job	-0.50	p<0.01*

*Statistically significant at the 0.01 level (2-tailed)

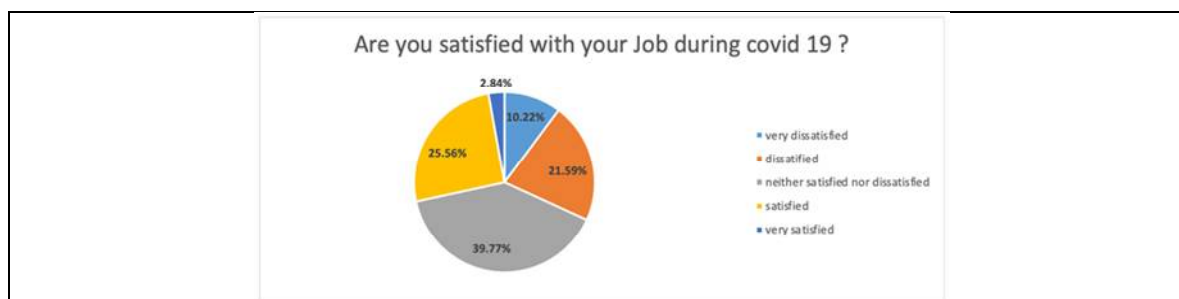


Figure 1: Job satisfaction during COVID -19 pandemic

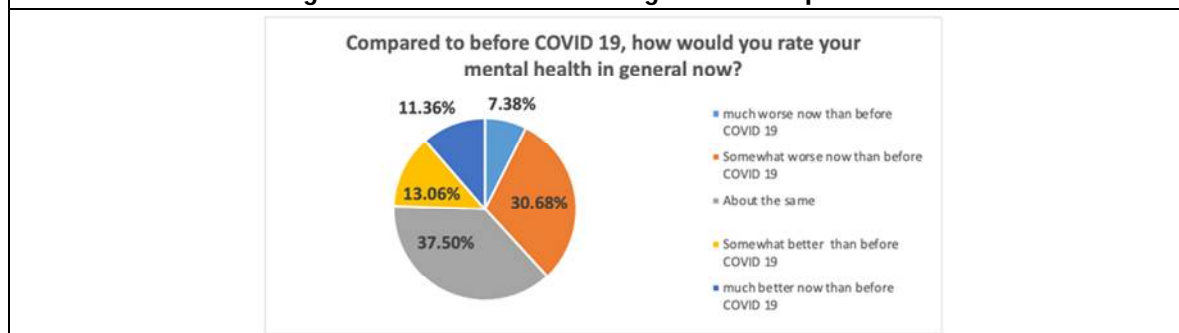


Figure 2: Mental health





Designing of Collagen *Aloe vera* Bio-Composite Scaffold for Effective Wound Healing Process

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ABSTRACT

The aim of the study was to design a biocomposite scaffold as eco-friendly wound dressing material to enhance effective wound healing. Collagen was used as base component for development of wound healing material. Collagen was extracted from the *Sardinella longiceps* fish waste materials (Scales, Skin, and Muscles). Collagen was then impregnated with *Aloe vera* extract by cross linking separately with glutaraldehyde and PEG (Polyethylene glycol) to form biocomposite scaffolds (collagen+ aloevera+ glutaraldehyde (Col.Av.Glut) and collagen +aloe vera+ PEG (Col.Av.PEG)). The formulated biocomposite scaffolds were subjected to chemical and physical characterization using FTIR, SEM, porosity property, and swelling property. Biocomposite scaffolds ((Col. Av. Glut) & (Col. Av. PEG)) were characterized by using FTIR for identification of the interaction between the functional groups of biocomposite scaffolds and *Aloe vera* extract. The FTIR results revealed the presence of three primary Amide (I, II, III) groups and bio composite (collagen +*Aloe vera* blend) groups in Col. Av. Glut biocomposite scaffold and Col. Av. PEG biocomposite scaffold. The biocomposite scaffolds morphology were observed by SEM. SEM image showed that the Col. Av. Glut biocomposite scaffolds have a more porous surface that can enhance the effective wound healing process. The SEM result of Col. Av. PEG biocomposite scaffolds significantly impacts the less porous surface. The percentage of swelling property of biocomposite scaffolds (Col. Av. Glut) was found to be above 70-80%, and Col. Av. PEG scaffold was found to be less than 50%. The Col. Av. Glut biocomposite scaffolds proved to show high porosity rate when compared to Col. Av. PEG scaffold. The Col. Av. Glut biocomposite scaffolds presented a high porosity rate compared with Col. Av.



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PEG scaffold. Col. Av. These results demonstrated that Col. Av. Glut biocomposite scaffolds with improved physicochemical, biocompatibility, and cell proliferation properties could be effectively used as wound dressing materials.

Keywords: Biocomposite scaffold, *Aloe vera* extract, biocompatible, wound dressing material, glutaraldehyde and PEG (Polyethylene glycol).

INTRODUCTION

Wound healing is a complex process involving many sequential overlapping phases of biochemical reaction such as hemostasis, inflammation, proliferation, and remodeling. Wound healing is a natural process which occur in the body, whereby, body repair itself the injured area. Some complication like internal factors (diseases) and external factors (microbial infection) can interfere with the normal wound healing process, which leads to cause chronic wound [1]. Wound dressing materials are made from cotton wool, bandages, and gauzes to maintain a moist environment at the wound site, to absorb the surplus amount of wound exudate. It allows gas exchange, which protects the wound area against bacterial infection. An essential property of wound dressing material should be easy to remove from the wound site and improve biocompatibility and biodegradability. Collagen is a connective tissue protein present in the extracellular matrix (ECM). Wound dressing material are prepared using collagen as the base material because it has several properties such as low antigenicity, low immune reactive, high biocompatibility, low inflammatory, and plays a vital role in granulation tissue formation, cell attachment, re-epithelialization, formation of new extracellular matrix. *Aloe vera* is rich in antioxidant and possess active polyphenols compounds which promotes wound healing[2-4]. According to a recent report, 160 million fish are captured, and 141 million were utilized as food. At the same time, the remaining 40 -80 % raw materials are produced as waste. Fish waste materials form a significant solid waste. Improper disposal of fish waste materials causes environmental pollution [5]. Therefore proper utilization of fish waste material can be converted into a valuable product. In the present study, the wound dressing material has been prepared using collagen isolated from *Sardinella longiceps* fish waste materials (scales, skin and muscles) and incorporated with *Aloe vera* extract using glutaraldehyde as a cross-linker. This biocomposite wound dressing material was examined for its physical characteristic, and chemical characters [6]. *In Vitro*, studies were performed by using biocomposite wound dressing material were carried out in fibroblast cell lines to evaluate its biocompatible.

MATERIAL AND METHODS

Chemical Reagents

25% glutaraldehyde solution, ethylene glycol solution, and glacial acetic acid were purchased from Hi-media. All the reagents used were analytical grade.

Extraction of Collagen

Collagen was extracted from *Sardinella longiceps* fish waste materials (scales, skin, and muscles) using 0.5M of acetic acid. Fish waste materials were washed twice in 5 % NaCl to remove non-collagenous protein. The demineralization of fish waste materials was treated in 0.1M NaOH for 48hrs. Demineralized fish waste materials were then treated with 0.5M acetic acid. 0.7M NaCl was used for salting out of collagen from the supernatant (Muthumari et al., 2013). All the procedures were performed under 4 °C. Then extracted collagen was lyophilized and stored in a refrigerator for further use [7, 8].





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Preparation of *Aloe vera* gel

The matured *Aloe vera* leaves were collected from a single plant, and leaf rinds were removed. The pulp of *Aloe vera* was extracted, homogenized, and centrifuged at 5000 rpm for 30mins at 4 °C to remove the debris. Then collect the supernatant, lyophilized, and stored at -20 °C until use [9].

Preparation of biocomposite

Collagen solution was prepared using 0.05M of acetic acid in the ratio of 1:10. The solution was stirred using a magnetic stirrer for 1 hour and incubated for 24 hours at 4 °C. *Aloe vera* gel extract with different concentrations of 250 mg/ml (A) and 750mg/ml (B) was added to 20 ml of collagen solution and mixed well. Added 0.5 ml of 25% glutaraldehyde solution to solution A and added 0.5 ml of ethylene glycol solution B for cross linking process. Then the solution was poured into the petri plate and allow to air-dry and stored. The prepared biocomposite scaffold sheet was stored at -20°C. The biocomposite material (Isolated collagen from fish waste material incorporated with aloe vera) was characterized [10].

Characterization

Microscopic examination

The surface morphology of the biocomposite was analyzed by scanning electron microscope. The surface biocomposite was coated using a sputter coater for 90 sec, using a 15kV accelerating voltage [11].

FTIR

Fourier transform infrared spectroscopy was used to determine the functional group of synthesized biocomposite samples using Shimadzu 8201 PC. The spectral region was observed between 4000 and 400 cm⁻¹. The KBr disc method was used to record the spectra [12].

Swelling property of Biocomposite scaffold

The swelling property of the biocomposite scaffold was measured by distilled water. A small piece of collagen biocomposite was immersed in distilled water at room temperature. The wet weight of biocomposite (*Ws*) was recorded every 1hr for 10-20 minutes, and excess water was removed with filter paper. The dry weight of the biocomposite scaffold was recorded (*Wd*). The percentage of the swelling weight of biocomposite was calculated by using the formula [13].

$$Es = \frac{(Ws - Wd)}{Wd} * 100$$

Where *Ws*= Wet weight of biocomposite scaffold

Wd= Dry weight of biocomposite scaffold

Es is the percentage of swelling property of the biocomposite scaffold.

Porosity Measurement of biocomposite scaffold

Porosity measurement of biocomposite scaffold was determined through the liquid displacement method. The scaffold was immersed in ethanol. Ethanol was used as a displacement liquid due to its easy penetration into the pores of the scaffold, and it will not generate shrinkage or swelling in the scaffold. Biocomposite scaffold of known weight was immersed in a test tube containing a known volume (*V1*). The scaffold sample was immersed in ethanol for 3-5 min and then pressed to force the air from the scaffold to allow the ethanol to flow into the pores of the scaffold. The total volume of displacement liquid (ethanol) and displacement liquid impregnated into the scaffold was recorded as *V2*. Then the scaffold was removed from the test tube, and the remaining volume of ethanol was noted as *V3*. The porosity was calculated by using the formula [13, 14].

$$\text{Porosity } (\epsilon) = \frac{(V1 - V3)}{(V2 - V3)} * 100$$





RESULTS AND DISCUSSION

Collagen is a natural biopolymer abundantly present in skin, bone, cartilage, and ligaments. Collagen is widely used in biomedical fields such as wound dressing material and drug delivery transport. Collagen was impregnated with *Aloe vera* extract and synthesized as biocomposite scaffold. Therefore, biocomposite scaffold is used as wound dressing material which enhances effective wound healing due to its drug release from the biocomposite collagen scaffold.

Microscopic Examination

The biocomposite scaffold Col. Av. Glut scaffold surface morphology was studied by scanning electron microscopy (Figure 1(A-C)). Col. Av. Glut scaffold pores were uniform and interconnected due to the glutaraldehyde cross-linker. Biocomposite scaffold Col. Av. PEG scaffold image showed an irregular porous structure and was not interconnected to one another (Figure 1 (D-F)) Medarametla Kishore Babuet *al.*, (2013) reported that scaffold prepared by using two different cross-linkers shows different surface morphology [17].

FTIR

The FTIR spectrum of the Col. Av. Glu and Col. Av. PEG biocomposite scaffold samples are presented in Figure 2(A, B, C, D, E, F). They exhibited three main amide peaks, and their functional groups are shown in Table 1. The Col. Av. Glu biocomposite scaffold amide peaks were at range of 1627 cm^{-1} - 1699 cm^{-1} (Amide I); 1509 cm^{-1} - 1589 cm^{-1} (Amide II); 1242 cm^{-1} - 1257 cm^{-1} (Amide III) were attained from FTIR spectra results of Col. A v. Glu biocomposite scaffold of Collagen extracted from fish waste material (Scales, Skin, and Muscles) was shown in figure 2 (A, B, C). An absorption peak of 1558 cm^{-1} - 1589 cm^{-1} (presence of aromatic nitro compound) was obtained in Col. Av. Glu biocomposite scaffold which indicates that plant extract (aloe vera) has been strongly interconnected with collagen. The Col. Av. PEG biocomposite scaffold amide peak at 1702 cm^{-1} to 1720 cm^{-1} (carbonyl C=O stretching); 1502 cm^{-1} to 1597 cm^{-1} (N-H stretching of hydrogen-bonded); 1242 cm^{-1} - 1257 cm^{-1} (Amide III). This indicates that Amide I and Amide II has not formed in this biocomposite scaffold due to the cross-linker used to link the collagen and plant extract (Figure 2(D, E, F)). Our results are similar to that of Silva, *et al* (2013) who reported that comparing with two cross-linker, the glutaraldehyde cross linker enhanced biocompatibility and durability of the scaffold [18]. Functional groups of biocomposite of scaffold: A (Col. Av. Glut-extraction of Collagen from scales), B (Col. Av. Glut-extraction of Collagen from skin), C (Col. Av. Glut-extraction of Collagen from muscles), D (Col. Av. PEG-extraction of Collagen from scales), E (Col. Av. PEG-extraction of Collagen from skin), F (Col. Av. PEG-extraction of Collagen from muscles) was determined by using FTIR instrument.

Swelling property of Biocomposite scaffold

The swelling property of the biocomposite scaffold was determined by immersing the scaffold in distilled water at room temperature for 30 min. Water absorption of the biocomposite scaffold is depicted in figure 3, and the results showed that Col. Av. Glu biocomposite attained good water absorption capacity. Swelling or water absorption increased more than 80% within 20 minutes. This demonstrates that the Col. Av. Glu biocomposite scaffold can effectively absorb wound exudate from a wet wound and enhance wound healing. The Col. Av. PEG biocomposite scaffold showed a less swelling property when compared to glutaraldehyde and the water absorption rate was decreased significantly within 20 minutes. This confirms that the Col. Av. PEG biocomposite scaffold formation was not a complete scaffold formation. These results of the present study are comparable to that of Kumar *et al* (2008) [19].

Porosity Measurement of biocomposite scaffold

The porosity of biocomposite scaffolds pore size and surface area are essential factors for cell attachment and absorption of exudates from wound bed which are significant factors in wound healing. The porosity of biocomposite scaffolds was determined using a liquid displacement method using ethanol solvent, which can easily penetrate the biocomposite scaffold. The results are represented in figure 4, Col. Av. Glu (A) -75.4%, Col. Av. Glu (B) -



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72.5 %, Col.AV.Glut (C) -71.9%, Col.AV.PEG (D) -54.5%, Col.AV.PEG (E) – 54.4% and Col.AV.PEG (F)-45.5 %. The percentage of Col. Av. Glutbiocomposite scaffold porosity was above 70%, which shows that the porous nature of the scaffolds that can enhance wound healing and re-epithelialization. The porosity act as an important factor for selecting a good wound dressing material. Hence, Col.AV.Glutbiocomposite scaffold has efficient good porosity property, when compared to the Col.AV. PEG biocomposite scaffold (<70%) Jayakumar *et al*(2011), reported that cross-linker used for biocomposite synthesis might alter the pore size and structure [20].

CONCLUSION

The biocomposite wound dressing material was prepared using collagen as a base material and impregnated with *Aloe vera* extract and from which finally scaffold was formed. Therefore from the present study it could be concluded that the Col. Av. Glut bio composite scaffold dressing material can be considered as a best material which might be suitable for effective wound dressing.

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Funding: Self

Conflicts Of Interest

The authors declare no conflicts of interest.

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Table: 1 Functional group of the absorption peak

Biocomposite	A (Peak range cm ⁻¹)	B (Peak range cm ⁻¹)	C (Peak range cm ⁻¹)	D (Peak range cm ⁻¹)	E (Peak rangecm ⁻¹)	F (Peak rangecm ⁻¹)	Functional compounds
Amide-I	1627	1669	1696	1668	1604	1603	C=O stretch
Amide-II	1558	1509	1589	1589	1502	1597	N–H Bend
Amide-III	1242	1257	1249	1257	1249	1257	C-N stretch
Collagen + Aloe vera	3317	3319	3314	3012	3010	3015	N–H stretch


Figure-1: Biocomposite of scaffold: A (Col. Av. Glut- extraction of Collagen from scales), B (Col. Av. Glut- extraction of Collagen from skin), C (Col. Av. Glut- extraction of Collagen from muscles), D (Col. Av. PEG- extraction of Collagen from scales), E (Col. Av. PEG- extraction of Collagen from skin), F (Col. Av. PEG- extraction of Collagen from muscles).




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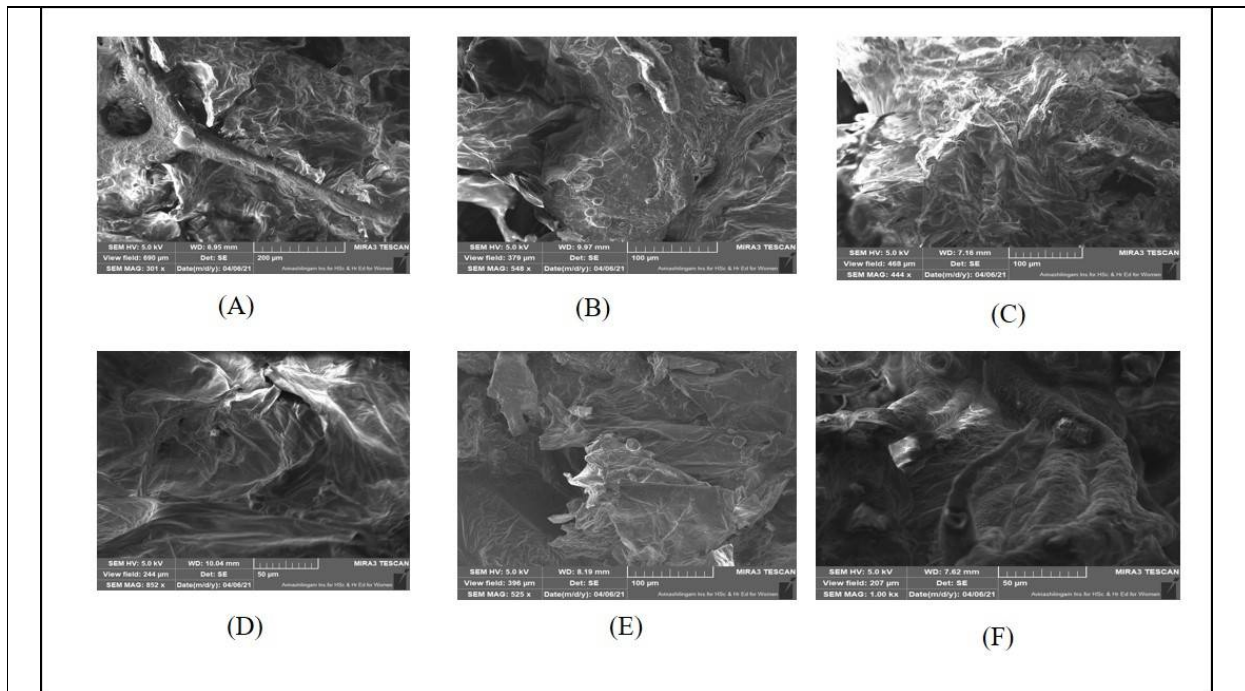


Figure-2: SEM results of biocomposite scaffold (X20-100 magnification); Col. Av. Glut: (A- extraction of Collagen from scales), (B- extraction of Collagen from skin),(C- extraction of Collagen from Muscles), Col. Av. PEG: (D- extraction of Collagen from scales), (E- extraction of Collagen from skin), (F- extraction of Collagen from Muscles).

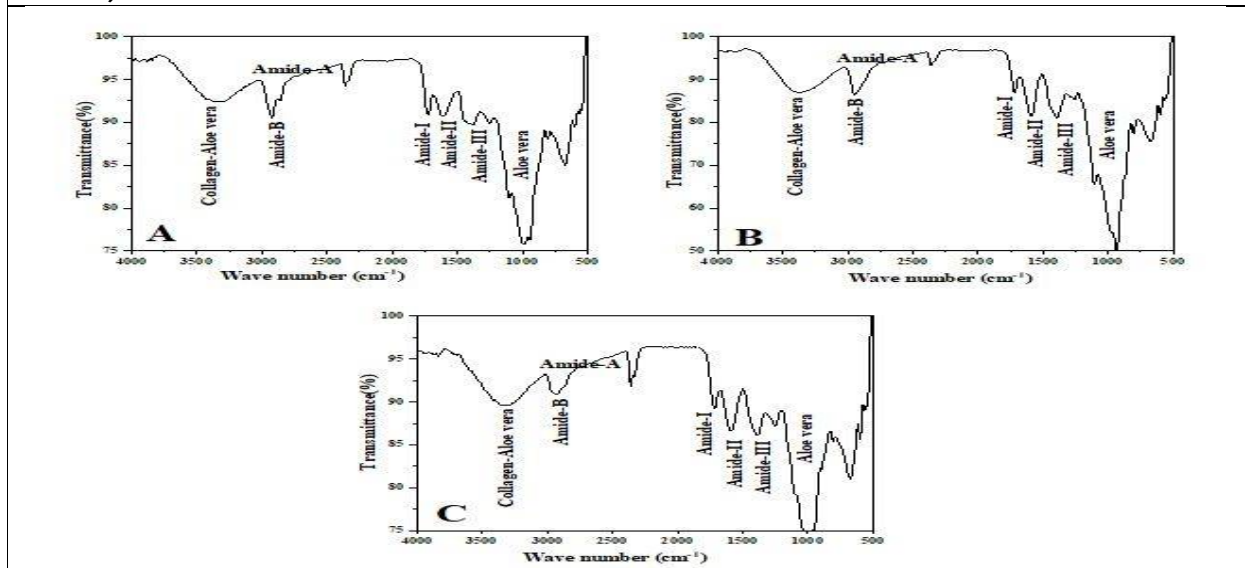


Figure-3 (A): FTIR results of biocomposite of the scaffold; A (Col. Av. Glut-extraction of Collagen from scales), B (Col. Av. Glut-extraction of Collagen from skin) and C (Col. Av. Glut-extraction of Collagen from muscles).





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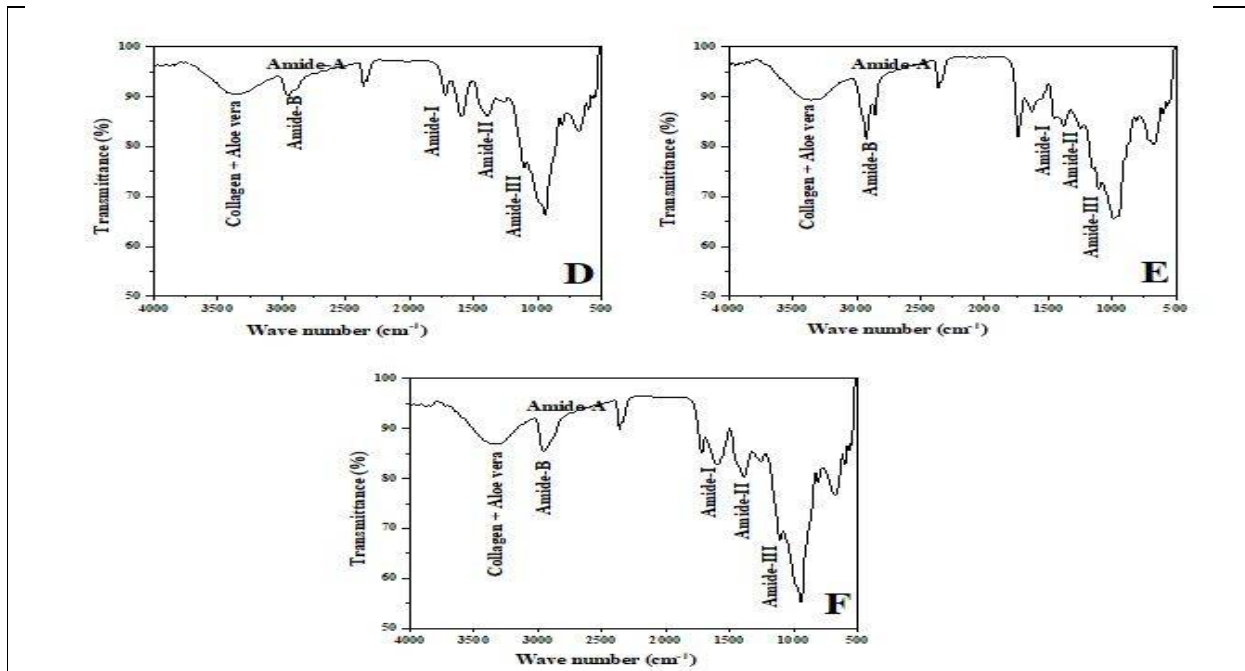


Figure-3 (B):FTIR results of biocomposite of the scaffold; D (Col. Av. PEG-extraction of Collagen from scales), E (Col. Av. PEG-extraction of Collagen from skin) and F (Col. Av. PEG-extraction of Collagen from muscles)

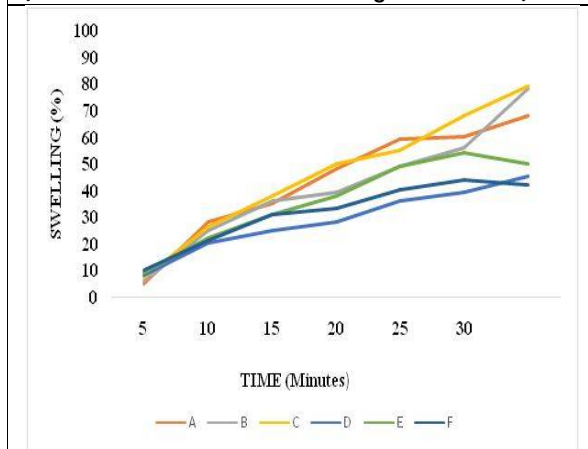


Figure-4: Swelling property of Col. Av. Glut: (A- extraction of Collagen from scales), (B- extraction of Collagen from skin),(C- extraction of Collagen from Muscles), Col. Av. PEG: (D- extraction of Collagen from scales), (E- extraction of Collagen from skin), (F- extraction of Collagen from Muscles). The swelling property of the biocomposite scaffold is expressed as a percentage. The results shown in the graphs are mean ± SD obtained from triplicate experiments.

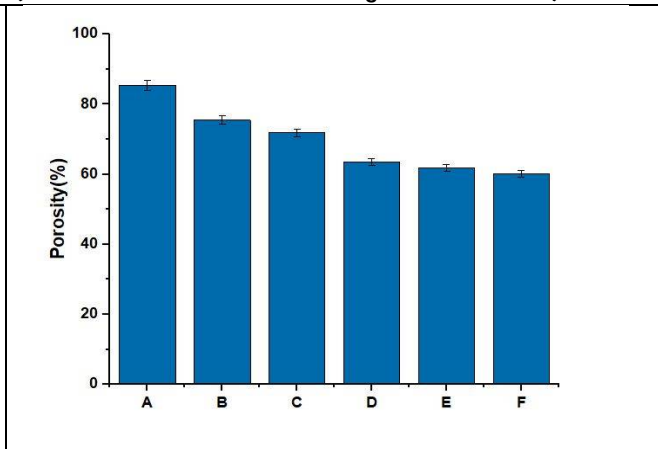


Figure-5:Porosity effect of Col. Av. Glut: (A- extraction of Collagen from scales), (B- extraction of Collagen from skin),(C- extraction of Collagen from Muscles), Col. Av. PEG: (D- extraction of Collagen from scales), (E- extraction of Collagen from skin), (F- extraction of Collagen from Muscles). The porosity of the biocomposite scaffold is expressed as a percentage. The results shown in the graphs are mean± SD obtained from triplicate experiments.





The Covid Lockdown has had a Significant Influence on Drug Rehabilitation Centers in India

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ABSTRACT

COVID Lockdown and addictive behavior are a hazardous combo that fuels each other's spread. The unique needs of the marginalized must be addressed if a nation is to recover from this devastating pandemic. Even in the midst of the lockdown, the realization of the need for addiction treatment and mental health has accelerated. As a result, it has been deemed necessary to fund rehabilitation institutions and efforts to rehabilitate addicts. This research looks into how people might be able to receive therapy for addiction withdrawal syndrome. and how do treatment providers see this circumstance as a benefit or a hindrance? A large number of therapy providers were contacted for this study in order to learn more about the current situation. As it falls under the category of government vital services, rehabilitation institutes that also serve as mental clinics are benefiting from the government's ease of mobilization during the lockdown on the ground. However, the centers that serves as de-addiction and rehabilitation centres for substance abusers are having difficulty enrolling new patients from different districts. During this lockdown, the addiction community and their suffering families are having a difficult time obtaining any form of recovery assistance. As a result of this study, the treatment providers of de-addiction cum rehabilitation institutions jointly expect different guidelines to be produced to support the addiction treatment service during this lockdown and in the future as well.

Keywords: hazardous, treatment, lockdown, Covid.





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INTRODUCTION

An increased number of Addicted people.

Substance abuse has become an imperative statement about global public health and social concern today. Increasing magnitude of the addiction problem and drug usage among children, young adults and adolescent receives much attention recent times. Protecting society from drug abuse is being considered as the most essential and burning need of the society during this lockdown period. The problem of drug abuse in country has increased and received alarming effect in last three decades. It has been emerged as an issue of vital public concern at various levels. Criminal and domestic violence cases related to addiction were increased consistently [2]. The report establishes that a substantial number of people use psychoactive substances in India, and substance use exists in all the population groups, but adult men bear the brunt of substance use disorders. This survey also indicates that there are wide variations in extent and prevalence of use across different states and between various substances.

India has performed study on substance abuse statistics. A survey on addiction was conducted on people for the first time in Indian history. From the survey conducted, the following information has been obtained. The most prevalent psychoactive substance used by Indians is alcohol (among those included in this survey). In the United States, 14.6 percent of the population (aged 10 to 75) consumes alcohol. In terms of absolute numbers, the country's alcohol consumption is estimated to be over 16 crore people. When compared to women, men use alcohol at a far higher rate (27.3 percent) (1.6 percent). For every woman who drinks alcohol, there are 17 men who do the same. Country liquor or 'desi sharab' (about 30%) and spirits or Indian Made Foreign Liquor (approximately 30%) are the most popular alcoholic beverages among drinkers. Chhattisgarh, Tripura, Punjab, Arunachal Pradesh, and Goa have the highest rates of alcohol consumption.

Cannabis and opioids are the second most often used substances in India after alcohol. In the previous year, about 2.8 percent of the population (3.1 crore people) reported using any cannabis product. There was also a distinction made between the legal type of cannabis (bhang) and various illegal cannabis products when it came to cannabis consumption (ganja and charas). Bhang was used by about 2% of the population (roughly 2.2 crore people), whereas illegal cannabis products, ganja, and charas were used by about 1.2 percent of the population (about 1.3 crore people). Uttar Pradesh, Punjab, Sikkim, Chhattisgarh, and Delhi have the highest rates of cannabis consumption. Opium (or its forms such as poppy husk known as doda / phukki), Heroin (or its impure form – smack or brown sugar), and a range of pharmaceutical opioids are used by about 2.1 percent of the country's population (2.26 crore individuals). Heroin (1.14 percent) is the most often used opioid in the United States, followed by prescription opioids (0.96 percent) and Opium (0.52 percent). The states with the highest rates of opioid use in the general population are Sikkim, Arunachal Pradesh, Nagaland, Manipur, and Mizoram (more than 10 percent).

According to the report, a significant percentage of people take sedatives and inhalants. Sedatives are used by about 1.08 percent of Indians aged 10 to 75 (about 1.18 crore persons) (non-medical, nonprescription use). Sikkim, Nagaland, Manipur, and Mizoram have the greatest rate of current sedative use. However, the top five states with the highest numbers of sedative users are Uttar Pradesh, Maharashtra, Punjab, Andhra Pradesh, and Gujarat. During this Corona pandemic outbreak, opening of liquor shop all in many states decision has been made by Indian government. But, no special measurement has taken to control the consumption of alcohol or any other abusive substances. So, create the support system for existing treatment program for addiction people is one of necessary action has to be taken by the government to safeguard the public interest.

Battling with withdrawal symptoms

Battling with withdrawal symptoms has been discussed in many research, Director of DIMHANS (Director of Dharwad institute of Mental Health and Neuroscience) addressed during this lockdown, "Need for proper counseling to addicts". Becker (2008) in his research on "Alcohol dependence, withdrawal, and relapse", enlightens the effect on withdrawal symptoms.





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Atul Ambekar, professor at the National Drug Dependence Treatment Centre and Department of Psychiatry of AIIMS, New Delhi, said: "During the lockdown period the availability of drugs is seriously restricted and so is the availability of treatment services for managing withdrawal symptoms. That is the reason there were multiple reports of patients seeking emergency treatment for withdrawal symptoms. It must be remembered that withdrawal symptoms are very distressing and sometimes may be life threatening as well [1]". When the Liquor shops reopened in Indian after the serious Lockdown, thousands of alcohol lovers rushed to their neighborhood stores - standing in long distance queues with no concern for social distancing. For many, it was a need, the only way of dealing with conditions like restlessness, insomnia, higher blood pressure, headache, vomiting, nausea, palpitation, tremors and decreased appetite [6].

Treatment availability for Addiction in Indian

Different categories of treatment providers are available for de-addiction and rehabilitation of addicts. Government funded centers, NGOs licensed under Indian mental health (IMH), Private de-addiction and rehabilitation centers and psychiatric clinics are available for providing rehabilitation service to addiction community. Dhawan (2016) in his study on "Preferences for treatment setting by substance users in India" detailed about 3 categories of treatment providers Government centers, NGOs and private centers [4]. Over 800 De-addiction Centers are available in India. Drug rehabilitation centers are prevailing in almost all part of India. In Tamil Nadu, 98 registered drug rehabilitation centers are available. Indian Mental Health is an authorized body for sanctioning license for this De-Addiction cum rehabilitation centers.

Rehabilitation centers functioning in psychiatric clinic comes under essential service of government, So, getting admitted to those centers makes easier for families as well as for the service providers. Hence, difficulty roused for all remaining segment of treatment providers which works on inpatient treatment category. Difficult in getting patient from neighboring districts are big challenge for treatment providers. Though facility of psychiatric clinic is prevailing in almost in all districts. Preferences of people may vary when it comes to rehabilitation services. Inpatient treatment program with cognitive behavioral therapy plays a major role in changing life style of addicted people. Claudia et al (2012) in their study on "Cognitive remediation therapy during treatment for alcohol dependence" proves significant improvement has been proved in inpatient treatment through cognitive therapies [3]. Problems during this lockdown period for getting treatment and getting connected counseled by a therapist or doctor has become a major trauma for the addiction community. Though the technology is supported enough to make a connection. Dr.Ahulaliya, a Delhi-based psychologist, addressed this lockdown webinar on "The impact of COVID-19 on rehab centers". Having human touch and having direct connectivity while counseling cannot be replaced by any online method. So, getting a direct connection with the therapist and with the treatment centre has become a major problem for people seeking treatment.

Covid Lockdown Effect on Rehabilitation Services:

From the above Figure (1), it is clearly understood, lockdown has become the great barricade for the treatment providers and the treatment seekers [7]. Withdrawal symptoms are life threatening ones. So, addressing this withdrawal symptom are equally important as pandemic. To keep this in mind, Rehab owners were approached to give their opinion on current situation.

RESEARCH METHODOLOGY

More than 1000 private rehabilitation centers are functioning in India for rehabilitation of an addict people. Among this 95 centers were selected based on convenience sampling. To avoid sampling errors 120 samples has been framed, out of 120, 95 questionnaires completed collected To a From this opinion survey, totally 85 rehabs center owners all over India were connected through ZOOM meeting. The zoom session was continued for complete 2 hours. This survey was conducted with the support from "Brindhavan De Addiction cum Rehabilitation center" in





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Dindigul, Tamilnadu State. Questionnaires were collected by sending Google Sheet to the collected email addresses and phone numbers. From the opinion collected from them.

From the above table (1), it has been inferred that this lockdown situation is completely a hindrance to the rehabilitation centres running on drug addiction. No one treatment centre has found this situation favorable to de-addiction centers. Majority of the centers (98%) perceives this lockdown as a big hindrance only. 85% of treatment providers felt that they cannot get admission for new patient and 63% of respondents felt tough in collecting fees for existing patient and they insisted prominent delay in getting fees for regular service. 95% of respondents were struggling to manage their running capital expenses. 95% of respondents of private rehab centers demand separate guidelines for admitting patients to private rehabilitation centers working on addictive people during this lock down period, and they are insisting that guidelines have to be uniformly followed by all states in the country. 85% of respondents were expecting free Covid test facility must be available in all district of the country. 85% of respondents talks about difficulty in getting e.pass for migrating patient from their own district to different places for treatment. 70% respondents demand for structured procedure has to be established for admitting a new patient all over the country in order to control the virus spread in pandemic situation. Eminence admission process and spreading of virus can be controlled by this structured process. From the information collected, setting regulation for rehabilitation centers not only support rehab business but also support individual who are suffering with withdrawal symptoms, eventually it will help the society positively in controlling spreading of disease through alcoholic to family and control the crimes due to withdrawal symptoms.

Way forward and Conclusion

The most vulnerable members of society must be treated with extreme caution[7]. A government, society, and the private sector must all work together to create a solid support system. Family members and health-care providers must shoulder their fair share of obligations. Governments and legislative bodies must take action in this direction, prescription drug availability and accessibility, as well as ongoing drug addiction and harm-reduction treatments [8, 9, and 10]. While Withdrawal symptoms must be avoided and treated with caution. At all costs, the discontinuation of addictive behavior must be encouraged [11, 12, 13]. From the information collected, setting regulation for rehabilitation centers not only support rehab business but also support individual who are suffering with withdrawal symptoms, eventually it will help the society positively in controlling spreading of disease through alcoholic to family and control the crimes due to withdrawal symptoms. These society's outcasts must be protected. Receive straightforward, easy-to-understand guidance on.

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Table:1. Impact on Lockdown on de addiction centers in India

S.No	Variables	Not favorable	Neutral
1	Covid Lockdown	98 %	2%
2	Effect of Government Rules of Lockdown on Rehab Business.	86%	14%
3	Managing running capital with increased expense on necessaries.	95%	5%
4	New Patient admission During lockdown.	85%	15%
5	Fees collection from existing patient.	63%	37%
6	Supporting policy from the government for a lockdown period for the rehabilitation of substance abusers.	90%	10%

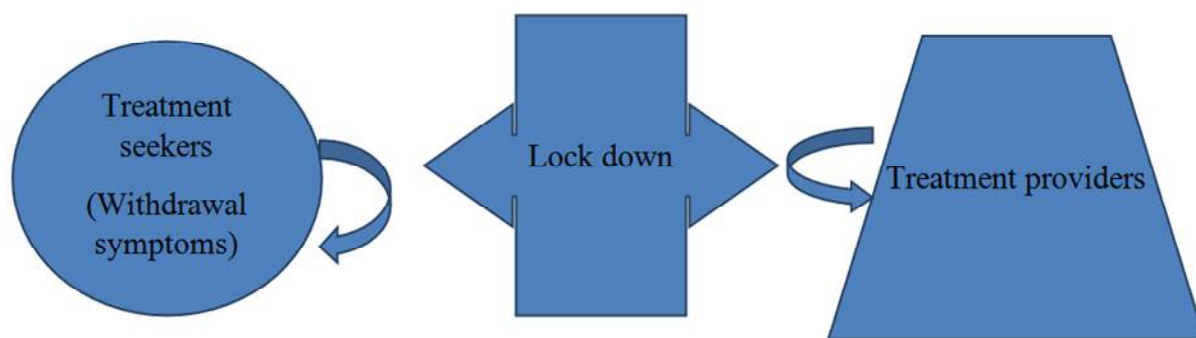


Fig. 1. Service of Rehabilitation centers for substance users during lockdown





Assessment of *In vitro* Growth of Duckweed on Basal Media

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ABSTRACT

Duckweeds are naturally grown in confined water bodies with specific chemical requirements. An attempt was made to propagate in three commonly used basal plant culture media. The proficiency of culture media has been found to be in the decreasing order among Shenk and Hildebrandt (1972), Murashige and Skoog (1962) and then in Gamborg's B5 (1968). *Lemna minor* L., *Spirodela polyrrhiza* (L.) Schleid. Both performed well, but the prior one grew faster than the second duckweed species. Mean doubling time recorded its maxima at 3.00 days, whereas the relative growth rate recorded its maxima at 0.75 per day.

Keywords: Duckweed, *Lemna minor* L., *Spirodela polyrrhiza* (L.) Schleid., Basal media, *In vitro* growth.

INTRODUCTION

Duckweeds represent the smallest free floating monocotyledons included in the family Lemnaceae [1]. Their cosmopolitan distribution, minute size and significant reduction of organs created difficulties regarding their taxonomic position and systematics [2]. Family Lemnaceae divided into two subfamilies viz Wolffioideae and Lemnoideae consisting of five genera namely *Spirodela* sp., *Landoltia*, sp. *Lemna* sp, *Wolffiella* sp, and *Wolffia* sp. [3]. Wolffioideae subfamily includes slow growing rootless duckweeds (*Wolffiella* sp, and *Wolffia* sp.) and Lemnoideae subfamily includes rooted duckweeds (*Spirodela* sp., *Landoltia*, sp. *Lemna* sp.). Duckweeds are characterized by rapid growth rate and vigorous accumulation of sugars. Some of the strains of duckweeds are known to double their biomass within 96 hours. All the members of duckweeds are found to occur together in aquatic water bodies or may occur isolated as well [4]. Members of Lemnaceae are important fresh water plants all around the world where aquaculture practices are advanced [5]. Duckweeds have flourished in the past few decades due to global warming and increase in eutrophication of water bodies. Due to high starch accumulation along with significantly high percentages of essential amino acids, they are served as food for cattles and poultry birds [6]. The members of duckweeds are widely used to test the toxicity of different insecticides and pesticides [7]. Duckweeds are also



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suitable for removing dissolved waters from polluted water bodies [8]. Among the five genera of Lemnaceae, *Lemna* sp, also known as lesser duckweeds, shows significant variability in the number of species and complexity [9]. Of them *Lemna minor* L. is the most abundant duckweed, cosmopolitan in occurrence. These plants bears free floating fronds which are coherent in groups, ovate in shape, bearing a single root on the dorsal surface. It is known to produce minute flowers bearing one stamen and one ovary, fruits bear ribbed seeds. *Spirodela polyrrhiza* (L.) Schleid. is commonly known as giant duckweeds owing to its large size as compared to the other members of duckweeds. Fronds are circular to ovate in appearance bearing numerous roots on the dorsal surface. Under adverse condition, it is known to produce a perennating structure called turions. Such structures sink to the bottom during unfavourable conditions and on return of ambient conditions, it germinates to give rise to new daughter fronds. *Spirodela polyrrhiza* (L.) Schleid. is known to accumulate nitrate and phosphate from surrounding water at a rapid pace [10]. According to Xu et al (2011), *Spirodela polyrrhiza* (L.) Schleid. can increase its dry weight upto 64% under stressful condition. The plant has low lignin and low fibre content which makes it a suitable source for bioethanol production [11]. Members of Lemnaceae are now being commercially utilized as an effective model plant for plant expression system owing to their elevated protein content, short life span and easy to culture in liquid medium [12]. Such plant systems are now an area of interest for production of alien proteins which are useful in the pharmaceutical industries and also as diagnostic tools. [13]. For such commercial utilization of duckweeds as plant expression system requires a stable and axenic culture induction protocol. The present paper aims in establishing an easy and efficient liquid culture protocol for *Lemna minor* L. and *Spirodela polyrrhiza* (L.) Schleid. under controlled *In vitro* growth conditions.

METHODS

Duckweeds viz. *Lemna minor* (L.) and *Spirodela polyrrhiza* (L.) Schleid. were taken as the experimental plants, identified with the help from the A.J.C Bose Indian Botanic Garden Shibpur herbarium (CAL). The plants in good health, green foliage were collected from several collection points in Malda districts, West Bengal, India and were subjected under *in vitro* growth using three basal culture media: Murashige and Skoog (1962), Gamborg's B5 (1968) and Shenk and Hildebrandt (1972) procured from Himedia (product code PT021, PT016 and PT059 respectively). Each individual plant was washed thoroughly in double distilled water thrice and then placed in the basal media full strength sterile solution at an initial count of 10 individual plants per 100 mL media. The growth culture set up petriplates were incubated in the culture room under cool white light of 2000 Lux intensity through 16/8 h photoperiod and 24±2 °C temperature. No intermittent addition or filtering out of used-up media done during the entire observation period of 18 days. Counting of individual plant was carried out after every 72 h or 3 days interval. Doubling Time (DT) and the relative growth rate (RGR) also calculated. The number variations were recorded and statistically analysed using SPSS v.15 software.

RESULTS AND DISCUSSION

The growth of duckweeds as mentioned on the basal media indicated more or less uniform response in MS basal and SH basal media, whereas *in vitro* growth in B5 basal medium is less. For *Lemna minor* L. and *Spirodela polyrrhiza* (L.) Schleid. The growth kinetics showed the following trends: (Table 1). The overall growth efficiency of *Lemna minor* L. was found to be superior than that of *Spirodela polyrrhiza* (L.) Schleid. The doubling time of *Lemna minor* L. was in MS basal than two other media, that indicated that, the media compositions in B5 and SH media favoured to some extent the growth and morphogenesis of *Lemna* sp. However the relative growth rate in it attained maximum when cultured in SH basal medium. The relative growth rate that indicates the daily fractional growth of the species showed that, the nutrients availability in MS medium is to some extent slower than the assimilation rate of the nutrients present in B5 and SH basal media. *Spirodela polyrrhiza* (L.) Schleid. Showed however different trends: here the Gamborg's B5 basal medium is the slowest performer. The intermediate position was occupied by the MS basal medium and like the previous case SH medium performed better than the other two media compositions. The ratio of the maximum plant unit obtained in viable green condition after the entire growth incubation period of 18 days in



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MS, Gamborg's B5 and SH for the duckweed species were found to be 1: 0.68:1.11 and 1: 0.71:1.13 respectively for the species studied.

Again analysing the comparative growth potential of the MS basal medium for the two duckweed species, the ratio of comparative increase per observation interval of 72 h were found to be 1:0.95, 1:0.91, 1:0.96, 1:0.99, 1:0.91, 1:0.91. the comparative ratio of doubling time for the two duckweed species was 1: 0.96. This ration shows that, the growth of *Spirodela polyrrhiza* (L.) Schleid. was faster. This trend was also followed in terms of relative growth rate, however the overall plant body unit number in *Lemna* sp. Is more than that of *Spirodela* sp. This apparent nondisjunction might be probably due to the fact that, in *Lemna minor* L. there is o one root, but in case of *Spirodela polyrrhiza* (L.) Schleid. There are a tuft of roots so the pace of morphogenesis could have been the deciding factor behind such observations. analysing the comparative growth assessment for the efficacy of B5 basal medium, the ration of maximum plant body unit number is 1: 0.97, the ratio of comparative increase per observation interval of 72 h were found to be 1:0.92, 1:0.89, 1:0.92, 1:0.94, 1:1, 1:0.94. Doubling time of the duckweed species were 2.90 and 2.93 respectively. The relative growth rates of these two species were very close to each other, 0.69 and 0.68 respectively. Here also relatively slow growth of the second duckweed species might be attributed to its morphological elaborations. Owing to the consideration for the efficacy of SH basal medium for the in vitro growth of the two duckweed species it could be stated that maximum viable plants were 173 and 165 respectively. The comparative growth per observation period for the two species recorded the ratio of 1:0.91, 1:0.96, 1:0.92, 1:0.96, 1:0.94, 1:0.94. Here also morphological structure and pace of morphogenesis might have the key parameters for guiding the growth kinetics of the species. As we know the major and minor elements are required in the plant physiology for many metabolic activities which are intricately related among themselves for the expression of morphological characteristics, so the balance between requirement and availability plays the crucial role for the growth and multiplication of the duckweed plants as assessed in the study.

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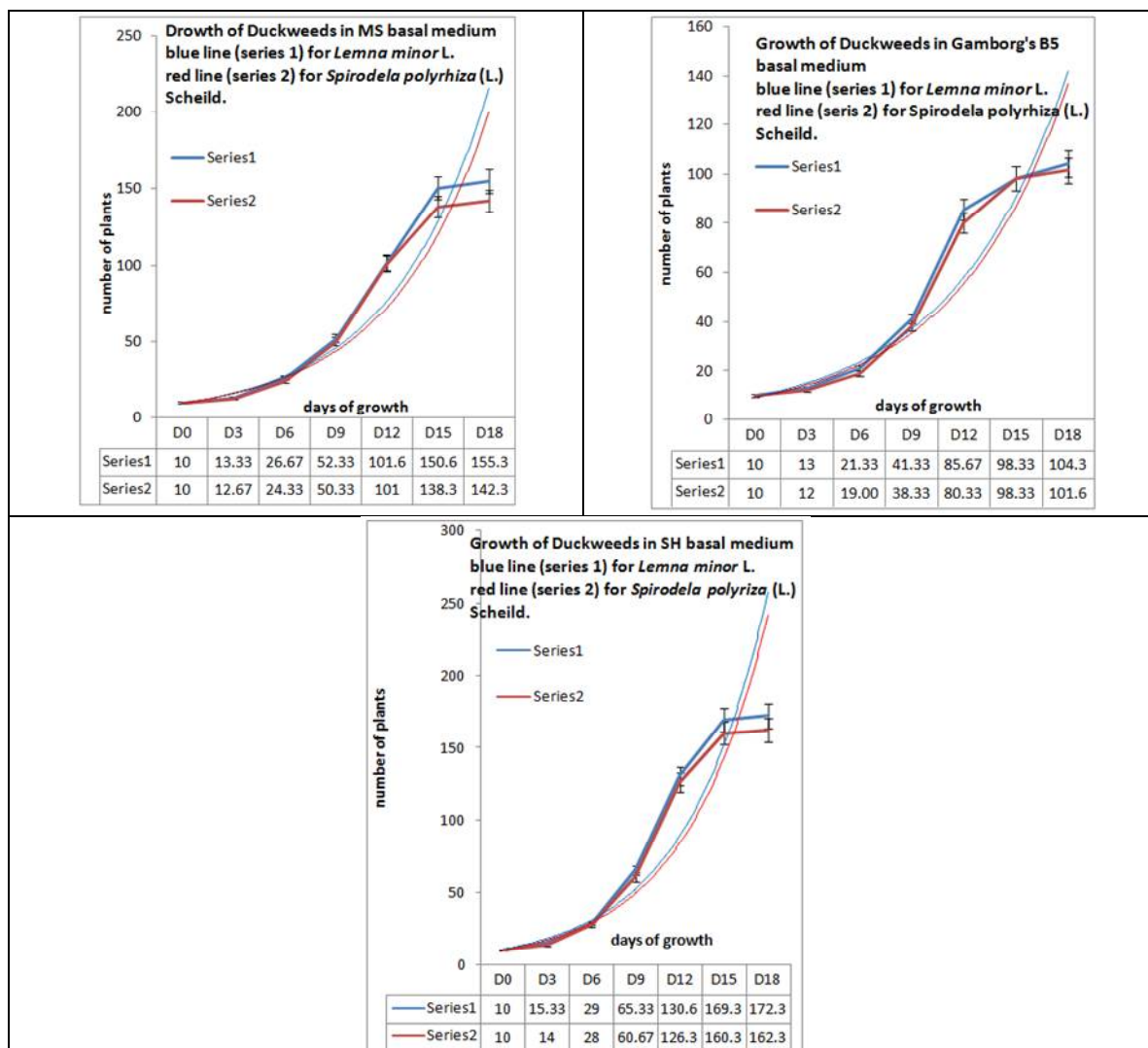


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Table 1: Maximum plant number recorded after 18 days of growth period.

Duckweed species	Growth	MS basal	Gamborg's B5 basal	SH basal
<i>Lemna minor</i> L.	Max. plant No.	155	106	173
	Min.DT	3.00 days	2.90 days	2.67 days
	Max. RGR	0.67 / day	0.69 / day	0.75 / day
<i>Spirodela polyrrhiza</i> (L.) Scheid.	Max. plant No.	145	103	165
	Min. DT	2.90 days	2.93 days	2.76 days
	Max. RGR	0.71 / day	0.68 / day	0.72 / day





A Descriptive Study to Assess the Physical Problems and Depression among Elderly Persons at Selected Old Age Homes, Nagapattinam

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ABSTRACT

Everyone must go through this stage of life at his or her own pace and in peace. Slow and steady physical impairment and functional disability are noticed resulting in increased dependency in the period of old age. It is estimated that approximately one fifth of the global elderly population suffers from some form of psychological disorders which prevents them from independently performing everyday activities. The quantitative descriptive research design was adopted for the study. The study setting was Avvai old age home, Namco old age home and Karunalaya old age home Nagapattinam. There is significant association between Diabetes mellitus, sleep problems ($p < 0.05$) and there is no significant association with other demographic variables

Keywords: psychological, Nagapattinam, old age, association, Diabetes mellitus.

INTRODUCTION

Ageing is a natural process. Everyone must go through this stage of life at his or her own pace and in peace. Slow and steady physical impairment and functional disability are noticed resulting in increased dependency in the period of old age. According to World Health Organization, ageing is a course of biological reality which starts at conception and ends with death. With advancing age, old persons have to cope with health and associated problems some of which may be chronic, of a multiple nature, require constant attention and carry the risk of disability and consequent loss of autonomy. India's population of 1.31 billion, the second largest globally, comprises 17% of the world's total (United Nations 2015), and the United Nations Population Division estimates that India's population will in fact overtake China's by 2028. Two in every three senior citizens in India suffer from some chronic disease, according to the first Longitudinal Ageing Study in India (LASI) released by the Union Ministry of Family and



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Health Welfare on January 6 2020. Around 23 per cent of the elderly population (age 60 years and above) have multi-morbidities; elderly women are more likely to have multi-morbidity conditions, in India, the prevalence of asthma, bronchitis, and COPD is higher among elderly age 60 and above (5.9 per cent, 1.6 per cent, and 2.8 per cent, respectively) than in older adults age 45-59 (3.1 per cent, 0.7 per cent, and 1.6 per cent, respectively).

Mental problems are well recognized health issue for elderly. It is estimated that approximately one fifth of the global elderly population suffers from some form of psychological disorders which prevents them from independently performing everyday activities. Depression is a major mental health problem, which has yet to be recognised as an important public health challenge for elderly people. About 322 million people affected with depression worldwide. Depression is the single largest contributor to global disability (7.5%, 2015) and a major contributor to suicides (800,000 annually.) Fifty-one studies from 16 States of India were included as 56 datasets, which estimated the prevalence of depression among Indian elderly population as 34.4%. Thus, depression among elderly population is likely to be a major cause of disease burden in the future.

Statement of The problem

A descriptive Study to Assess the physical problems and depression among Elderly persons at selected old age homes, Nagapattinam.

Objectives

1. To assess the physical problems among Elderly selected old age homes.
2. To assess the depression among Elderly selected old age homes.
3. To find the association between physical problems and depression with selected demographic variables.

Hypothesis

H1-There is a significant association between physical problems and selected demographic variables

H2-There is a significant association between depression and selected demographic variables

MATERIALS AND METHODS

The quantitative descriptive research design was adopted for the study. The study setting was Avvai old age home, Namco old age home and Karunalaya old age home Nagapattinam. The population of this study was elderly people and 88 samples was selected used purposive sampling technique. The data was collected using demographic variables; check list was used to assess the physical problems and Geriatric Depression long form scale was used to assess the depression. Physical problems consist of 35 questions and Depression scale consists of 30 questions. The scoring was Normal /No depression (0-9), Depression (10-19), and severe depression (20-30)

Criteria for sample selection**Inclusion Criteria**

- ❖ Age group between 65-85 years.
- ❖ Both male and female
- ❖ Willing to participate in this study
- ❖ Had oriented and conscious to participate in the study
- ❖ Able to understand and communicate in Tamil

Exclusion Criteria

- ❖ Psychologically unstable
- ❖ Critically ill
- ❖ Bed ridden person



**Raji and Kamala****Data Collection Procedure**

Formal permission obtained from the concern old age homes and written consent was obtained from the participants. 88 elderly people were selected from the three old age homes using inclusion criteria. Using check list for physical problems and Depression assessed by Geriatric Depression scale it took 20 minutes to collect the data from the participants.

Plan for data analysis

Distribution of demographic variables is analysed by descriptive statistics (Mean, standard deviation).

RESULTS AND DISCUSSION

Majority of the elderly persons were females (71.6)), Hindus (86.4% did not have any income of their own (73.9 %) Non Vegetarians (71.6%), were independent (96.6%) With regard to other variables, 43.2 % of them were aged 65-70 yrs, 46 % of them were married, 44.3 % were illiterates, 19.3 % are receiving Old age pension, 34.1 % of them did not have children, 37.5 % are staying in old age home for more than 5 years, 37.5 % of them are residing in old age home as children / family members neglected them.

Objective 1: To assess the common physical problems among elderly persons (65-85 years) selected old age homes.

In respiratory problems 29.5% elderly had shortness of breath and wheezing respectively control and experimental group. In cardiac problems 22.7% elderly had fainting and fatigue .In gastro intestinal problems 30.7 % elderly had heart burn after meals, 28.4% elderly had loss of 21.6 % elderly had constipation, 19.3 % elderly had mastication problem. Regarding genitourinary problems 17% elderly had frequency of micturition and 1% elderly had painful micturition. Regarding neurological problems 15% elderly had head ache . Regarding musculoskeletal problems 54.9% elderly had joint pain in control and experimental group respectively. 12.5 % elderly had back ache. Regarding skin problems 12.7 % elderly had dryness of skin. Regarding sleep 52.1 % elderly had trouble falling sleep at night .Regarding sensory problems 62.5 % elderly had blurred vision , 17% elderly using spectacles/lens.6.8% elderly had hearing difficulty , 2.3 & % elderly using hearing aids and 3.4% elderly had using dentures. Regarding chronic problems 28.4 % of the elderly had hypertension, 25 % had Diabetes Mellitus, 36.4 % of them had Cataract/ Glaucoma, 10. % of them had Rheumatoid Arthritis and only 3.4 % had known heart diseases.

To assess the depression among Elderly selected old age homes.

More than half of the elderly suffer from Mild Depression (55.7 & 58.4 %), followed by severe depression (20.2% & 21.6%) and 21.3 & 22.7% were normal in control and experimental group respectively..

To find the association between physical problems and depression with selected demographic variables.

There is significant association between Diabetes mellitus, sleep problems ($p < 0.05$) and there is no significant association with other demographic variables. Hence the research hypothesis (H1) was accepted. There is statistically significant association between all the QOL domains Scores and Psychological problems (Depression) among elderly persons. Hence the research hypothesis (H2) was accepted.

DISCUSSION

In this study findings shows that elderly persons who are residing old age home had physical problems like dyspnea, wheezing, palpitation, anorexia, indigestion, urinary problems, sleep disturbance and chronic illness like diabetes mellitus, hypertension, cataract, arthritis and psychological problems like depression. The study findings supported by M.Anitha Rani , Palani G and Sathiyasekaran BWC(2012) assess the morbidly profile of the elderly in old age home ,Chennai. Result findings shows that Hypertension was prevalent among 83 elders (39.5%). Of the 83





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hypertensive, 23 were newly diagnosed at the time of survey and the rest were under treatment. The overall prevalence of visual problems among the elders studied was found to be 35.1%.The over all prevalence of musculoskeletal problems among the elders studied was .The overall prevalence of respiratory diseases among the elders studied was found to be 27.1%.around to be 34.8%The overall prevalence of gastrointestinal disorders among the elders studied was found to be 25.2%. The nature of gastrointestinal disorders was constipation 14.8%, gastritis 6.7%, and indigestion 6.7%, loss of appetite 6.7%, haemorrhoids 2.4%, hernia 1.4% and diarrhoea 0.9%
The another study findings supported by Revathy N and Dr. P Muthumari (2019) conducted a study on effectiveness of group reminiscence therapy on levels of life satisfaction and depression among elderly adults at Sri Narayani Hospital and Research Centre, Vellore. Findings shows that majority of elderly adults 33 (82.5%)were mildly depressed and 7 (17.5%) were moderately depressed.

CONCLUSION

The study conclude that the elderly persons who were residing old age had hypertension, had Diabetes Mellitus of them had Cataract/ Glaucoma, Rheumatoid Arthritis had known heart diseases. In depression more than more than half of the elderly had mild depression.

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Table 1 –Frequency and Percentage Distribution of Physical Problems among Elderly Persons

S.No	Problems	Frequency	Percentage
Respiratory Problems			
1.	Shortness of breath	25	28.4
2.	Cough	12	13.6
3.	Wheezing	26	29.5
Cardiac Problems			
4.	Palpitation	17	19.3
5.	Chest pain	12	13.6
6.	Fatigue	20	22.7
7.	Fainting	31	35.2
Gastrointestinal Problems			





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8.	Do you have Tooth ache	2	2.3
9.	Mastication problem	17	19.3
10.	Swallowing difficulty	12	13.6
11.	Stomach upset	9	10.2
12.	Heart burn after meals	27	30.7
13.	Constipation	19	21.6
14.	Loose stool	4	4.5
15.	Loss of appetite	25	28.4
16.	Piles	0	0
Genito Urinary Problems			
17.	Painful urination	1	1.1
18.	Frequency of micturition	15	17.0
Neurological Problems			
19.	Head aches	14	15.9
20.	Tremor of hands	11	12.5
21.	loose balance while walking	9	10.2
Musculoskeletal Problems			
22.	Joint pain	47	53.4
23.	Back ache	15	17.0
24.	Swollen ankles	16	18.2
25.	Varicose vein	4	4.5
Skin Problems			
26.	Dryness of the skin	11	12.5
27.	Itching	8	9.1
28.	Boils / Blister on skin	2	2.3
Sleep			
29.	Trouble falling asleep at night	46	52.1
30.	Feel sleepy always	22	25.0
SENSORY PROBLEMS			
Vision			
31.	Blurred vision	55	62.5
32.	Using spectacles/ Lens	15	17.0
Hearing			
33.	Hearing difficulty	6	6.8
34.	Using Hearing Aids	2	2.3
Dental Problem			
35.	Use of Dentures	3	3.4

Table 2 - Frequency and Percentage Distribution of Psychological Problems (Levels of Depression) among Elderly Persons

Levels	Frequency	Percentage %
Normal	20	22.7
Mild Depression	49	55.7
Severe Depression	19	21.6





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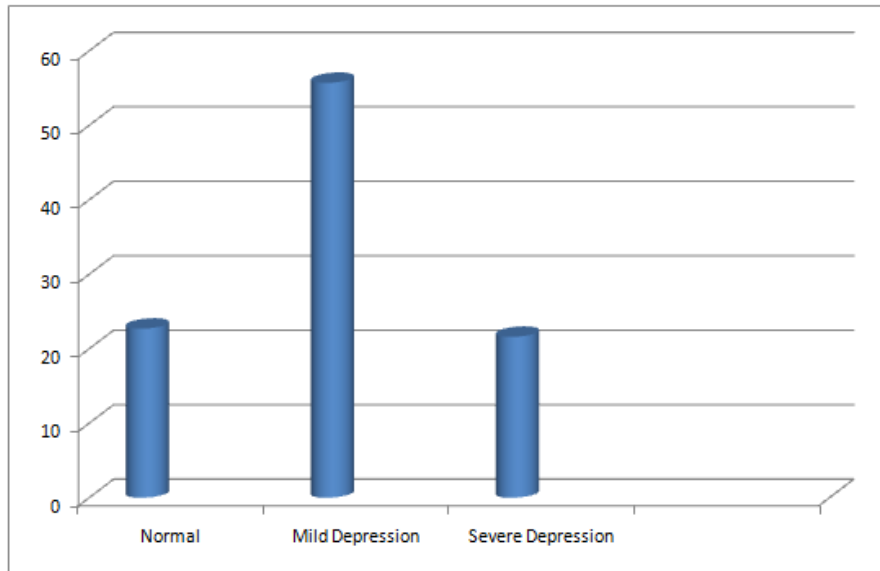


Fig.1. Frequency and Percentage Distribution of Psychological Problems (Levels of Depression) among Elderly Persons





Method of Construction for Factorial Experiments using Bipartite Graphs

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ABSTRACT

The graphs play an important role in area of mathematical sciences, agricultural and medical fields, in particular the complete bipartite graphs is used to construction of complete and incomplete block designs. The complete block designs like Randomized Block Design (*RBD*) and Latin Square Design (*LSD*) are only one factor can be tested at a time. If we want to more than one factor can be tested then we have to conducted separate simple experiments for each factors. To overcome this problem, factorial experiments are introduced in which more than one factor can be tested simultaneously and interaction effects also tested. The factorial experiments may are classified into two types are symmetrical and asymmetrical factorial experiments. In factorial experiments if the number of level each factor is the same and then it is called the symmetrical factorial experiments otherwise asymmetrical factorial experiments. In this paper, method for construction of symmetrical factorial experiments using bipartite graphs with a numerical example.

Keywords: RBD, LSD, Factorial Experiments, Bipartite graphs.

2020 Mathematics and Statistics Subject Classification: 05B15, 05C51, 62K15.

INTRODUCTION

The first paper in graph theory was written by Euler in 1936 when he settled the famous unsolved problem of his day, known as the Konigsberg Bridge problem. In the last three decades graph theory has established itself as a worthwhile mathematical discipline and there are many applications of graph theory to a wide variety of subjects which include operation research, statistics, chemistry, natural sciences, engineering, computer science etc. Graph theory is the study of relationships. Graphs through a framework provide answers too many arrangement, networking, optimization,

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matching and operational problems. For example, Google maps uses graphs for building transformation systems, where intersection of two or more roads are considered to be a vertex and the road connecting two vertices is considered to be an edge, thus their navigation system is based on the algorithm to calculate the shortest path between two vertices. In graph theory, a component which allows to exhibit series of data on a chart is known as line graphs or bar graphs. When any two vertices are joined by more than one edge, the graph is called a Multi-graph.

A graph without loops and with at most one edge between two vertices is called a simple graph. Unless stated otherwise, graph is assumed to refer to a simple graph. When each vertex is connected by an edge to every other vertex, then it is called a complete graph. A direction may be assigned to each edge to produce what is known as a directed graph, or digraph. A Levi graph or incidence graph is a bipartite graph associates with an incidence structure. Levi graph is named after F. W. Levi in 1942. From a collection of points and lines in incidence geometry, it forms a graph with one vertex per point, one vertex per line and an edge for every incidence between a point and a line. Design of experiments is mainly used in medical and agricultural fields. R. A. Fisher developed three basic principles of experimental designs. They are randomization, replication and local control. Randomization is the random process of assigning each treatment to the experimental units. The main objective of randomization is to remove bias and the other sources of extraneous variation which are uncontrollable. Replication allocates an efficient way of increasing the precision of an experiment.

To increase the precision, it yields more observations when the same treatment is used. Randomization and replication doesn't remove all extraneous sources of variation. To reduce the experimental error, the replication is used with local control. The treatments are assigned completely at random is called *CRD*, so that each experimental unit has the same chance of receiving any one treatment. The *CRD* is rarely used in field experiments, where there is generally large variation among experimental plots in such environmental factors as soil. The treatments are allocated randomly to the experimental units inside each block, where, all treatments appear at least once in each block, is known as *RBD*. It provides more accurate results than *CRD*, due to grouping. In *LSD*, each treatment is assigned to each time period the same number of times and to each subject the same number of times. Superimposing two *LSD* of same order where the pair occurs exactly once is called *MOLS*. Here, the Latin squares taken are mutually orthogonal. Complete block design is design in which all the treatments will occur in each block. *RBD* and *LSD* are some of the complete block designs. In other words, if size of block is equal to number of treatments, then it is a full replication and the design is called as complete block design. The simple experiments like *RBD* and *LSD* are only one factor can be tested at a time.

If we want to more than one factor tested then we have to conducted separate simple experiments for each factor. For example if consider the agricultural production (yield), that the factors of production are seeds, irrigation and fertilizer. If we want to test the performance of yield in simple experiments, then we have to conducted one experiment for seed another for irrigation and another one for fertilizer particularly. It will lead to more time and cost. To overcome this problem, factorial experiments are introduced in which more than one factor can be tested simultaneously. In our example the different factors production namely seed, irrigation and fertilizer can be tested in single factorial experiments. Thus the time and cost are significantly, saved by factorial experiments. This is the primary advantage of factorial experiments over simple experiments.

The secondary factorial experiments is that not only main effects (seed, irrigation and fertilizer) are to be tested and also three interactions say (seed) \times (irrigation), (seed) \times (fertilizer) and (irrigation) \times (fertilizer) etc., may also be tested. The agricultural production, industrial production and any fields of the day of today life intervals more than one factor with different levels are tested consequently. The application of factorial experiments has become popular rather than the factorial experiments over simple experiments. Factorial experiments may are classified into two types are symmetrical factorial experiments and asymmetrical factorial experiments. In factorial experiments if the number of level each factor is the same, and then it is called the symmetrical factorial experiments. For example there are two factors namely *A* and *B* each with three levels. Then the factorial experiments are defined by $(3 \times 3) = 3^2$ it





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is called as symmetrical factorial experiments with 2 factors each with 3 levels. In a factorial experiment if the number of level of different factors are unequal. It is called asymmetrical factorial experiments. Suppose there are two factors A and B , where the factor A having 2 levels and B factor having 3 levels. Then the asymmetrical factorial experiments is defined by (2×3) . J.D.Godolphin (2019) have derived the construction of 2^n and 2^{n-p} blocked factorial designs to estimate main effects and selected two-factor interactions problem Particular consideration is given to the special case of designs with blocks of size four and tables of designs are given for the block size. IAbhishek K. Shrivastava (2013) have discussed the efficient construction of split-plot design catalogs using graphs. The efficacy of this approach is demonstrated by presenting catalogs of two-level regular fractional factorial split-plot designs of up to 4096 runs, which is much larger than available in existing literature. M. L. Aggarwal et.al. (2006) has proved the interaction graphs for $4^r 2^{n-p}$ fractional factorial designs.

Taguchi (1959, 1987) introduced the concept of linear graphs associated with various orthogonal arrays. Linear graphs are the graphical representation of allocation of main effects and two-factor interactions among various columns of orthogonal array. Ankenman and Dean (2003) have given an excellent review on Taguchi's methodology. Joglekar and Kacker (1989) and Kacker and Tsui (1990) discussed the concept of linear graphs for planning industrial experiments. Barton (1999) and Wu and Hamada (2000) discussed the concept of linear graphs. Li et al. (1991), Wu and Chen (1992), Chen, Sun and Wu (1993) and Sun and Wu (1994) developed interaction graphs (linear graphs) for two-level and three-level fractional factorial designs under different design criteria. These designs enable one to estimate all main effects and required two-factor interactions Aggarwal, Gupta, and Chowdhury (2001) developed interaction graphs which enable one to estimate three factor interactions along with all main effects and required two-factor interactions. In this paper, method of construction for bipartite graphs using symmetrical factorial experiments through an example.

Preliminaries

Bipartite Graph

A graph $G=(V, E)$ is said to be a bipartite graph if its vertices set V can be segregated into two subsets V_1 and V_2 such that each edge of G connects a vertex of V_1 to a vertex V_2 . These graphs are denoted by $K_{m,n}$, where m and n are the numbers of vertices in V_1 and V_2 respectively.

Complete Bipartite Graph

A graph $G=(V, E)$ is said to be a complete bipartite graph if its vertices set V can be separated into two subsets V_1 and V_2 such that each vertex of V_1 is connected to each vertex of V_2 . The number of edges in a complete bipartite graph is $m \times n$ as each of the m vertices is connected to each of the n vertices.

Symmetrical Factorial Experiments

The symmetrical factorial experiments is with n factors each s levels is denoted by s^n namely $2^2, 2^3, 2^4, \dots, 2^n$.

The 2^2 Symmetrical Factorial Experiments

The factorial experiment the simplest types involves 2 factors each with 2 levels. Then the factorial experiments 2^2 as 4 treatment combinations is 00, 10, 01, 11 (or) $a_0b_0, a_1b_0, a_0b_1, a_1b_1$ (or) (1), a, b, ab . Then the corresponding treatment effects (factorial effects) are denoted by $(M), A, B$ and AB . Where, A denote the main effect due to factor A ; B denote the main effect due to factor B ; AB denote the interaction effect due to the simultaneous occurrence of both the factors of A and B and (M) denotes the general mean effect (or) null effect.

The 2^3 Symmetrical Factorial Experiments

Let 2^3 (3 factors with 2 levels) is a factorial experiments is a symmetrical factorial experiments which involves the 3 factors namely A, B and C each with 2 levels 0 and 1. Then there $2^3 = (2 \times 2 \times 2) = 8$ treatment combinations,





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namely; 000, 100, 010, 110, 001, 101, 011, 111 or $a_0b_0c_0, a_1b_0c_0, a_0b_1c_0, a_1b_1c_0, a_0b_0c_1, a_1b_0c_1, a_0b_1c_1, a_1b_1c_1$ or (1), a, b, ab, c, ac, bc, abc . Then the corresponding factorial effect may be denoted by, $(M), A, B, AB, C, AC, BC$ and ABC , where, A denote the main effect due to factor A ; B denote the main effect due to factor B ; C denote the main effect due to factor C ; AB, BC, AC denote the interaction effect due to the simultaneous occurrence of both the factors of A and B ; A and C ; B and C respectively and ABC is called three factor interactions due to the simultaneous occurrence of all 3 factors. (M) Denotes the general mean effect or null effect. The various main effects and interaction effects can be obtained by Yates table.

$$\text{Main effect } A (\text{M.E } A) = \frac{1}{2^2} [-1 + a - b + ab - c + ac - bc + abc] = \frac{1}{2^2} [(a - 1)(b + 1)(c + 1)]$$

$$\text{Main effect } B (\text{M.E } B) = \frac{1}{2^2} [-1 - a + b + ab - c - ac + bc + abc] = \frac{1}{2^2} [(a + 1)(b - 1)(c + 1)]$$

$$\text{Similarly, Main effect } C (\text{M.E } C) = \frac{1}{2^2} [(a + 1)(b + 1)(c - 1)], \text{ Interaction effect } BC = \frac{1}{2^2} [(a + 1)(b - 1)(c - 1)]$$

$$\text{Interaction effect } AC = \frac{1}{2^2} [(a - 1)(b + 1)(c - 1)] \text{ Interaction effect } ABC = \frac{1}{2^2} [(a - 1)(b - 1)(c - 1)]$$

Clearly, various factorials effects (Main and Interaction) in the 2^3 factorial experiments are linear contrast and orthogonal.

Method of Construction for Factorial Experiments Using Bipartite Graph

Step 1: Consider the set of vertices V of graph a G and distinct the set of vertices V into two subsets $V_1 =$ Replicate I, Replicate II, Replicate III and $V_2 = 100, 001, 111, 101, 110, 000, 011, 010$ are the replicates and treatments.

Step 2: Let the vertex $V_1 =$ replicate I is connected by the edge $V_2 =$ treatment combinations.

Step 3: Continue step1 let $V_1 =$ replicate II is connected by the edge $V_2 =$ treatment combinations.

Step 4: Then the vertex $V_1 =$ replicate III is connected by the edge $V_2 =$ treatment combinations.

Step 5: Similarly the same procedure is using to draw graph for all the different orders to get the bipartite graphs of factorial experiments.

Statistical Analysis of 2^3 Symmetrical Factorial Experiments

Let us suppose the 2^3 factorial experiments are conducted in RBD with r replicates. Let y_{ij} denote the observations corresponding to the i^{th} treatment and j^{th} replicates. Then, the linear model for 2^3 Symmetrical factorial experiments is denoted by

$y_{ij} = \mu + t_i + r_j + e_{ij} \quad i = 1, 2, \dots, 8 \quad j = 1, 2, \dots, r$ Where, y_{ij} is the observation corresponding to i^{th} treatment and j^{th} replicates; μ - refers general mean effect which is fixed; t_i -is the fixed effect due the i^{th} treatments; r_j - is the fixed effect due the j^{th} replicates and e_{ij} random error effect $N(0, \sigma^2)$. Then, the statistical analysis of 2^3 factorials experiments in RBD layout is same as that of simple RBD except that the sum of squares due to various treatments. Let T_{ijk} denote the treatments total of the treatment combinations a_i, b_j and $c_k (i, j, k = 0 \text{ or } 1)$. Then the sum of squares due to the various factorial effects (main / interaction effects) can be obtained from the Yates table of sign. The sum of squares due to main effect A is given by

$$A = \frac{\{-T_{000} + T_{100} - T_{010} + T_{110} - T_{001} + T_{101} - T_{011} + T_{111}\}^2}{N} \quad B = \frac{\{-T_{000} - T_{100} + T_{010} + T_{110} - T_{001} - T_{101} + T_{011} + T_{111}\}^2}{N}$$

$$C = \frac{\{-T_{000} - T_{100} - T_{010} - T_{110} + T_{001} + T_{101} + T_{011} + T_{111}\}^2}{N} \quad AB = \frac{\{T_{000} - T_{100} - T_{010} + T_{110} - T_{001} - T_{101} + T_{011} + T_{111}\}^2}{N}$$





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$$BC = \frac{\{T_{000} + T_{100} - T_{010} - T_{110} - T_{001} - T_{101} + T_{001} + T_{111}\}^2}{N} \quad AC = \frac{\{T_{000} - T_{100} + T_{010} - T_{110} - T_{001} + T_{101} - T_{001} + T_{111}\}^2}{N}$$

$$ABC = \frac{\{-T_{000} + T_{100} + T_{010} - T_{110} + T_{001} - T_{101} - T_{001} + T_{111}\}^2}{N}$$

In 2^3 factorial experiments the factorial effect that can be tested are $A, B, AB, C, AC, BC,$ and ABC . Thus, there are $2^3 - 1 = 8 - 1 = 7$ treatment combinations (Factorial effect) each with 1 df and they you raise to df is 7. The replicate has $(r-1)$ df and the total is $(2^3r - 1) = (8r-1)$. Then the error df can be obtain by, Error $df =$ Total $df -$ Replicate $df -$ Treatment $df = (8r-1) - (r-1) - 7 = 7r-7 = 7(r-1) = (2^3-1) (r-1)$. To test for the significance of any factorial effect (main / interaction effect) $F -$ test is used.

$$F = \frac{\text{Mean Sum Sqaure of factorial effect (Treatment)}}{\text{Mean Sum Sqaure Error}} \sim F_{1,7(r-1)} \text{ at } \alpha\% \text{ for a given level of significance.}$$

Thus, in a 2^3 factorial experiments of various factorial effects A, B, AB, C, AC, BC and ABC are mutually orthogonal to each with 1 df . Further, these factorial effects are tested by the same error variance. Hence various factorial effects (main / Interaction) are estimated with the same precision in the 2^3 factorial experiments.

Inference: The observed value of F is greater than the expected value of F for given level of significance then the null hypothesis of (equal factorial effect) any factorial effects (main / interaction). That is $F > F_{\alpha}$ at $\alpha\%$ level of significance is rejected. Otherwise it is accepted.

Applications

Construction of 2^3 Symmetrical Factorial Experiments using Bipartite Graphs

The experiment was conducted in RBD on paddy crop with three factors each at two levels. The factors were Table 02. The order of treatment combination is vpw . They are represented by the levels of the factors. Thus, 000 indicates the treatments combination $v_0p_0w_0$. The net plot size was 200 sq.m. The results is using complete bipartite graph in the following steps as;

Step 1: Let us consider the vertex $V_1 =$ replicate I is connected by the edge $V_2 = 100$ treatment combination through a 108.2 kg yields of paddy as; Figure 01.

Step 2: Continue the above step of vertex $V_1 =$ replicate I is connected by the edge $V_2 = 001$ treatment combination through a 128.9 kg yields of paddy as; Figure 02.

Step 3: Continue the above steps the vertex $V_1 =$ replicate I is connected by the edge $V_2 = 111$ treatment combination through a 116.8 kg yields of paddy as; Figure 03.

Step 4: Followed by above steps the vertex $V_1 =$ replicate I is connected by the edge $V_2 = 101$ treatment combination through a 112.4 kg yields of paddy as; Figure 04.

Step 5: Similarly, the same procedure to method of construction for $V_1 =$ replicate I, replicate II and replicate III and $V_2 = 100, 001, 111, 101, 110, 000, 011$ and 010 to get the factorial experiments using bipartite graph and table is given below; Figure 05 and Table 03.

Test whether there is any significant difference between yields of paddy with different levels?

Solution: Using the design expert statistical software normal and half-normal graph is given below; Table 04.

ANOVA Table Symmetrical Factorial Experiments (Table 05)

The model F -value of 5.35 implies the model is significant. There is only a 0.38% chance that an F -value this large could occur due to noise. P -values less than 0.0500 indicate model terms are significant. In this case V, W, VP are



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significant model terms. Values greater than 0.1000 indicate the model terms are not significant. If there are many insignificant model terms (not counting those required to support hierarchy), model reduction may improve your model.

Fit Statistics (Table 06)

The **predicted R^2** of 0.2006 is not as close to the adjusted R^2 of 0.5920 as one might normally expect; that is the difference is more than 0.2. This may indicate a large block effect or a possible problem with your model and/or data. Things to consider are model reduction, response transformation, outliers, etc. All empirical models should be tested by doing confirmation runs. Adeqprecision measures the signal to noise ratio. A ratio greater than 4 is desirable. Your ratio of 7.835 indicates an adequate signal. This model can be used to navigate the design space.

Coefficients in Terms of Coded Factors (Table 07)

The coefficient estimate represents the expected change in response per unit change in factor value when all remaining factors are held constant. The intercept in an orthogonal design is the overall average response of all the runs. The coefficients are adjustments around that average based on the factor settings. When the factors are orthogonal the VIFs are 1; VIFs greater than 1 indicate multicollinearity, the higher the VIF the more severe the correlation of factors. As a rough rule, VIFs less than 10 are tolerable. The following graphs are given below; (Figure 09 – 24).

CONCLUSIONS

In this paper, method for construction for factorial experiments using bipartite graph through numerical example. The simple experiments like *RBD* and *LSD* are only one factor can be tested at a time. If we want to more than one factor tested then we have to conducted separate simple experiments for each factor but factorial experiments is simultaneously to test more than one factors and interaction effects can also tested by using bipartite graphs.

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Table 1: ANOVA for 2³ Factorial Experiments in RBD (with layout of r replicates)

SV	df	SS	MSS	F - Ratio
Replicates	(r-1)	Q _R	$M_R = \frac{Q_R}{(r-1)}$	$F_R = \frac{M_R}{M_E}$
Treatments M.E A	2 ³ -1 = 7 1	Q _A	M _A =Q _A	$F_A = \frac{M_A}{M_E}$
M.E B	1	Q _B	M _B = Q _B	$F_B = \frac{M_B}{M_E}$
M.E C	1	Q _C	M _C = Q _C	$F_C = \frac{M_C}{M_E}$
Two – factor Interactions AB	1	Q _{AB}	M _{AB} = Q _{AB}	$F_{AB} = \frac{M_{AB}}{M_E}$
BC	1	Q _{BC}	M _{BC} = Q _{BC}	$F_{BC} = \frac{M_{BC}}{M_E}$
AC	1	Q _{AC}	M _{AC} = Q _{AC}	$F_{AC} = \frac{M_{AC}}{M_E}$
Three Factor Interaction ABC	1	Q _{ABC}	M _{ABC} = Q _{ABC}	$F_{ABC} = \frac{M_{ABC}}{M_E}$
Error	7(r-1)	Q _E	$M_E = \frac{Q_E}{7(r-1)}$	-
Total	(8r-1)	Q	-	-

Table 2: Construction of 2³ Symmetrical Factorial Experiments using Bipartite Graphs

Factors	Levels	
Paddy Variety	v ₀	ADI-31
	v ₁	Vaigai
Plant Production Schedule	p ₀	Old Practice
	p ₁	New Schedule
Irrigation Schedule	w ₀	Local Practice
	w ₁	New Schedule

Table 3: The factorial experiments using bipartite.

Replicate I	Treatment Combinations	100	001	111	101	110	000	011	010
	Yield	108.2	128.9	116.8	112.4	115.8	122.8	119.8	114.6
Replicate II	Treatment Combinations	110	111	011	001	101	010	000	100
	Yield	108.6	125.3	122.8	129.1	123.8	113.3	127.8	117.6
Replicate III	Treatment Combinations	000	010	001	011	100	111	110	101
	Yield	126.0	119.5	134.6	120.4	107.1	116.5	124.0	115.8





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Table 4: ANOVA Table Symmetrical Factorial Experiments

Source	Sum of Squares	df	Mean Square	F-value	p-value	Remarks
Block	61.06	2	30.53	-	-	-
Model	810.66	7	115.81	5.35	0.0038	Significant
A-V	320.47	1	320.47	14.81	0.0018	-
B-P	56.12	1	56.12	2.59	0.1296	-
C-W	154.53	1	154.53	7.14	0.0182	-
VP	272.70	1	272.70	12.60	0.0032	-
VW	0.2204	1	0.2204	0.0102	0.9210	-
PW	3.60	1	3.60	0.1666	0.6894	-
VPW	3.01	1	3.01	0.1391	0.7147	-
Residual	302.90	14	21.64	-	-	-
Cor. Total	1174.62	23	-	-	-	-

Table 5: Fit Statistics

Std. Dev.	4.65	R ²	0.7280
Mean	119.65	Adjusted R ²	0.5920
C.V. %	3.89	Predicted R ²	0.2006
		Adeq. Precision	7.8352

Table 6: Coefficients in Terms of Coded Factors

Factor	Coefficient Estimate	df	Standard Error	95% CI Low	95% CI High	VIF
Intercept	119.65	1	0.9495	117.61	121.68	-
Block 1	-2.23	2	-	-	-	-
Block 2	1.39	-	-	-	-	-
Block 3	0.8417	-	-	-	-	-
A-V	-3.65	1	0.9495	-5.69	-1.62	1.0000
B-P	-1.53	1	0.9495	-3.57	0.5072	1.0000
C-W	2.54	1	0.9495	0.5011	4.57	1.0000
AB	3.37	1	0.9495	1.33	5.41	1.0000
AC	-0.0958	1	0.9495	-2.13	1.94	1.0000
BC	-0.3875	1	0.9495	-2.42	1.65	1.0000
ABC	-0.3542	1	0.9495	-2.39	1.68	1.0000

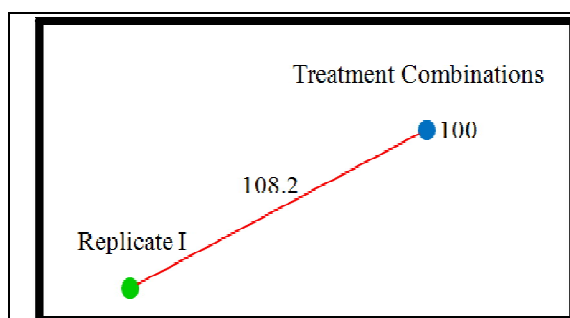


Figure 01

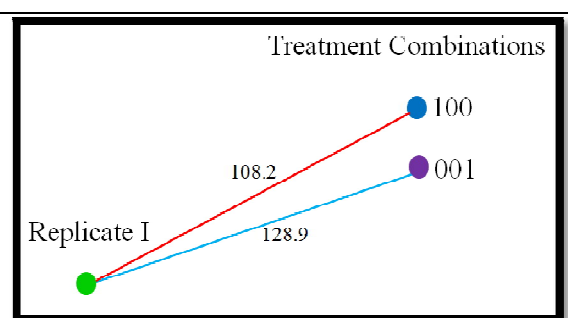


Figure 02





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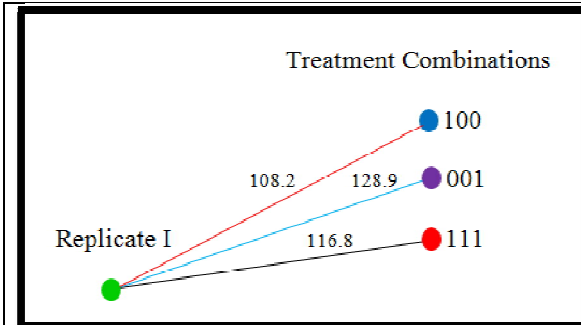


Figure 03

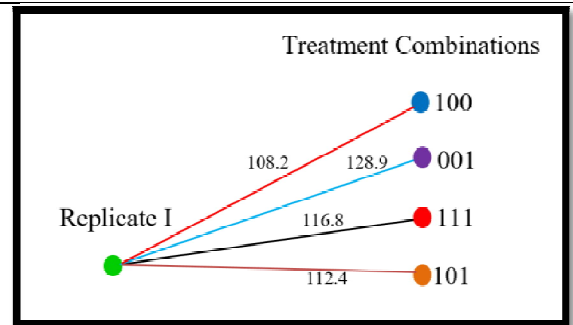


Figure 04

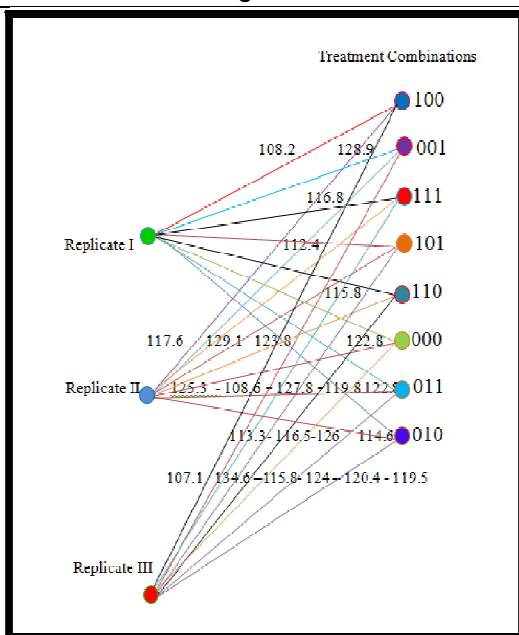


Figure 05

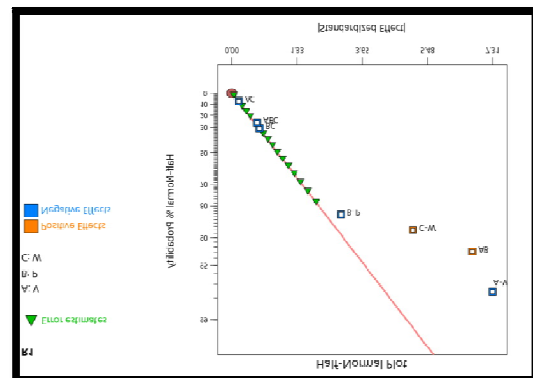


Figure 06: Half- Normal Graph

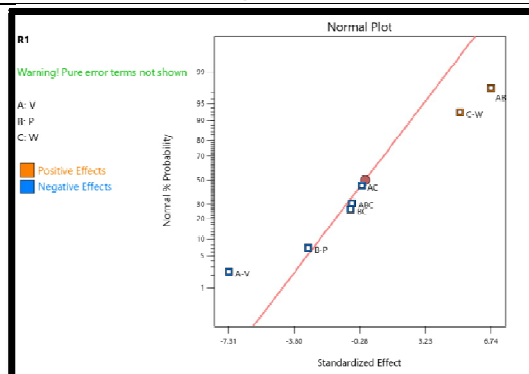


Figure 07: Normal Graph

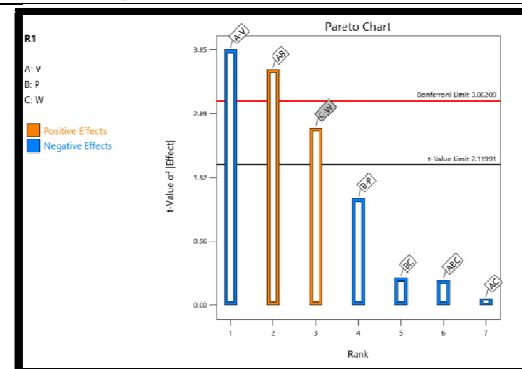


Figure 08: Pareto Graph





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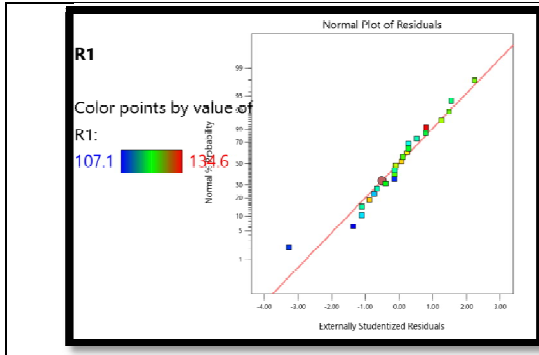


Figure 07: Normal Plots - Graphs

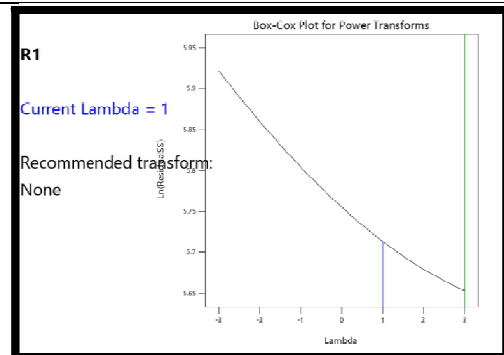


Figure 08: Box-Cox Plot Graph

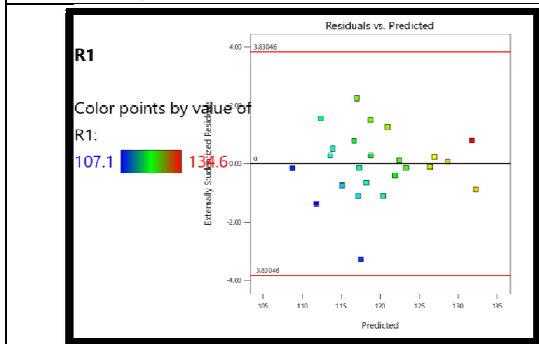


Figure 9: Residual vs Prettied Graph

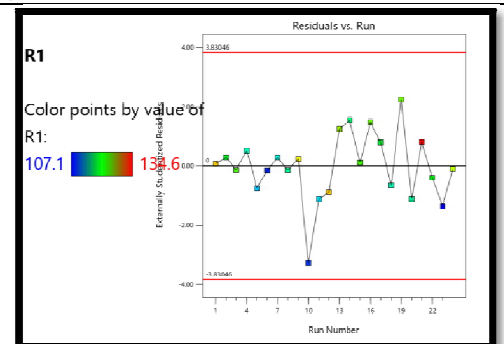


Figure 10: Residual with Run Graph

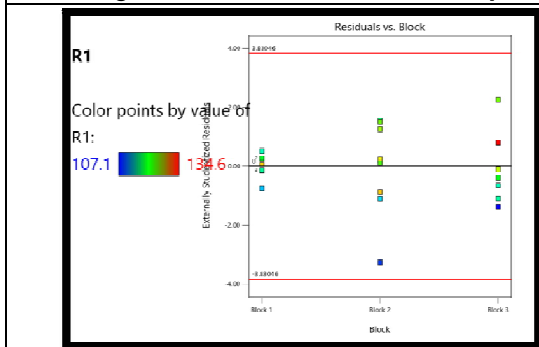


Figure 11: Residual vs Factor Graph

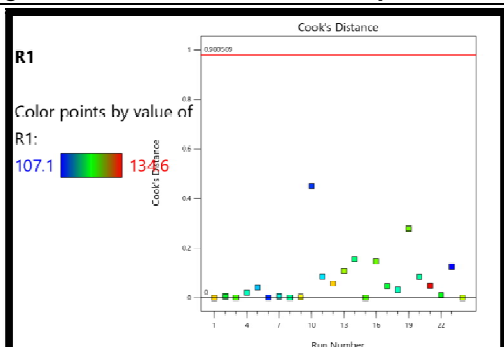


Figure 12: Cook's Distance Graph

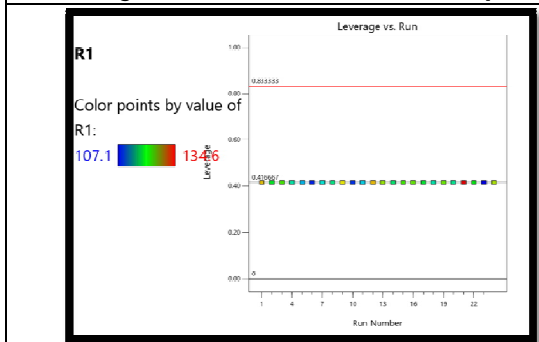


Figure 13: Leverage vs Run Graph

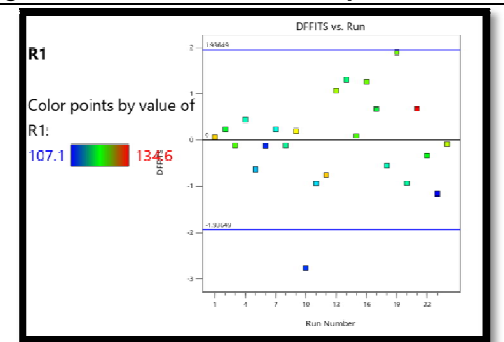


Figure 14: Dffits vs Runs Graph





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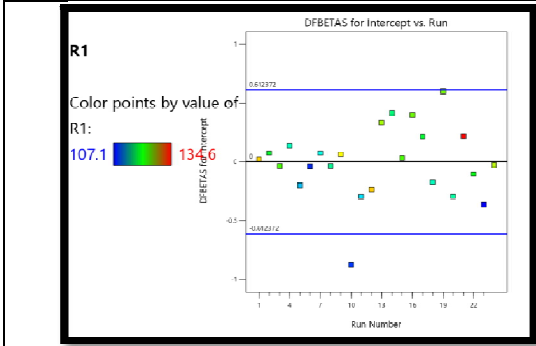


Figure 15: Debetas for Intercept vs Run Graph

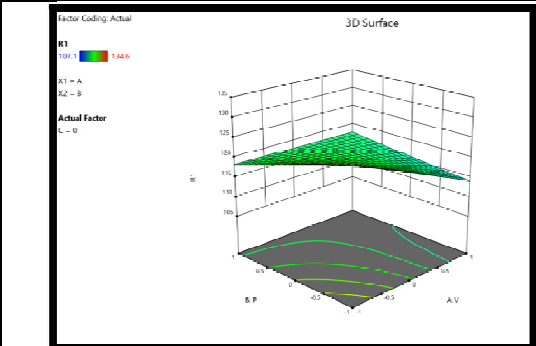


Figure 16: 3-D Surface Graph (V vs P)

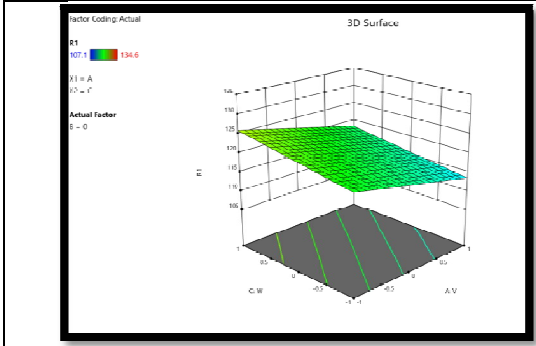


Figure 17: 3-D Surface Graph (V vs W)

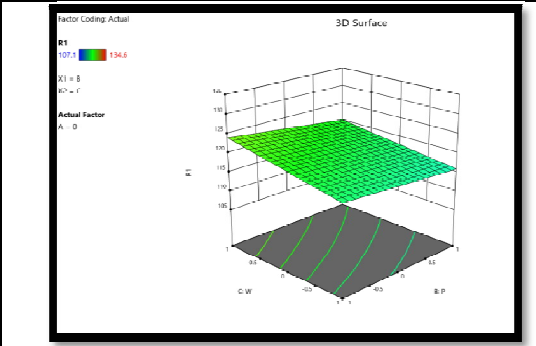


Figure 18: 3-D Surface Graph (P vs P)

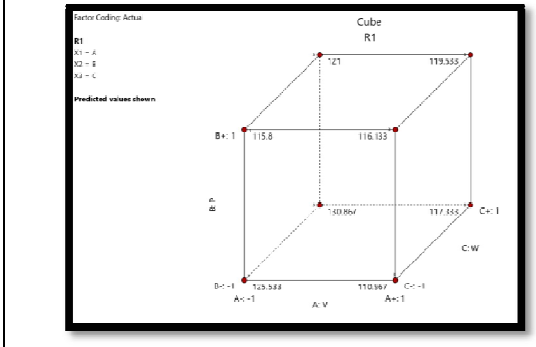


Figure 19: 3-D Surface (V vs W vs P)

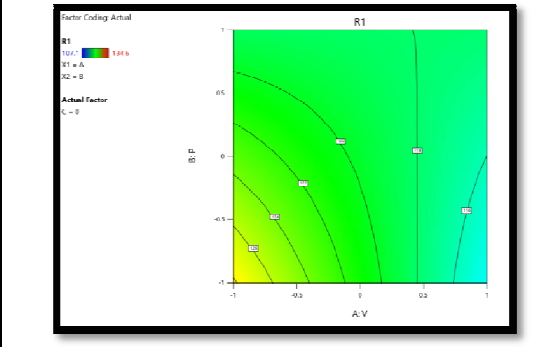


Figure 20: Contour Graph (V vs P)

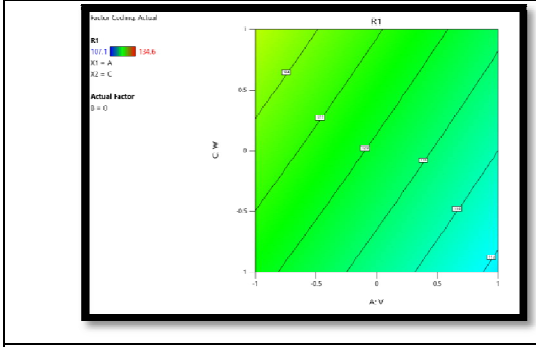


Figure 21: Contour Graph (V vs W)

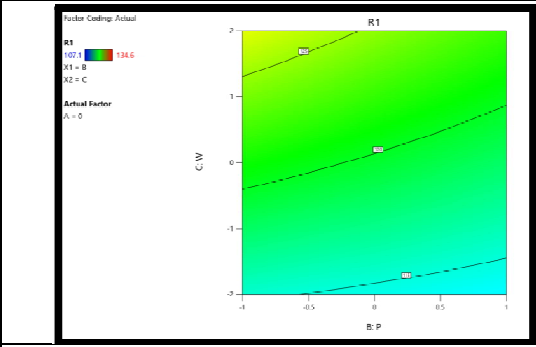


Figure 22: Contour Graph (W vs P)





The Status of Higher Secondary School Laboratories for Quality Education in Case of Krishnagiri, Southern India

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ABSTRACT

Practical activities are essential in all level of science education and in particular it is highly significant in Higher secondary schools. To evaluate the current implementation practices of laboratory activities we carried out a survey in Higher secondary schools of Krishnagiri Zone, southern India. The data were collected from two sources- primary and secondary sources of data. The Primary data was obtained from teachers and students with the help of interview schedule. From the research findings of this study conducted in Krishnagiri Zone, it is vividly evident that the quality of teaching and learning of science without laboratory is a parlous state.

Keywords: respondents, methodology, data analysis, laboratories.

INTRODUCTION

A high quality science education in Higher Secondary Schools contributes to developing scientific literacy and would be expected to predispose students to study the enabling sciences at university. "Generating higher levels of participation in science-related studies at university appears to be partly dependent on strengthening science education in secondary schools" [1, 2]. Science education imparts a method of inquiry and a systematic way of processing knowledge about the physical world [3]. For this reason, science education provides part of the foundation for any knowledge-based effort to improve health, nutrition, family planning, environment, agriculture, and industry. Practical work has been defined as an experiment performed by the teacher for demonstrations, or series of experiments and observational exercises carried out by the students to relate theoretical knowledge with practical activities done in the laboratory, classroom, field or elsewhere [4, 5]. Science is a practical subject. Science



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curricula should give students the opportunity to practice the processes of investigation in authentic contexts, and in secondary schools this should involve working in well-equipped and supported laboratory environments. Practical activities are essential in all level of science education and in particular it is highly significant in Higher secondary schools to help students in internalizing and understanding the theoretical knowledge of science fields such as Chemistry, Biology and Physics. To accomplish the goal of practical activities in science, the equipment and experiments have to be carefully selected to give students a relevant experience and also the understanding is enhanced if the activities are coming from the daily life of the students. Provision of relevant equipment and reagents is a necessary, but not sufficient condition for successful science teaching. Other factors such as the absence of trained laboratory technicians, suitability of equipment, commitments of teachers and education sector administrations distribution, etc., influence the quality of practical activities [6, 7].

Statement of the problem

A number of reviews and reports on secondary science education e.g., [4] have highlighted problems with engaging students' interest in the study of science and the teaching-learning method is less inquiry-oriented, and also the students less engage in practical science investigations. The chalk and talk nature of secondary science education is the poor method of teaching in 21st century. Today Science is more based on inquiry-oriented [4, 7]. Efforts to reform secondary science education through the implementation of practical and more inquiry-oriented pedagogy will only be effective if science teachers are supported with adequate laboratory facilities, science equipment and with high quality technical support. Higher levels of technical support will be required to implement a more inquiry-oriented and authentic science curriculum. Failure to implement a more engaging secondary science curriculum will see the continued drift of students away from the sciences in the secondary schools with serious consequences for university science enrolments and the quantity of trained professionals in science, engineering and technology that are needed to drive the country economy. Science laboratories are essential for the fulfillment of individuals needs as well as for the national growth. Science laboratories implementation requires above all qualified, well trained laboratory technicians, teachers and dedicated leaders; hence, assessing the resources and challenges in carrying out the science laboratory problems becomes unavoidable and necessary. Given that there has been no research conducted in Krishnagiri Zone on a zonal scale to investigate the status and quality of Higher secondary school science laboratory status, there is a need to investigate the nature of technical support, the role of technicians, the teachers commitment, the presence of equipped laboratory and how they are working, etc. needs a research.

Objectives of the study

1. To evaluate the current implementation practices of laboratory activities in Higher Secondary schools of Krishnagiri Zone.
2. To assess the preparations and experiences of schools in implementing practical activities as indicated in the student textbook.
3. To identify the major problems that hinders the implementation of practical work in Higher secondary schools of the study area.

METHODOLOGY

The data were collected from two sources- primary and secondary sources of data. The Primary data was obtained from teachers and students with the help of interview schedule. To substantiate the data obtained from the primary sources, documents such as annual plans and laboratory reports, annual reports, directives, journals and published and unpublished documents were reviewed and used as secondary sources of data. The data collection methods used was questionnaire, interview and observation in this study. A total of two hundred and seventy nine copies of the questionnaire were distributed to the respondents (Table-1). The researcher used excels software to calculate frequency counts and percentages to analyze the data from close-ended questions. The findings related to each research question were analyzed and discussed in relation to the review literature.





Data analysis

The collected data are analysed in six parts.

General Characteristics of the Respondents.

Implementation of laboratory activities in research schools.

Respondents' response on Facilities and Functions of Science Laboratories.

Laboratory technicians' cases.

Factors that Affect laboratory activities in secondary schools.

The rank of Suggested solutions to the problems.

General Characteristics of the Respondents

The subjects of the study were teachers, students and laboratory technicians at Krishnagiri Zone. The result on the table 2 below showed that most of the teachers have experience in their work and all of them have a qualification of M.Sc., B.Ed. Regarding to class size, most respondents indicated that the number of students within the class are 30-40.

Analysis of Data on Implementation of laboratory activities in research schools

This is part deals with the presentation, analysis and interpretation of data on the implementation of laboratory activities in the Higher secondary schools of Krishnagiri Zone. The result on the Table 3 above showed that all respondents (100%) reacted positively that laboratory activities are important for better understanding of science subjects. Similarly, the respondents agreed that science education is ineffective without laboratory activities. Generally science is a practical based subject that needs real environmental practice for better understand it. The result justified that promoting laboratory activities in science subjects provides students with increased access to understand the nature effectively.

Analysis of respondent's response on Facilities and Functions of Science Laboratories.

It was found from table 4,

Most schools have separate lab rooms for laboratory activities of each science subject. Teacher respondents rated the quality of building and furniture as very good in 75.6%, good in 6.7%, unsatisfactory in 10.1%, while it was in 7.6% was poor laboratories. For similar questionnaire, most of the student respondents said that the science laboratory buildings and furniture are poor (6.9%) and 53.1% respondents result showed unsatisfactory in secondary schools of the study area. 85(53.1%) students and 39(24.4%) teachers responded that their school laboratories were not well equipped with chemicals, apparatus and reagents based on the student text book. Only very small number of students 75(46.9%) and teachers 90(75.6%) responded that the teaching and learning process was not affected by the shortage/inadequacy of laboratory equipments and materials in their school. 28.7% students and 8.4% teachers responded that the laboratory activities were done in opposite shift from the normal class time as a makeup class. A few number of respondents result showed that the laboratory activities have its own period at normal students shift.

Analysis of Data on laboratory technicians' cases

This section of the analysis deals with an assessment on the presence or absence of laboratory technicians for science subjects, the way the schools tried to solve the problems associated with it in the Higher secondary schools of Krishnagiri Zone.

It was found from table 5,

100% teachers represented that there were no laboratory technicians in all schools. This shows that all of the secondary schools did not have laboratory technicians. But laboratory activities need a trained laboratory technician for its material managements and safety. 42% of teachers mentioned that the major reason given for having no technicians in secondary schools were lack of trained laboratory technicians in the market. Only a small number of schools gave budget constraints and unwillingness of schools/education units to recruit laboratory technicians as



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reason for having no technician. In all schools that did not have laboratory technicians; the most junior science teachers perform the duties of the laboratory technician. 8(6.7%) of teachers' satisfaction was low. From this it is possible to conclude that teachers' low or medium satisfaction can affect directly or indirectly the teaching learning process. The teachers' skills in assessing their students' learning depend also on how deeply they themselves satisfied on all the process in the school.

Factors that Affect laboratory activities in Higher secondary schools in Krishnagiri Zone

This part of the analysis was to assess the views of the teacher and school PVS responses on the factors that affect laboratory activities in the higher secondary schools of Krishnagiri Zone.

It was found from table 6,

Teachers responded that lack of adequate equipments and materials and lack of appropriate laboratory time/schedule share the highest points, 50.4% and 67.2% respectively as factors that affect laboratory activities in secondary schools of the study area. In regard to lack of teachers' commitment, teacher respondents rated it as the least factor (21.0%) that affects the practical activities in Higher Secondary Schools of Krishnagiri Zone. Teachers' lack of training, lack of students' interest and absence of reward for practical activity were also taken as factors that affect the effective laboratory activities in the study area. This implies that the major factors that affect teachers' performance in practical activities were lack of appropriate laboratory time/schedule, absence of reward, lack of necessary equipments and materials, teachers' lack of training and commitment.

The rank of Suggested solutions to the problems

Respondents were asked to rank the possible solutions to the problems of laboratory activities in Higher Secondary schools of Krishnagiri zone.

It was found from table 7,

Teachers were indicated that awareness training for teachers on laboratory activities and setting up a well equipped laboratory respectively were the high value sharing solutions for the laboratory problems. Training of laboratory technicians and material support (furniture, chemicals, and reagents) were also mentioned as important things to solve laboratory related problems in secondary schools of the study area. There were some practical suggestions such as preparation of time table for practical activities is important. The schedule for the laboratory activities is not only a problem of secondary schools of Krishnagiri zone but it is country wide problem which needs policy decision.

RECOMMENDATIONS

From the research findings of this study conducted in Krishnagiri Zone, it is vividly evident that the quality of teaching and learning of science without laboratory is a parlous state. Based on the findings of the study and conclusions drawn, the following recommendations were forwarded.

- Only theoretical teaching for science subjects is not effective. Therefore; it should be encompass a combination of lecture, accompanied by practical demonstrations and range of laboratories activities.
- Laboratory technicians should be appointed for all schools for effective learning. In order to develop competence in the area of laboratory skill, training for science teachers and laboratory technicians shall be actively given for effective and efficient laboratory activities.
- Science teachers should be motivated and supported by colleagues, school administration, parents and the larger community. Providing incentives for those technicians and teachers who work in laboratory effectively and efficiently is important to motivate themselves and to initiate other teachers too.
- Government must give great attention for school laboratory buildings, laboratory equipments, chemicals and reagents.
- All schools should have laboratories for science with adequate supplies of equipment and reagents for practical work in science. Also there should be laboratory assistants in all schools to help with the proper maintenance of





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laboratory facilities and equipment and also to assist in the preparation for practical experiments so that teachers include more inquiry-based practical work for students in science.

- There should be regular monitoring of all teachers in the school system to ensure accountability and quality education.

CONCLUSION

The results of the current study have shown that all respondents reacted positively that laboratory activities are important for better understanding of science subjects in the classroom. Practical activities have a long distinctive and central role in the science curriculum and science educators have suggested that many benefits accrue from engaging students in science practical activities. Specifically inquiry-type laboratories have the potential to develop students' abilities and skills such as: posing scientifically oriented questions, forming hypotheses, designing and conducting scientific investigations, formulating and revising scientific explanations, and communicating and defending scientific arguments.

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Table 1: Population and Sample Size of Respondents

Selected Hr. secondary Schools	Respondents			
	Teacher(B+C+P)*	Laboratory Technician	Students	Total
Sri Vijay Vidyalaya Matric HSC	(11+7+8)	-	20	46
Vailankanni Matric HSC	(10+7+6)	-	20	43
Kingsley Gardens Matric HSC	(4+3+4)	-	20	33
St. Kanakadasa Matric HSC	(6+4+5)	-	20	45
MTV Matric HSC	(4+2+4)	-	20	30
Selva Matric HSC	(5+2+3)	-	20	30
Bharath Matric HSC	(6+4+4)	-	20	34
Gonzaga Matric HSC	(7+4+4)	-	20	35
Total sample size	119	-	160	279

*B=Biology, C=Chemistry, P=Physics, HSC=Higher Secondary school



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Table 2. General characteristic of the respondents

No	Item		Respondents					
			Teachers (N=119)		Students (N=160)		Laboratory technicians (N=0)	
			No	%	No	%	No	%
1	Sex	M	59	49.6	80	50.0	-	-
		F	60	50.4	80	50.0	-	-
2	Work Experience (years)	<5	42	35.3			-	-
		5-10	77	64.7			-	-
3	Qualification	M.Sc., B.Ed.	119	100.0			-	-
4	No of students in class		30-40		6 schools		75%	
			40-50		2 schools		25%	

Table 3

No	Items	Choices (N=119)			
		Strongly disagree	disagree	agree	Strongly agree
1	Students should practice in lab for better understanding of your subject	-	-	49(41.2%)	70(58.8%)
2	Science education is effective without laboratory activities?	110(92.4%)	9(7.5%)	-	-
3	Science is a primarily a practical subject for addressing real situations.	-	-	3(6.7%)	116(93.3%)

Table 4

Item no	Description	Alternatives	Students (N=160)	Teachers (N=119)
1	Is there a separate room for biology, chemistry and physics laboratory works in your school?	Yes	130(81.3%)	110 (92.4%)
		No	30(18.7%)	9 (7.6%)
2	The quality of science laboratory buildings and furniture in secondary schools	Very good	28(17.5%)	90(75.6%)
		Good	36(22.5%)	8 (6.7%)
		Unsatisfactory	85(53.1%)	12(10.1%)
		Poor	11(6.9%)	9(7.6%)
3	Does your school science laboratory well equipped with chemicals, apparatus and reagents based on the student text book?	Yes	75(46.9%)	90(75.6%)
		No	85(53.1%)	39(24.4%)
4	When is lab session carried out in your school?	In its arranged period	114(71.3%)	109(91.6%)
		In opposite shift as make up class	46(28.7%)	10(8.4%)





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Table 5

Item no	Description	Alternatives	Teachers (N=119)
1	Is in your school laboratory technician for biology, physics and chemistry?	No	119(100.0%)
2	Reasons for not having laboratory technicians	Lack of trained laboratory technicians	50(42%)
		Budget constraints	14(11.8%)
		Unwillingness of schools/education units to recruit laboratory technicians	35(29.4%)
		Total responses *	99
3	Who is responsible for performing the duties of a laboratory technician?	Science Teacher	119(100%)
		Total responses *	119
4	Do and teachers get regular training on laboratory activities?	Yes	98(82.4%)
		No	21(17.6%)
5	The respondents' satisfaction on laboratory activities of the secondary schools	Very high	80(67.2%)
		high	70(58.8%)
		Medium	65(54.6%)
		Low	8(6.7%)

*Respondents gave more than one response

Table 6

Item	Descriptions	Teachers (N=119)
1	Absence of reward	28(23.5%)
2	Lack of appropriate laboratory time/schedule	80(67.2%)
3	Lack of adequate equipments and materials	60(50.4%)
4	Lack of teachers commitment	25(21.0%)
5	Lack of students interest	50(42%)
6	Teachers lack of training	32(26.9%)
*Total responses		150

*Respondents gave more than one response

Table 7

Items	Teachers' response (N=119)
Awareness training for teachers' on laboratory activities	98(82.4%)
Material support (furniture, chemicals, reagents)	20(16.8%)
Preparing schedule for laboratory per week	18(15.1%)
Setting up a well-equipped laboratory	10(8.4%)





A Pilot Study on Assessing the Quality of Educational Pamphlet Intervention Tool for Childhood Cancer Survivors and Caregivers

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ABSTRACT

The present study aims to develop and validate dietary pamphlets for pediatric cancer survivors and caregivers. There have been no research studies that validate the educational pamphlet intervention tool for childhood cancer survivors. 1) To validate the nutrition pamphlets. 2) To develop and formulate nutritional pamphlets. 3) To emphasize the nutrition benefits for both childhood cancer survivors and their parents. This study was quantitative research and snowball sampling carried out for three months. Study participants were selected based on the inclusion criteria and exclusion criteria. A total number of 9 experts were approached via social platforms. The five-point Likert scale was used better for scoring. The analysis part was quantified using the content validity index (I-CVI). Collected and analyzed the responses from the nine experts. The content validation was done by item-level content validity index (I-CVI). Item level content validity index (I-CVI) was calculated for nine experts, which was found to be 0.84. The modified final draft of the nutrition educational pamphlet where suggestions were incorporated was circulated by mail to nine experts. The developed educational tool was expected to ensure awareness and significant intervention for outpatient and inpatient childhood cancer follow-up.

Keywords: childhood cancer, survivors, pamphlet, nutrition education, validate.



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INTRODUCTION

India has made substantial development in childhood cancer treatment and nutrition care in the last few decades. However, current data showed the minor occurrence of childhood cancer exclusively in leukemia type. In high-income countries, 80% of children diagnosed with cancer will become long-term survivors; nevertheless, low- and middle-income countries, including India, have 90% of the pediatric population and more than 80% of the childhood cancer burden. According to population-based cancer registries, the age-adjusted incidence rate showed the highest childhood cancer rates of all types, both girls and boys, in Delhi, south India -Chennai, northeast India- Aizawl district, respectively [1,2]. Nutrition intervention and follow-up care is a significant area in Childhood cancer survivorship. The tremendous outcomes of Pediatrics cancer nutrition care have improved constantly over the past few decades [3]. In pediatrics, cancer has been diagnosed mainly at the age of 0-14 years and includes malignant neoplasms of various etiology: age, gender, civilization and geography. The Madras metropolitan tumor registry is a population cancer registry, one of the oldest registry networks in India. Consequently, the cancer registry data for children and survivors in Chennai are reliable compared to other registries. Age-standardized incidence of childhood cancers had increased by 2% per year among boys and 1% among girls in Chennai over the past two decades [4].

Childhood cancer registration is not obligatory in India. However, the childhood cancer method registration has been a vital source of prevalence, incidence, morbidity and mortality data, which will lead to understanding the etiology, prevention, and better improvement in evaluation and monitoring for childhood cancer survivors in their adolescent age group [5,6]. Acute lymphoblastic 80%, Lymphomas 10%, CNS 4%, and abdominal malignancies 6% are the most common cancer children were survivors compared to other types of cancer. The prevalence of malnutrition children cancer has not been complicated compared to the general population, but they are nevertheless at risk of becoming obese and overweight. A cohort study found that children who had cancer survivors of acute lymphocytic leukemia and those who received whole-body radiation therapy were at higher risk of late symptoms. Other outcome includes obesity, hyperlipidemia and diabetes mellitus among pediatric cancer survivors. The risk mechanism changes have variations in leptin, adiponectin, improper dietary intake and likelihood variations in the composition of the gut microbiota, which could be the repercussion of radiation therapy [7].

Treatment for the childhood cancer population does not mean children are in good nutritional status. After Completing the treatment protocols, children need adequate nutrition and clinical follow-up into adulthood to help determine the long-term effects of the cancer treatment. Unfortunately, the emphasis of healthcare programs has been towards reproductive health, communicable diseases, and malnutrition with inadequate attention towards the childhood cancer population. The present study focused on validating dietary pamphlets for pediatric cancer survivors to improve their healthy lifestyles.

Aim: The present study aim is to develop and validate dietary pamphlets for pediatric cancer survivors and caregivers.

Objectives: To validate the nutrition educational pamphlets. To develop and formulate nutritional pamphlets. To emphasize the nutrition benefits for both childhood cancer survivors and their parents.

Need of the Study

- Few research articles have been conducted to develop and validate nutrition booklets or pamphlets for different lifestyle-related diseases. Thus, there exists a lacuna in researches focusing on developing and validating dietary pamphlets, particularly for pediatric cancer survivors and caregivers.
- Although nutrition education is a combination of lifestyle changes in the advanced technology world, many traditional tools exist to teach a healthy lifestyle: nutrition booklets, handbooks, guidelines, and at an advanced level are podcasts, websites, mobile app, and blogs.



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- However, the general public still prefers written material pamphlets, which is easy to access and illustration model ease to understand the subjects. Hence, this study focused on developing and validating dietary pamphlets for pediatric cancer survivors to improve their healthy lifestyles.

MATERIAL AND METHODS

Sample size: 9 experts

Study design: Quantitative research and snowball sampling.

Study duration: The study period was from July to September 2021.

Assemble and create the content of nutritional educational material

Phase I Establish the goals of developing the questionnaire for evaluation and collecting responses from panel reviewers

In the primary stage, the Research investigator developed the formal questionnaire. After that, standard questionnaire contents were cross-checked with research experts. After obtaining inputs from experts approved questionnaire has been developed as a google form. At the same time, generating the questionnaire in terms of the five-point Likert scale helped better for scoring. The content of the nutritional education pamphlet features an in-depth review of the literature. The questionnaire was validated for the following 1) content of the pamphlet, 2) need of nutrition pamphlet for childhood cancer survivors 3) easy to access and understand 4) illustration of the pamphlet. Study panel experts were contacted via Linked in and other social platforms. A panel of experts was included from various geographical locations to reduce bias and to follow linguistic terms. In addition, the questionnaire was disseminated via email to as many nutritionists and pediatric oncologists, i.e., 60 experts. Based on their suggestions, the researcher modified the pamphlet design and content. It undertook several revisions before the final draft. The revised final draft of the nutrition educational pamphlet was circulated by mail to nine experts who had a minimum experience of 10years, along with an acknowledgment letter covering the intention of validating the nutritional pamphlet for childhood cancer survivors (Figure 1).

Criteria for sample selection:

Inclusion criteria:

- Nutritionists and oncology pediatricians were included in the study.
- Subjects with more than 10years of experience in the field of nutrition and pediatric oncologist.

Exclusion criteria:

- Subjects with less than 10years of experience in the field of nutrition and pediatric oncologist were excluded.

Phase II Validation of nutrition educational tool and translation process

The pamphlet involves adobe photoshop, Canva and Microsoft power point. The nutrition educational pamphlet agenda has been divided into two headlines with pictorial representation 1) Macronutrients (Carbohydrates, Protein, Fat) and 2) Micronutrients (Vitamins, Minerals, immune nutrients) and fiber as given in Fig.1. Based on the scientific research best practice tool, content validation was done by item-level content validity index (I-CVI). After finalizing, the nutrition educational pamphlet was translated to the regional language (Tamil) by two experts in the regional language (Figure2). Finally, both versions of Tamil and English pamphlets were provided to the general population, particularly bilingual experts, to improve layman terms and understanding for caregivers of childhood cancer survivors.

Ethical Consideration

The committee has provided ethical clearance for the present study (REF: IEC/19/AUG/153/59). Therefore, the research proposal was approved by the institutional ethical committee.



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The analysis part was quantified using the content validity index (I-CVI). The calculation and analysis part was organized in the Microsoft Excel 2019 version. While calculating I-CVI values, relevance rating must be recorded as one if a scale between 3 to 5 is considered one and 1 or 2 considered zero.

RESULTS

All experts gave feedback and the content was analyzed. Four pediatric oncologists and five nutritionists were involved in the validation process. The subjects selected for the study were of both genders ranging from 30-50years. Four experts were 100% satisfied with all the questions and gave a positive response. All experts agreed with (Q1, Q2, Q7, Q9) shown in (table1). Content validity is the degree to which fundamentals of an assessment are relevant and meaningful for specific evaluation purposes [8,9]. For example, a survey study conducted among hospital nurses showed that many hospitals do not have nutrition educational pamphlets for childhood cancer children. Based on research articles, using I- CVI is a good choice for quantifying content validity [10]. The present study validation performed by the experts' results showed I-CVI is 0.84 its explained perfect level of agreement for the pamphlet's content (table 2).

DISCUSSION

Lack of educational brochures on nutrition for many diseases affects the population after treatment. Nutrition education is a vital resource to the patients and their caregivers, and it will help improve the knowledge about the health status and quality of life of the patients. Lack of communication between the therapists and patients after discharge, printed educational manuals are very easy to access to the population and their caregivers. As also found in the descriptive study, the informative, educational brochure provides greater clarity on the topics and strengthens the community [11]. The survey study results showed ICVI of 0.95, SCVI of 1.0.91 and 0.91 for the domains of relevance, purpose and content, respectively. The booklet had categories of myths and taboos as well as the prevention and importance of diagnosis [12]. The validation study on evaluating and validating educational videos in the prevention of diarrhea in children. The CVI value was 0.97 for content relevance [13].

Another validation study was the evaluation of an educational manual for maternal breastfeeding. I-CVI, which had been calculated at 0.97 excellent rates [14]. The validation of educational booklets for individuals with HIV study results showed a more significant 0.8 I-CVI, 100% of content to be understood and relevant 95%. The booklet is evidence-based on tremendous resources for HIV patients [15]. Comics story-based educational technology was used breastfeeding guidance for schoolchildren. Practical and theoretical relevance CVI was showed greater than 0.80. In terms of language clarity, values of CVI 0.90 were obtained. The experts well thought about educational technology appropriate, attractive and logical for the audience [16]. Evaluated the educational booklet for preventing HIV-vertical transmission, CVI value 0.87 was found and level of agreement 91.1-100% was excellent target population response [17]. Nowadays, wide-ranging communities are comfortable with virtual nutrition consultation, authentic nutrition podcasts, healthy lifestyle news magazines. However, diet brochure, booklets and posters, on the other hand, have their own audience. Nutrition intervention counseling and pamphlets are predominant to children with cancer pre and post-treatment, even in palliative care settings. The current pilot study is a small portion of ongoing research.

CONCLUSION

This study described the development and validation of the dietary pamphlets. The developed educational tool was expected to ensure awareness and significant intervention for outpatient and inpatient childhood cancer during



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follow-up. However, based on this research, educational technologies do not replace written pamphlet education and face-to-face counseling. To the superlative of our knowledge, there is no publication-related nutrition educational pamphlet for childhood cancer survivors and their caregivers to understand the subjects need to know for better take care of their child. Future research will elaborate on this pilot study to evaluate the efficacy of this pamphlet in a target population.

Contributor ship Statement

First author conceived, carried out the study and writing part, edited the manuscript, corresponding author supervised the manuscript edited and coauthor supported the work.

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Conflict of Interest

The authors declare no conflict of interest.

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Table :1 Relevance ratings on the item scale by nine experts of Nutrition educational pamphlet.

Question	Expert 1	2	3	4	5	6	7	8	9	Number of Agreement
Q1	1	1	1	1	1	1	1	1	1	9
Q2	1	1	1	1	1	1	1	1	1	9
Q3	1	1	1	1	0	1	1	1	1	8
Q4	1	0	1	1	1	1	1	1	1	8
Q5	1	1	1	0	1	1	1	1	1	8
Q6	0	1	1	1	1	1	1	1	1	8
Q7	1	1	1	1	1	1	1	1	1	9
Q8	1	0	1	1	1	1	1	1	1	8
Q9	1	1	1	1	1	1	1	1	1	9
Q10	1	1	0	1	1	1	1	1	1	8

Table: 2 Questions and content validity index (I-CVI) of nutrition educational pamphlets.

S.no	Question	Context validity index (I-CVI)
1	Would you like to recommend nutrition-related pamphlets for patients?	0.9
2	Is the content of the pamphlet adequate?	0.9
3	Is the content of the booklet clear and readable?	0.8
4	Is the pamphlet easily understandable?	0.8
5	Are the content and presentation of the brochure appropriate?	0.8
6	Do you find the pamphlet informative?	0.8
7	Can this nutrition pamphlet be suggested for childhood cancer survivors?	0.9
8	Is this pamphlet a supportive guide for children who completed treatment?	0.8
9	Do you find pamphlets helpful to acquire nutritional information for a childhood cancer survivor?	0.9
10	How would you rate the overall pamphlet?	0.8
	Scale content validity index (S-CVI) = Average of I-CI	8.4/10 =0.84*





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Figure 1 . Nutritional education pamphlets for pediatric cancer survivors and caregivers



Figure 2. Nutritional education pamphlets for pediatric cancer survivors and caregivers





Study of Stability in Cosmetic Preparation and Effect of Different Components in Stability - A Review

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ABSTRACT

The stability of pharmaceutical products may be a broad area that encompasses many potential routes of degradation. Stability Testing is that the process for determining, through storage at defined conditions and testing at specific intervals, how long a drug substance or product remains safe and effective at particular storage conditions. within the life sciences, chemical, and food and beverage sectors, stability studies are conducted to research the impact of environmental variables on product quality. The period of time of a product and also the viability of its formulation are both stricken by environmental factors. Stability testing is employed to indicate how the life of Pharmaceutical Ingredient (API) or Finished Pharmaceutical Product (FPP) changes over time as a results of various environmental conditions like temperature, humidity, and light. The research of product-related aspects that influence quality, like API interaction with excipients, container closing systems, and packaging materials, is a component of the soundness programme. These studies provides better storage conditions and also gather information during preformulation stage to supply a stable product.

Keywords : Stability , Cosmetic preparation , Stability Studies , Stability testing

INTRODUCTION

The quality, safety, and efficacy of drug formulations are all ensured by the stability of pharmaceutical products. It is a lengthy process that necessitates a significant investment in terms of money, effort, and scientific knowledge in order to achieve the desired level of quality [1] .



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Pharmaceutical analysis and stability studies, which are necessary to determine the identity, potency, and purity of components, are key phases in the development stage. A pharmaceutical product's stability refers to the formulation's ability to stay within its physical, chemical, microbiological, toxicological, and protective requirements in a certain container or closure system. The expiry duration or shelf life of a pharmacological preparation is a measure of its stability. All pharmaceutical products have a shelf life that is an important quality factor. Changes in content consistency, appearance, and environmental conditions like as temperature, humidity, and pH can all affect the product. The physical changes due to the impact of vibration, abrasion and temperature fluctuations and also oxidation, reduction reactions may lead to formation of degradation product [2]. This is because the pharmaceutical product should follow the guidelines issued by Regulatory bodies like ICH, WHO, or other regulatory agencies. USP defines stability of pharmaceutical product as " extent to which a product retains within specified limits and throughout its period of storage and use (i.e.shelf life) "

In case of pharmaceutical preparation different types of stability can be considered they are :

- 1) Chemical Stability - Each active ingredient retains its chemical integrity and labelled potency within the specified limit.
- 2) Physical Stability - The properties like appearance, palatability, uniformity, dissolution and suspend ability are retained.
- 3) Microbiological - Sterility or resistance to microbial growth is retained according to specified requirement.
- 4) Therapeutic - Therapeutic activity remain unchanged.
- 5) Toxicologic - No significant increase in toxicity occurs [3].

IMPORTANCE OF STABILITY STUDIES

- ✓ Establish shelf life for the drug product
- ✓ Determine Container closure system suitability
- ✓ Provide evidence as to how the quality of the drug product varies with time.
- ✓ Assure to the patient economic considerations legal requirement
- ✓ Determine recommended storage conditions [4].

Stability of cosmetic preparation

❖ Effect of different ingredients

1) The topical application of L-ascorbic acid (vitamin C) is not a new practise. Because of its numerous beneficial effects on the skin, it has long been employed in pharmaceutical and cosmetic preparations. It is widely known that the structural features of formulations influence the stability of all vitamin C derivatives. Liposoluble derivatives, such as IPAA, are able to penetrate the skin better and have good stability when compared to vitamin C free form. Patricia M.B.G. Maia Campos et al. undertook a study to assess the chemical stability as well as the preclinical and clinical efficacy of dermocosmetic formulations containing IPAA for skin hydration and microrelief. IPAA was the first lipoidic-liqui form vitaminC derivative and is one of the most often used ascorbic acid derivatives in cosmetic formulations. Accelerated storage conditions, such as temperature variation, are commonly used in stability prediction to cause rapid chemical changes in formulations. Formulation samples were kept at ambient temperature or in uncontrolled temperature incubators with humidity and photoperiod controls set at 37° C or 45° C. Aliquots were examined for IPAA concentrations at 7-day intervals over a 35-day period (short term stability). Long-term stability tests were done 90 and 180 days following storage at room temperature to validate the results of the accelerated stability studies. 1 percent IPAA was applied to each volunteer's face and forearm daily for 15 days in the trial. Prior to beginning the measurements, the individuals were acclimatised for 30 minutes in a temperature and humidity controlled setting (20–22° C and 45–55 percent, respectively). The measurements were taken before (baseline values), 3 hours after (immediate effect), and 15 days thereafter (long term effect). Long-term stability investigations (over 6 months at room temperature) backed up the duration anticipated in accelerated stability assessments, with less than 15% of IPAA lost after 6 months. Furthermore, it was discovered that when the formulations were held at 37° C for 3 months, less than 15% of the IPAA was lost. After 6 months at ambient

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temperature or 3 months at 37^o C, the formulation showed no physical, physicochemical, or organoleptic changes, losing no more than 15% of the active component. From this, it appears that tetraisopalmitoyl ascorbic acid, a fat soluble vitamin C derivative, has good stability, with a shelf-life of 6–12 months for formulations containing the ascorbic acid derivative tested [5].

2) In the case of cosmetics, customers have indicated a strong desire for natural goods, prompting the cosmetics business and scientific community to look for alternate sources and raw ingredients. The stability of cosmetic emulsions made with natural ingredients such as wine, grape seed oil, and mastic resin was investigated. Both wine and grapeseed oil are made from natural ingredients. Natural antioxidants like flavanoids, natural colourants like anthocyanins, and natural fragrance components like terpenes and esters are abundant in red wines. Grape seed oil is a high-quality dietary oil that contains a high amount of unsaturated linoleic acid, vitamin E, and phytosterols. The oil-to-water ratio in the emulsions prepared by Pelagia Glampedaki et al was 20:80 (v/v), while the wine concentrations in the aqueous phase were in the range of 5–100 percent (v/v). The emulsifying agent was glycerol monostearate. The emulsion stability is measured by determining droplet size and measuring surface tension and interfacial tension, among other things. Surface tension measurements of the aqueous phase with a Sigma 70 tensiometer (KSV Instruments Ltd., Finland) and interfacial tension measurements of the two-phase system with a K6 tensiometer (Krüss, Germany) at 25°C using various dilutions of both white and red wine with the best emulsifier. Because of the wine's high content in phenolic compounds, which have antioxidant ability, including a sufficient concentration of p-OH-benzoic acid derivatives, which could operate as natural preservatives, larger quantities of red wine show no mould development or other surface changes. The ideal percentage of wine addition in the droplet research for both series of emulsions, white and red, was 20% (v/v), which might be attributable to the identical ethanol content of the two wines, and in the preparation combined with 2% (w/v) mastic resin. Due to the presence of the resin, the oil droplets in both emulsions are larger. These compounds may interact with glycerol monostearate (GMS) in the film structure, expanding it due to their bulky stereochemistry. However, the observed increase in oil droplet size in the presence of the resin did not result in the two-phase systems being unstable. Natural substances may also have an impact on cosmetic preparation stability [6].

3) verbascoside, is a caffeoyl phenylethanoid glycoside in which the phenylpropanoid caffeic acid and phenyletanoid hydroxytyrosol form an ester and an ether bond. The antioxidant, anti-inflammatory, and photoprotective characteristics of a phenylpropanoid glycoside are well-known. *Buddleia davidii* meristematic cells were used to make verbascoside, which was done utilising a sustainable biotechnology platform that uses in vitro plant cell culture technology. The high hydrophilic character of verbascoside led us to investigate its derivatization to get the semi-synthetic derivative VPP, an acyl derivative of verbascoside, which has a limited range of probable applications. Stability Studies of Verbascoside, a Novel Antioxidant, in Dermo-Cosmetic and Pharmaceutical Topical Formulations were carried out by Silvia Vertuani et al. Verbascoside and VPP in various aqueous solutions were used to make the samples. Verbascoside was soluble in EtOH/H₂O (80:20) and buffered aqueous solutions with pH values of 5, 6, and 7, respectively. Only the EtOH/H₂O mixture was able to dissolve VPP. The samples were divided into two groups: dark (naturally kept in the absence of light) and oven (accelerated ageing in a 40 °C oven). Various formulations of verbascoside and VPP were treated to accelerated ageing in a 40 °C oven. Three distinct formulations comprising 0.3 percent of the active component were used in the study. On both verbascoside and VPP, the HPLC with the goal of assessing their composition over time was exposed to accelerated ageing in an oven at 40 °C. For both verbascoside and VPP, alternative formulations and pH conditions were examined in this study. The stability of verbascoside is influenced by the formulation composition and pH values. In the dermocosmetic and medicinal domains, the stability and antioxidant capabilities of verbascoside and its derivative VPP produced through a synthetic alteration should be of great interest in order to study their potential as cosmeceutical and pharmacological components [7].

4) From a thermodynamic standpoint, cosmetic emulsions, like other macro emulsions, are intrinsically unstable systems. Cosmetic goods, unlike medicinal ointments, must penetrate deep into the skin, whereas emulsions are only intended for the skin's immediate surface, i.e. the epidermis. Organic cosmetics are often known as eco-friendly



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cosmetics. *Calendula officinalis* L. (Asteraceae), popularly known as marigold, is an annual herb native to the Mediterranean region. *Rosmarinus officinalis* L. (Lamiaceae), commonly known as rosemary, is a household plant used internationally as a food flavouring agent and is extensively distributed in the Mediterranean region. These ancient botanicals offer an intriguing, largely untapped source of possible new cosmetics creation. A Stability Study of OW Cosmetic Emulsions Using *Rosmarinus officinalis* and *Calendula officinalis* Extracts was undertaken by Evi-Maria Varka et al. Olive oil was used in this project, and olive oil is a natural oil. GMS was chosen as the emulsifier since it is an environmentally benign emulsifier that is extensively used in lotions, creams, powders, and other products. Emulsification was achieved by mixing water or water extract with olive oil or oil extract in a glass tank with a 9.5 cm internal diameter and an impeller spinning around the centre axis.

The higher the creaming index value in an emulsion, the more destabilised it is. Emulsions containing *Calendula officinalis* extracts are more stable than those containing *Rosmarinus officinalis* extracts, owing to lower creaming index values (results were not changed up to 30 days for *Calendula officinalis* emulsions). In both situations, emulsions with oily extracts were the most stable. The evolution of the creaming index has two distinct characteristics: Creaming rate reduces as oil phase is enriched with oil extract; creaming rate lowers as emulsifier concentration increases. Droplet size decreases when GMS concentration rises and emulsions are enhanced with herbal extracts, much as it does in droplet size distribution. *Calendula officinalis* emulsions have higher droplet size stability (smaller droplets) than *Rosmarinus officinalis* emulsions, and *Calendula officinalis* emulsions have remarkable pH stability over time. The combined processes of droplet coalescence and droplet breaking produce the droplet size distribution that results from the emulsification method. Due to a reduction in the effective interfacial tension of the droplet, the presence of surface active components in herbal extracts inhibits coalescence (stabilising the water film between colliding droplets) and improves breakage. As a result of the interaction of these factors, smaller droplets and more stable emulsions are produced. Herbs in cosmetic emulsions can improve the stability of emulsions without the need for additional chemical stabilizers [8].

5) When compared to alternative preparations containing only one of the vitamins, combined vitamins in a single formulation exhibited a somewhat reduced degradation rate. The importance of chemically stable ester derivatives of vitamins A, C, and E in achieving adequate outcomes in skin ageing treatments has piqued curiosity. The current work, according to Mirela Donato Gianeti et al, could aid in the development of more stable liposoluble vitamin formulations. Because the ester forms of vitamins A, C, and E are more stable, studies have shown that they are effective in cosmetic compositions. When vitamins are taken together, they may have a synergistic effect. To ensure the stability of cosmetic formulations including vitamins, physical and chemical aspects of the vehicle, such as pH and water content, as well as the combination of active components, should be taken into account. The most essential parameters in physical stability are rheological properties, which define spreadability characteristics. The results demonstrate that the formulations displayed pseudoplastic behaviour, with a flow index of less than 1, which was unaffected by adding vitamins to the vehicle formulation. Furthermore, the addition of vitamin derivatives had no effect on the perceived viscosity or consistency index of the formulations. Furthermore, storage between 37 and 45 °C resulted in no changes.

The method adopted to verify chemical stability of the formulations included in the study was HPLC with UV detection. Different degradation kinetics for vitamins A, C, and E were observed in formulations containing vitamins, either alone or in combination. When these vitamins were mixed in one formulation, their deterioration rate was marginally lower than when they were stored separately, at 45 and 37 degrees Celsius and 75 percent relative humidity. In terms of stability, the vitamin combination outperforms the vitamins individually. Formulations containing vitamins A, C, and E were preserved in PVC pots (37 mm in diameter x 29 mm depth) for up to 189 days at 45, 37, and 25 °C and 75 percent relative humidity (RH). Physical characteristics, which are highly important in the production of topical formulations, were examined in the stability studies, and the formulations studied exhibited satisfactory stability. The chemical stability of formulations including vitamin derivatives in combination was improved. As a result, it is more appropriate to design more stable formulations combining liposoluble vitamin derivatives in combination [9].



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The Indian standards for cosmetic in most cases require that the manufacturer should declare “Best Use Before.....(month /year) .In case of drugs and pharmaceuticals there are international regulatory guidelines eg: WHO Stability guidelines .But there are no regulatory guidelines for cosmetic products .However European Cosmetic , Toiletry and Fragrance Association (CTFA) and Cosmetic Toiletry and Perfumery Association (COLIPA) have published guidelines as stability testing cosmetic products.

Stability Testing of Cosmetics

General Preservation Tests

Temperature preservation Tests

In this test cosmetics are stored at different temperatures and observation are made in the different properties of cosmetics. Temperature at which cosmetics should be stored is dependent on the climatic conditions of the area in which cosmetics are to be marketed. For warm and hot region temperatures such as room temperature 45°C and 50°C etc may be included in the storage conditions.

Parametres to be observed may include

- ◆ Changes in extrenal apperance
- ◆ Changes in fragrance
- ◆ Physicochemical properties eg: pH , Viscosity , Turbidity etc...

Stability studies should be carried out in the same container in which the product is to be ,marketed. The other point that may be considered is decrease in amount of cosmetics with use exposing the product to more air.

Photostability test : Cosmetic can be exposed to light of varying degree during window display. It is important for a cosmetic product to be photostable.

- a) Outdoor exposure test - Cosmetic can be exposed to mid summer sun for a number of days or weeks.
- b) Inside exposure test - The variations in outdoor exposure can be minimized by using artifical light having spectrum close to natural light. Normally xenon arc lamp is commonly used .The stability is evaluated as the degreee of colour charge ΔP compared with controls ie , unexposed samples.
- c) Fluorescent light exposure - Cosmetic under study is exposed to fluorescent light.

General Performance and Effectiveness Tests

To evaluate any deterioration in the original performance and effectiveness of each type of cosmetics. In case of

Skin care cosmetics : change in texture, change in lasting quality , covering power ,luster colouring ability.

Cosmetic for nails : change in luster , drying speed etc.

Aerosol Stability Tests

In case of areosol cosmetics they are composed of two components , namely concentrate , and propellent. There are many problems which may attributed to the structure and materials of the valves and concentrate.

1. **Corrosion test** - Aerosol container should be left up right and inclined for short term and long term at room temperature and at elevated temperature.
2. **Leakage test** - To carry out leakage test , fill the aerosol container with a pre determined measured test weight. The container should be left up right ,horizontal and inclined at room temperature for long and short term periods. In event of leakage there would be loss in weight.
3. **Blockage test** - Both low and high temperature s should be selected.

Accelertaed Stability Test

1.**Temperature and humidity Combination Tests** - Cosmetic should be stored at predetermined temperature and humidity.

2.**Cyclical Temperature Tests** - In which the temperature and humidity are not fixed .It will be changed cyclically every day.





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3.Stress Test - This test have been designed taking into consideration the overall stress and time period of actual usage. This test indicates the stable life span of the product from physical changes induced by stress over a fixed level [10].

The signs of cosmetic product instability you should be looking for when you're testing your formulations: 1.Your

Your formulation changes colour

Maintaining a product's colour throughout its shelf life is a critical part of ensuring that your product's formulation is stable. If your formulation starts to lose its colour, then this is a sign of cosmetic product instability.

Your formulation loses its fragrance

The scent of a cosmetic product is often one of the biggest drivers behind your customer buying it. After all, no one wants to put a smelly formulation on their skin.

A reduction in scent intensity is generally deemed to be acceptable in a formulation (unless it's a perfume), but when the actual nature of the scent itself changes this could be a sign of chemical or microbial changes in the product.

Your formulation has separated

One of the biggest challenges faced by formulators making emulsions is ensuring that those emulsions remain stable. If your emulsion isn't stable, then over time you may start to see the water and oil splitting away from each other again.

Your formulation's pH has shifted

If your product's pH shifts over time, then it may not only cause damage to your customer's skin, but it may also render the preservative inactive and leave your product wide open to microbial contamination.^[11]

CONCLUSION

We came to the conclusion that stability is the most important factor in any formulation. The change in stability of the product may affect its usage and lead to serious consequences. The products should be confirmed all levels of stability in trials and studies. If any interruption occurs, it will be confirmed and reported. Each ingredient in the preparation plays a pivotal role in the stability of the product. During this time, some agents will improve stability, while others may reduce compatibility or make compatibility less stable. The use of both natural and synthetic agents will enhance the stability of the product. But its quantity and effectiveness may be affected by the preparation. The active constituent may be involved in the activity. In addition, stability studies under various conditions are required prior to marketing. Otherwise, the appearance, odour, and other physical features of cosmetic products will be varied, so manufacturers should do an accurate test study. Stability tests are carried out so that recommended storage conditions and shelf life can be included on the label to ensure that the medicine is safe and effective throughout its shelf life. Cosmetics are a popular and widely used human preparation for body parts. So safety is important That's why the manufacturers should guarantee the product quality. And the area of preparation, ingredients, climatic conditions, all the factors should be thoroughly checked to ensure their quality.

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A Study to Assess the Effectiveness of Art Activities to Improve the Quality of Life Among Elderly People Residing Old Age Home, Nagapattinam.

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ABSTRACT

QOL is largely determined by their ability to maintain autonomy and independence as people age advances. Assessment of QOL plays an important role in the management of old age home and QOL tends to maintain a state optimal level based on the appraised status in the major domains of health, work and family or societies. To assess the effectiveness of art activities to improve the quality of life among elderly people residing old age home, Nagapattinam. Quasi experimental Research Design. 177 elderly people selected by purposive sampling technique. The tool used for data collection was demographic variables and WHO QOL BREF scale. Post Hoc Analysis (Pair wise Comparison) of QOL domains Scores reveal that, there is significant difference within groups between all the pairs of Overall QOL and Health ($p < 0.001$) Except the pair- Post Test 1 Vs Post Test2 in QOL and Health ($p > 0.05$). ie. QOL and Health Scores were higher in Post Tests than Pretest. It can be attributed to the effectiveness of intervention upon QOL among Elderly persons. The study concluded that art activities was effective to improve the Quality of life among elderly.

Keywords: QOL, Quasi experimental, Health, BREF scale



**Raji and Kamala****INTRODUCTION**

Ageing is a relative term. Health influences the age of a person and on the other hand, age also influences health. As people above sixty years of age are accounted as senior citizens; the 'grand parents' or the 'elderly people' are synonymously used with the 'senior citizens'. Traditionally, in India, it has been a part of a culture, for society and the family to take care of older persons. Senior citizens are held in high esteem and are given priority and respect in all matters [3]. The percentage of the elderly in India has been increasing at an increasing rate in recent years and the trend is likely to continue in the coming decades. The share of population over the age of 60 is projected to increase from 8 percent in 2015 to 19 percent in 2050 (Figure 1.2). By the end of the century, the elderly will constitute nearly 34 percent of the total population in the country[8]. Quality of life among elderly is an important area of interest among the elderly which reflects the health status and wellbeing of this susceptible population. Older age brings increasing vulnerability as a result of physical and functional decline, and concomitant burdens on health and social care services. Maintaining good health and wellbeing are often portrayed as markers of healthy or successful ageing. Loneliness, improper medical care, financial instability and emotional distancing from the other members of the family compel the old to lead an institutional life. The numbers of old age homes are fast increasing which quite heart is breaking. The institutions need to satisfy certain services for the protection and improvement of the quality of life of the old in that institution. The people who belong to the society have a greater responsibility to check the quality of service in that institution.

According to the American Art Therapy Association, art therapy is defined as "a mental health profession that uses the creative process of art making to improve and enhance the physical, mental, and emotional well-being of individuals of all ages." It is based on the belief "that the creative process involved in artistic self-expression helps people to resolve conflicts and problems, develop interpersonal skills, manage behavior, reduce stress, handle life adjustments, and achieve insight[63]. The World Health Day theme in 2012 was "Good health adds life to years." The major attention of the WHO was mainly on the productive lives among the elderly people and not a dependency for their families and communities. Rapid evolution of biomedical knowledge and techniques has resulted in new life expectations not only of adding years to life but also QOL to years.

Statement of The Problem

A study to assess the effectiveness of art activities to improve the Quality of Life among elderly, selected old age home, Nagapattinam.

Objectives

- To assess the QOL among elderly persons in control and experimental group.
- To evaluate the effectiveness of art activities to improve the Quality of Life among elderly in control and experimental group.
- To find the association between QOL with selected demographic variables.
- To find the correlation between QOL with selected demographic variables.

Hypothesis

H 1: There will be significant difference in the post test on QOL among elderly persons in experimental group after implementation of art activities.

H2: There will be significant association between QOL with selected demographic variables.

METHODOLOGY

Quantitative approach with Quasi experimental design was adopted to assess the effectiveness of art activities to improve the Quality of Life among elderly, selected old age home. The study was conducted at Anubavam old age home, Namco Trust (Keelaiyur & Nagapattinam), Avvai village welfare society, Bharatha matha old age home



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,Karunlaya old age home and Manitha neyam old age home. Out of seven homes, three old age homes allotted as experimental group and four old age homes allotted for control group. Totally 180 samples selected (90-Experimental group, 90-Control group), by non probability purposive sampling technique. During post test one participants from control group and one participants from control group dropped during study due to physical illness. Finally 177 samples participated in the study. WHO QOL BREF scale was used to assess the quality of life. The scoring interpreted as <33 Normal QOL, 34-66 – Moderate QOL, > 66 - Poor QOL and its transformed as 100 score. Criteria for sample selection

Inclusion Criteria :

Elderly people between 65 - 85 years.

Both Male and Female

Able to walk, stand and move both their upper and lower limbs without the use of any supportive devices

Able to understand Tamil

Exclusion criteria:

Psychologically unstable

Critically ill

Bed ridden

Visual and Hearing impairment

Chronic illness like cancer, Paralysis.

Data collection Procedure

Formal permission obtained from the in charge person of the old age home. 180 samples selected for the study, due to drop out finally 177 samples participated in the study. In pre test WHO QOL BREF scale used to assess the QOL. Weekly three days art activities like mandala coloring, zentangle drawing, scribbling and clay activities have done by the participants under the guidance and supervision by the researcher. After four weeks, posttest level of Quality of Life assessed with the same scale.

RESULTS AND DISCUSSION

Majority of the elderly persons were females (71.6, 74.2), Hindus (86.4, 91%), did not have any income of their own (73.9, 67.4%), Non Vegetarians (71.6, 84.3%), were independent (96.6, 91 %) in Control and Experimental group respectively. With regard to other variables, 43.2 & 36 % of them were aged 65-70 yrs, 46 & 47.2 % of them were married, 44.3 & 41.6% were illiterates, 19.3 & 23.6 % are receiving Old age pension, 34.1 & 39.3% of them did not have children, 37.5 & 48.3 % are staying in old age home for more than 5 years, 37.5 & 43.8 % of them are residing in old age home as children / family members neglected them in Control and Experimental group respectively. There is no significant difference ($p>0.05$) between control and experimental group with regard to demographic variables except Dietary habits ($p<0.05$). Therefore, both the groups are comparable and homogenous.

Objective 1.To assess the QOL among elderly persons in control and experimental group.

In control group 46.6 & 46.6 % had average QOL in physical domain, 43.2 & 46.6 % had low QOL in psychological domain, around half of them had low QOL in social domain (48.9, 51.1%) and majority of them had average QOL in environmental domain (64.8, 60.2%) in pretest and post test 2 respectively. In experimental group, in pretest around half of them had low QOL in physical, psychological and social domain (48.3, 56.2, 52.8 %) and 60.7 % had average QOL in environmental domain. However in Post test 2 majority of them had average QOL in all the domains (67.4 , 58.4, 57.3, 68.5% in physical, psychological, social and environmental domain respectively).

Objective 2.To evaluate the effectiveness of art activities to improve the Quality of Life among elderly in control and experimental group.

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Post Hoc Analysis (Pair wise Comparison) of QOL domains Scores reveal that, there is significant difference within groups between all the pairs of Overall QOL and Health ($p < 0.001$) Except the pair- Post Test 1 Vs Post Test2 in QOL and Health ($p > 0.05$). ie. QOL and Health Scores were higher in Post Tests than Pretest. It can be attributed to the effectiveness of intervention upon QOL among Elderly persons. Statistically significant difference in post test 1 and 2 of all the QOL domains and total Scores, between control and experimental group ($p > 0.05$) which can be attributed to the effectiveness of intervention upon QOL among elderly persons. i.e. QOL scores are significantly higher in experimental group than control group in post-tests, which can be attributed to effectiveness of intervention on QOL among elderly. Hence it can be interpreted that research hypothesis (H1) was accepted and reveals that selected interventional programme was effective to improve the Quality of life among elderly.

Objective 3.To find the association between QOL with selected demographic variables.

There is no statistically significant association between QOL domains Scores and selected demographic Variables of elderly persons in pretest of experimental group ($p > 0.05$) except Age and environmental domain, Educational status and social domains scores ($p < 0.05$). Hence, the research hypothesis (H3) was accepted.

There is no statistically significant association between QOL domains Scores and selected demographic Variables of elderly persons in post test 2 of experimental group ($p > 0.05$) except Monthly income with social and environmental domain scores ($p < 0.05$). Hence, the research hypothesis (H3) accepted.

Objective 4.To find the coorelation between QOL with selected demographic variables.

There is significant positive correlation between all the domains of QOL ($p < 0.001$) among Elderly Persons in Post Test 2 of Experimental Group. It reveals that when QOL domain increased overall QOL increased. It shows intervention was effective in experimental group. The study findings supported by Choi, Yeon Hee and Jeon, En Young (2013) Effects of Art Therapy on Cognition, Depression, and Quality of Life in Elderly. As a quasi-experimental study with a nonequivalent control group, this study used a pre-post design. The subjects consisted of a random sample of women over 65 years of age who had been registered as being at high-risk for dementia at the Public Health Center of the G City, and the Dementia Support Center. Of these elders, 30 were assigned to the experimental group and 33 to the control group. The intervention was conducted twice a week for 5 weeks. Results shows that after the program, cognitive function, depression, and quality of life were significantly better in the experimental group than in the control group

CONCLUSION

Many elderly persons expressed its pleasurable while performing art and recreational activity. There was a significant difference between mean post test score Quality of Life between the control and experimental group.

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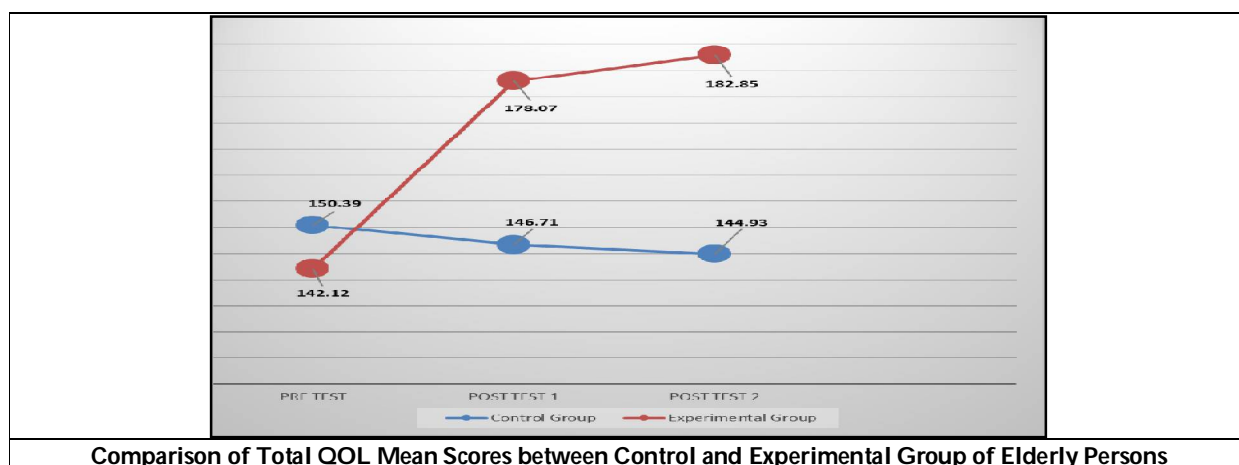


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Frequency and Percentage Distribution of Levels of QOL among Elderly Persons in Control Group and Experimental Group

Domains and Levels	Control Group (n=88)				Experimental Group (n=89)				
	Pretest		Post Test 2		Pretest		Post Test 2		
	f	%	f	%	F	%	f	%	
Physical									
Low	34	38.6	35	39.8	43	48.3	23	25.8	
Average	41	46.6	41	46.6	41	46.1	60	67.4	
High	13	14.8	12	13.6	5	5.6	6	6.7	
Psychological									
Low	38	43.2	41	46.6	50	56.2	22	24.7	
Average	40	45.5	37	42.0	28	31.5	52	58.4	
High	10	11.4	10	11.4	11	12.4	15	16.9	
Social									
Low	43	48.9	45	51.1	47	52.8	27	30.3	
Average	33	37.5	31	35.2	39	43.8	51	57.3	
High	12	13.6	12	13.6	3	3.4	11	12.4	
Environmental									
Low	26	29.5	30	34.1	27	30.3	12	13.5	
Average	57	64.8	53	60.2	54	60.7	61	68.5	
High	5	5.7	5	5.7	8	9.0	16	18.0	





Long Covid Rehabilitation Including All Domains – A Narrative Review

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ABSTRACT

Covid 19 disease is mostly occurred due to novel coronavirus Sars Cov 2. The after effects of covid 19 usually remains for some time period and it is characterised as below. Acute covid 19 – symptoms are remained from one week to four weeks. Covid 19 infection with symptoms which last more than one month to 3 months. Long covid is considered when symptoms last more than three months. There are some others symptoms too which will affect different systems of the body, other than respiratory symptoms. Symptoms may change with time. There are many synonyms of long covid like “long haul covid”, “post covid 19 syndromes”, “post covid effect”, but WHO has described this condition as “long covid”. Long COVID is an emerging infectious disease that hasn't worked out yet, but it can badly invalidate and affect people regardless of hospitalization or severity of acute COVID 19. First question that comes in our mind is how can we come to know that patient with covid 19 is requiring rehabilitation.

How will we plan treatment protocol for that? The unprecedented global health crisis occurred due to Covid-19 has led to impairments in various aspects that is causing Long Covid condition. It has raised a need to rethink over the rehabilitation in all the domains including Cardio-respiratory system, Neurological system, psychological aspect and Nutritional requirements to combat the effect of symptoms on quality of life. Rehabilitation planning are formulated on the basis of assessment. Planning is based on the patient's sign, symptoms, difficulties to perform any task, wishes and values, coupled with knowledge about prognosis and available treatment, and sets short term, mid-term goals and long-term treatment goals. It does not target on any specific treatments, as each patient's needs and symptoms are different and varies with time, but does explain very well what should be done, when and why. Health services have treated effectively to the COVID-19 pandemic crisis, despite a similar lack of direct evidence-based research. At present, detailed research of prognosis after COVID-19 is lacking. There are

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many evidences available for prescribing treatment but due to lack of evidences and research regarding which treatment protocols will elucidate the symptoms, there are less conclusions drawn. This article shows that rehabilitation for covid can also provide evidence-based interventions based on existing recent published research.

Aim of this narrative review is to analyse the available literature related to the evaluation of long covid symptoms and plan the rehabilitation program depending on the patient's requirements. Literature was searched using many electronic databases. Moreover, lists of different references of most relevant articles were searched to increase the search accuracy, as much as possible. Studies which are representing the various effects of covid-19 and their treatment protocols required to combat the long covid symptoms on domains including Cardio-respiratory system, Neurological system, psychological aspect and Dietary aspect have been included in this narrative review. Results of the studies evaluating different effects of long covid-19 on an individual's life have shown that the symptoms due to post covid effect affects different systems in the body (Cardio-respiratory system, Neurological system, Psychological and social well-being and Dietary aspect) and leads to deterioration in the quality of life of a person to a greater extent. Due to affection of major body systems by post covid effect, there is requirement of putting equal attention over all the domains that are distressed by post covid effect. Therefore, by adequate management of all the domains that are affected, there can be improvement in one's quality of life to greater extent. Many literatures suggest the increasing need of putting equal attention on all the affected components of various body systems and provide adequate management for all the domains.

Keywords: Long covid, SARS COV, Covid rehabilitation

INTRODUCTION

"Long COVID" word is used to describe the presence of different symptoms, regardless of positive viral status, even days, weeks or even months after SARS Covid 19 infection. It is also known as "post-COVID syndrome". It is essentially continuous or can be essentially relapsed and in remission. Common symptoms are fatigue, shortness of breath, cognitive dysfunction, as well as other symptoms that generally affect the functioning of daily activities. Symptoms may relapse after the first recovery from the acute COVID 19 episode or persist after the original illness. Symptoms can also change or reoccur over time [1,2]. The effects of COVID19 on the multi-organ system have been reported in most, if not all, body systems, including the cardiovascular, pulmonary, renal, cutaneous, nervous, and psychiatric systems. Various health effects may persist after the acute illness has subsided (pulmonary fibrosis, myocarditis, etc.). It is unclear how long the effects on the multi-organ system will last and whether the effects can lead to chronic health. There are a variety of other new or ongoing symptoms and clinical findings that can occur in people with varying degrees of acute SARSCoV2 infection, including mild or asymptomatic SARSCoV2 infection. These effects can overlap with multi-organ complications [3]. The natural history of SARSCoV2 infection is currently being studied. Researchers are actively investigating the prevalence, mechanism, duration, severity, and risk factors associated with post-COVID disease after acute SARSCoV2 infection. Elderly patients and patients with underlying illness may be at increased risk of serious illness, but young people, including those who were well before SARSCoV2 infection, also reported symptoms that persisted for months after acute illness [3].

METHODOLOGY

Nutritional Requirements

Risk of malnutrition in covid-19 patients is related to chronic pathologies or secondary impairments (diabetes, obstructive pulmonary diseases, renal insufficiency, cardiovascular diseases and any other neurological

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impairments) in body and also due to reduction of food intake caused by nausea, vomiting, diarrhoea and loss of appetite [4]. Cintoni et al. supported a personalized meal supply protocol combined with oral food supplements to adequate the high energetic and protein requirements induced by covid-19[5]. According to Emanuele Cereda et al. due to prolonged presence of symptoms of covid-19, the bedrest and immobility phase will lead to body weakness and reduction in body's immune functions to combat and aid in recovery. So, along with adequate calorie intake, protein-rich foods help in rebuilding the weakened muscles, improves strength, functions and assists in prolonged recovery [6]. According to general guidelines, consumption of 25-35 grams of protein at each of the 3 meals and 10-20 grams of proteins at each of the 2 snacks per day helps in recovery. Sprouts of moong, alfalfa, chickpea and flax seeds are best source to fulfil the protein requirements. Eating in portions throughout day is beneficial than eating large portion at once. Caccialanza et al. reported and gave a protocol on an early nutritional supplement for non-severe COVID-19 patients. Their proposal is based on the observation that almost all patients present at the time of hospitalization had a severe inflammatory status and anorexia, which led to a strong reduction in food intake. Adequate calorie intake is required for rebuilding the strength and to prevent stress on the body systems. At least 35-47 calories per kilogram of body weight should be consumed. If solid food can't be consumed then, beverages with calories like milk, juice, smoothies can be consumed for calorie uptake [7]. Vitamin C and Vitamin D rich foods should be consumed to enhance the immunity and bone health in an individual. Zinc supplements should be involved in the diet which is essential for healthy immune system. [7]

Physiotherapy Rehabilitation [8,9,10,11]

The main concern in COVID-19 is the involvement of the lungs and respiratory system which may result in dyspnea, low blood oxygen saturation and respiratory complications. Diaphragmatic breathing is to normalise pattern of breathing as it is altered in covid 19. It also enhances ventilation perfusion ratio. It aerates alveoli at its full capacity. Various exercises are useful to inflate alveoli properly like chest expansion exercise. A patient can perform chest expansion exercise with the combination of upper limb movement, back and abdominal movement, and lower limb also. It enhances the expansion of lower chest so more fresh air enters into the lungs, thereby improving the lung capacities and volumes. Incentive spirometer are also very useful. It has two types: volume and pressure. A patient can use according to their need. It also gives biofeedback to the patient to breathe in and it reduces the chances of atelectasis (alveolar collapse). Balloon blowing exercises are also useful to promote forceful expiration. As more and more carbon dioxide come out from the lungs by this exercise, it helps in discarding the carbon dioxide from the lungs. Candle blowing exercises are also included in covid 19 pulmonary rehabilitation. It also enhances forceful exhalation.

Cleofas Rodriguez-Blanco et al. suggested that aerobic exercises as such as treadmill, bicycle, jogging, and dancing are also helpful in improving the endurance of the cardiovascular system and also the quality of life. Swimming is the best exercise to improve endurance of the respiratory system. In the covid 19, many patients have lost their weight so there is a reduction of fat mass and muscle mass. They are feeling early exertion from mild daily activities also. Gentle exercises and stretching are useful in this. In many patents, sleep disturbance is very common because of prolonged hospital stay, side effects of medication and anxiety. Harry Crook et al. suggested that increase in activity level may normalise the pattern of sleep. There are many techniques like relaxation, meditation, pranayama, yoga, listening a soft music, reading a book before going to a bed. Try to avoid brain stimulation activities like watching a tv, using a phone and playing a game. Patients recovering from COVID-19 disease usually experience a feeling of fatigue, weakness and exhaustion both physically and mentally due to gentle activities. To recover and to get speedy recovery is to walk little distance and mild exercise. Ask patients to decide on the number of activities they need to do that day or even across the week, then make a plan to spread out the activities so they have adequate rest periods. Begin with very small goals and gradually progress the amount. Kay Cooper et al. recommended that to improve physical strength and function, it is recommend that the patient doesn't stay in bed all day, try to make him sit in a chair for meals and activities and go on short walks. Try to do each exercise for 5 to 20 repetitions daily.

- Seated knee extension
- Seated hip flexion



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- Sit-to-stand
- Shoulder press
- Shoulder strengthening
- Seated triceps dips
- Bridging
- Sideways leg lift
- Straight leg raises
- Standing leg exercises

Khushali Jain et al. physiotherapy along with medical management does prove beneficial in improving functional capacity, ability to carry out daily chores and participation in society. A period of 4 weeks with two supervised sessions seemed too beneficial to these patients.

Psychological Support

Delfina Janiri et al. found that post-Covid-19 women were more vulnerable to psychological distress than their male counterparts. Patients who recovered from Covid-19 and who reported psychological distress presented with more occurrences of cyclothymic and depressive affective temperament [12]. Johan Hendrik Vlaker et al. suggested that the stress caused by the COVID19 pandemic weighs heavily on almost everyone, especially those who are fighting COVID19 and are now experiencing a protracted symptom known as long COVID [13]. In one recent study in Wuhan, China, researchers found that 6 months after acute infection and hospitalization for COVID-19, 63% of patients reported fatigue or muscle weakness, 26% reported sleep difficulties, and 23% reported anxiety or depression. Psychosocial support typically refers to a person's perception of care or support from others, as well as a sense of belonging to a social network that gives reciprocal aid. Adequate and positive psychosocial support has been shown to help reduce stress, anxiety, and depressive symptoms, as well as improve sleep quality.

It's likely that early psychological intervention and social support can help COVID-19 positive people improve their physical and mental health. Because anxiety and sadness are prevalent unpleasant emotions experienced by patients during infectious disease epidemics, social support may be useful in lowering stress and anxiety levels. It is found from the study that improvement of sleep quality for patients were positively associated with the improvement from COVID-19 and better social support. Reduction in depression was positively associated with higher level of education. Uncertainty, disinformation, over information, a lack of health treatment, loneliness and separation from loved ones, and the loss of life, among other things, could have contributed to their mental health issues. Furthermore, the participants' older age and more critical condition may explain some of the high ratio of psychosocial difficulties. Older persons, in particular, were more likely than those in need of medical and mental health care to be nervous, depressed, and sleep deprived.

Shankar et al. suggested that higher education is widely acknowledged as a key socioeconomic factor of health. It can provide people with the financial, social, and personal resources they need to improve their physical and mental health, as well as strengthen their capacity to make better health decisions [14]. Psychologists can reduce many of the psychological symptoms of COVID, by interventions like trauma therapy, cognitive behavioural therapy to establish new behaviours such as sleep hygiene, and acceptance and attachment therapy for those suffering from illness anxiety. Betty Pfefferbaum et al. suggested that Peer support often means that people share knowledge, experience, or practical help with each other when living with the same or similar health problems. Many online Long-COVID peer support groups have been established for people who use Long-COVID. These are safe places for people using Long COVID to access peer support. Therefore, these groups maintain mutual respect and confidentiality. Physiotherapist can be a part of this group where a group session can be conducted to provide not only the exercise training but also the social and psychological support by providing proper education and motivation [15].

Financial crisis

Global economy adversely was affected by the pandemic (COVID-19). Some patients with chronic illness may have died of COVID 19. Others lose their employer-sponsored health insurance coverage, face financial constraints due to



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unemployment, and further delay care. For the first time in 60 years, GDP showed negative growth, exacerbating the serious financial crisis and recession. It had a great impact on the quality of life of the population. Self-separation, marginalization and travel bans mean that labour force is declining in all sectors of the economy, leading to unemployment. The entire industry is facing a deadlock that paralyzes most industrial sectors. The COVID-19 disease quickly instigated substantial disruption to human societies, health care systems, and economies worldwide. The jobs and income losses have led to further hunger and had adverse and negative effects on individuals' quality of life. The main threat to the future of health care organizations is approaching the horizon. It is the devastating economic impact of social distance and other epidemic response strategies. The decline in the rate of return on investment in financial institutions is affecting the general public who earn household expenses from the rate of return on deposits. The low rate of return on deposits creates psychological stress on those who are dependent on their investment. Price increases have increased and purchasing power has declined. Steven H. LoGiudice et al. conducted a study showing the help provided by some financial relief as part of the Coronavirus Aid, Relief, and Economic Security Act and the Pay check Protection Program and Healthcare Enhancement Act, allocating a total of \$175 billion in relief funds to hospitals and other health-care providers. \$50 billion had been distributed by early may [16].

CONCLUSION

From the various studies included in the study, it was concluded that various systems of body are affected due to post covid effect. By providing adequate attention and rehabilitation to all the systems equally, the overall quality of life can be improved to a greater extent.

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Effectiveness of Proprioceptive Neuromuscular Facilitation along with Strengthening and Muscle Energy Technique along with Static Stretching on Pain and Dynamic Stability in Elderly with Knee Osteoarthritis : A Pilot Study

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ABSTRACT

OA knee is common condition that causes pain and limits function in elder population. More pain leads to decreased walking speed⁵, reduced dynamic balance and postural control during gait. Physical therapy treatment such as PNF, MET, Strengthening and stretching exercise may decrease the pain and increase dynamic stability in elderly with knee OA. Aim of the study is To compare the effective of Proprioceptive Neuromuscular Facilitation along with Strengthening and Muscle Energy Technique along with static stretching on pain and dynamic stability in elderly with knee osteoarthritis. Twenty subjects who were diagnosed with OA knee were taken in this study. They were divided into 2 groups. Group A (n=10) was treated with PNF along with strengthening of lower extremity. Group B (n=10) was treated with MET along with static stretching of lower extremity. NPRS, WOMAC and BBS was taken before and after treatment session. Duration of Intervention was 5 days a week for 4 weeks. Result was statistically inspected using t-test by SPSS version 20. There was significant decrease in pain, improve dynamic stability in elderly people with knee osteoarthritis. As comparing both techniques, group examination showed that MET along with static stretching (group B) is better than PNF along with strengthening (group A).(p<0.05) This study concluded that MET along with static stretching is more effective in decreasing pain and improving dynamic stability than PNF along with strengthening in elderly with knee osteoarthritis.

Keywords: Osteoarthritis , Proprioceptive Neuromuscular Facilitation, Muscle Energy Technique, Western Ontario And McMaster Universities Arthritis Index, Berg Balance Test.



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INTRODUCTION

Osteoarthritis of knee joint is a common chronic joint disease that causes knee pain and disability [1]. It is the most common form of osteoarthritis and characterized by the chronic degeneration of the articular cartilage, related to mechanical overload, which results in pain and dysfunction in elderly people [2]. The prevalence of OA knee is 40% at the age of 65 year old and older than that are symptomatic [3]. Increased joint pain and reduced joint range of motion (ROM) are the common complaints associated with OA knee and confirmed by physical examinations [4,5]. Greater pain leads to decreased speed of walking, reduced dynamic balance and postural control during gait [6,7,8]. Reduced ROM prevents active flexion and extension motion of lower extremities and leads to dysfunction in patients with OA knee [9]. Falls are also the major cause of death in people aging above 85 years [10]. Many tools were used to determine fall risk in people in the past. However, the most commonly used is the Berg balance scale [11,12]. The study done by Lajoie and Gallapher, they concluded that scores lower than or equal to 46 on Berg balance scale classify subjects as fallers with 93% of specificity. Reduced strength is pointed as the major cause of falls in this population and therefore, maximal torque should be accessed on daily-life clinical tests [13].

Previously all exercise programs proposed to reduce fall risk in this population but proprioceptive neuromuscular facilitation technique is presented as an interesting choice. Lee and Kerrigan had stated that exercise programs with objective to enhance balance on elderly should involve coordination and proprioception activities and not only strengthen the muscles also briefly stretched before contraction, exciting neuromuscular endings which produce higher levels of force [14]. The patterns in PNF are executed in diagonal pattern that is parallel to muscular topography, which produces the physiological movements as a gait [15]. It was also suggested that a higher balance between agonistic and antagonistic muscles activation is achieved after PNF exercises reducing co activation [16]. The age-related decline of muscular capacities in the lower extremities is one intrinsic key factor for the higher risk of fall and, for that reason, a classical strength training has the potential to improve balance performance [17,18]. However, the ability to respond to sudden perturbations and postural threats as the cause of a fall event also strongly relies on the successful application of general mechanism responsible for the dynamic stability, i.e., increase in the base of support and counter-rotating segments around the center of mass [19].

Muscle energy technique was developed by Ruddy and Fred Mitchell. Muscle energy techniques (MET) describe those manipulative treatments in which a patient actively uses his or her muscles from a controlled position and in a specific direction against a distinct counterforce. The amount of force applied by the patient and the therapist may vary from minimal to maximal contractions. The duration of the contraction may vary from a few to several seconds [20]. Principles used in muscle energy technique are Post-isometric relaxation and Reciprocal inhibition. Effects of muscle energy technique are to strengthen weakened muscles, to reduce localized edema, increase the range of motion and to lengthen the shortened muscles. Physical therapy treatment such as PNF, MET, Strengthening and stretching exercise may decrease the pain and increase dynamic stability in elderly with knee OA. But there is lack of evidence that comparing Proprioceptive Neuromuscular Facilitation along with Strengthening and Muscle Energy Technique along with static stretching can reduce pain and improve dynamic stability in elderly population.

Hence the purpose of this study is to compare the effective of Proprioceptive Neuromuscular Facilitation along with Strengthening and Muscle Energy Technique along with static stretching on pain and dynamic stability in elderly with knee osteoarthritis.

MATERIAL AND METHOD

A pilot study was conducted at sainath hospital, Ahmedabad. Total twenty subjects with knee osteoarthritis were taken in this study according to inclusion criteria. They were divided into 2 groups 10 in each group. Group A was treated with PNF along with strengthening exercise of lower extremity and Group B was treated with MET along with static stretching of lower extremity. The inclusion criteria are (A) Age : > 60 years, (B) Both genders were taken,



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(C) Kellgren and Lawrence radiographic grade ranged from 1 to 3. (D) Knee joint pain. Exclusion criteria of this study are (A) Presence of any orthopedic trauma in lower extremity. (B) Presence of any severe cardiovascular or neurological condition. (C) Previous knee surgery. Outcome measures of this study are Numeric pain rating scale (NPRS), Western ontario and mc master universities arthritis Index (WOMAC), Berg balance test (BBS). NPRS was taken to measure pain, WOMAC scale was taken to assess function, BBS was taken to assess dynamic stability in elderly people. All the Outcome measures were taken before and after the intervention. Duration of Intervention was 5 days a week for 4 weeks. Group A was treated with PNF along with strengthening exercise of lower extremity. PNF was given in the form of 4 patterns which are D1 FLEXION, D1 EXTENSION, D2 FLEXION and D2 EXTENSION. 3 sets of 10 repetitions were performed. Strengthening of lower extremity muscles includes hip flexor muscles, hip extensor muscles, hip adductor muscles and hip abductor muscles. 10 repetitions per session were performed.

Group B was treated with MET along with static stretching of lower extremity. MET was given in form of post isometric relaxation and reciprocal inhibition. In Post isometric relaxation, The patients was positioned in prone lying hip will be flexed to 90°. The patient was asked to flex knee using 20% of his strength. Resistance was applied to agonist muscle. The contraction was maintained for 5 seconds, 2 sets was performed, with 5 repetitions in each set. In Reciprocal inhibition The patients was positioned in prone lying, hip was flexed to 90°. The patient was asked to extend knee using 20% of his strength. Resistance was applied to antagonist muscle. The contraction was maintained for 5 seconds, 2 sets was performed with 5 repetitions and relaxation phase of 5 seconds in between. In static stretching of lower extremity includes Hamstring muscle, calf muscle, Quadriceps muscle, adductor and abductor muscle stretching. 3 reps of 15 seconds were performed.

RESULT

A pilot study involved 20 older adults age >65 years, who fulfill the inclusion criteria. These subjects were randomly divided into 2 groups and intervention was given in the form of Proprioceptive Neuromuscular Facilitation, Muscle energy technique, Stretching and Strengthening of lower extremity. The parametric test was used in statistical analysis because the distribution of data was normal. Paired t test is used to see the pre and post treatment effect. Unpaired t test was used compare both the groups. Table 1 shows means age of both the groups. Table 2 shows paired t test of Group A and B pre and post mean of all outcome measures. Table 3 shows unpaired t test between Group A and Group B. Result showed Significant improvement in all the outcome measures in Group B as p value being <0.05.

DISCUSSION

Osteoarthritis is a chronic degenerative disease. OA knee is the commonly affected joint in the older age group. In the present study, it investigated that short term training can improve function, pain and dynamic stability after administering physical therapy treatment in older adults. The results showed that pain, function and dynamic stability improved after the muscle energy technique and static stretching exercise (Group B). M.P.Pereira and M. Goncalves had done study on "Proprioceptive Neuromuscular Facilitation Improves Balance and Knee Extensors Strength of Older Fallers." and they stated that there is significant improvement on fall risk in elderly after a proprioceptive neuromuscular facilitation program and subject presented a higher performance on Berg Balance Scale. In this present study PNF along with strengthening of lower extremity muscles can improve dynamic stability in older population after 4 weeks of intervention.

Sushmita singh et al had done study on "Effect of post-isometric relaxation and reciprocal inhibition in osteoarthritis knee." They stated that the use of muscle energy technique improves both strength and endurance by increasing the flexibility of the muscles surrounding the joint. It is also beneficial in reducing localized swelling and increasing the restricted range of motion after applying muscle energy technique. In this present study there is significant





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improvement in pain and function were seen in group B who were treated with muscle energy technique and static stretching.

CONCLUSION

This study concluded that there was significant decrease in pain, improve dynamic stability in elderly people with knee osteoarthritis. Both the techniques are effective but group examination showed that MET along with static stretching (group B) is better than PNF along with strengthening (group A). (p<0.05)

Future of the Study

we can conduct study in larger population, we can conduct this study in different age group to improve pain of OA knee.

Conflict of Interest : Nil

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Table 1 shows mean age of both the group

AGE	MEAN	SD
GROUP A	65.9	5.80
GROUP B	65.3	5.01

Table 2 shows paired t test analysis of both the groups

	NPRS PRE LT	NPRS POST LT	NPRS PRE RT	NPRS POST RT	WOMAC PRE	WOMAC POST	BBS PRE	BBS POST
GROUP A	5.40	4.30	5.60	4.50	40.70	34.30	38.60	42.30
GROUP B	5.51	2.80	5.50	2.60	41.80	26.60	42.80	46.90

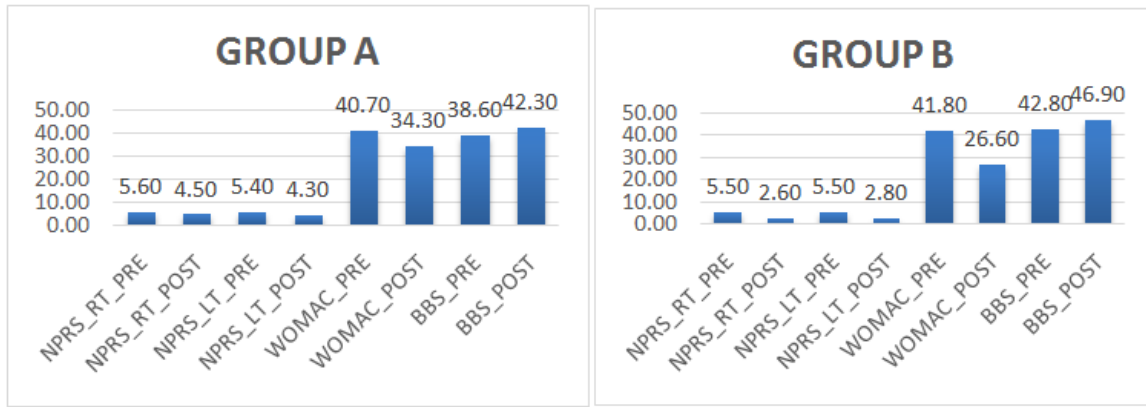
Table 3 shows comparison of both the groups.

	NPRS LT	NPRS RT	WOMAC	BBS
DIFFERENCE GROUP A	1.10	1.10	6.40	3.70
DIFFERENCE GROUP B	2.70	2.90	15.20	4.10





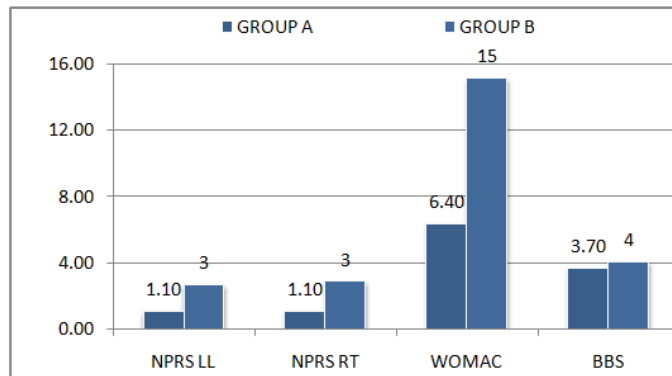
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GRAPH 1

GRAPH 2

Graph 1 and 2 shows paired t test analysis of group A and Group B



Graph 3 Shows comparison of both the groups





Analytical Study on *Inji Charu* (Ginger Juice) and *Inji Surasam* (Ginger Decantent) using the Gas Chromatography Mass Spectrum

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ABSTRACT

Siddha system is one of the ancient systems in the southern part of India. The Siddha physicians were preparing the medicine themselves and had knowledge about the ingredients and processing methods. This process of development resulted in use of temperature, pressure, catalyst, appropriate combination of synergetic and antagonist ingredients. Thirty two types of dosage forms are laid down for oral medication. Among these the *Charu* (Juice) and *surasam* (Decantent) is commonly used. Ginger or scientifically known as *Zingiber officinale* Roscoe (Zingiberaceae) is a powerful functional food and potential nutraceutical with a long history of medicinal application. The aim of the present study was to investigate the presence of the bioactive compounds and comparing *Inji Charu* (Ginger Juice) with *Inji Surasam* (Ginger Decantent). The purified fresh ginger was crushed and squeezed to get the *Inji Charu*, half of the *Inji Charu* was poured into the heated mud pot to prepare the *Inji surasam*. Prepared samples were analyzed by Gas Chromatography Mass Spectrum (GCSMS). Nonanedioic acid, bis (2 methyl propyl) ester and Octadecanoic acid, 4 hydroxy-, methyl ester compounds and octotech-9-anoic acid, 9-hexadecenoic acid and oxyrene-2 carboxylic acid, 3- [3,4,5,5-d] -, methyl ester compounds were identified in *Inji Charu* and *Inji Surasam*. Further research can be conducted by examining the activities of the samples so that the therapeutic usage of these processes can be established.

Keywords: Ginger, *Inji Surasam*, *Inji Charu*, GCMS





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INTRODUCTION

Ginger or scientifically known as *Zingiber officinale* Roscoe (Zingiberaceae) is a powerful functional food and potential nutraceutical with a long history of medicinal application [1]. Siddha medicine is an ancient medicine and its origin from Tamil tradition. Pharmaceutics of siddha systems is a well-developed branch and great emphasis on drug preparation methods and dosage form. The physicians themselves were preparing the medicine and therefore had knowledge about ingredients and processing methods. This process of development resulted in use of temperature, pressure, catalyst, appropriate combination of synergetic and antagonist ingredients. Thirty two types of dosage forms are laid down for oral medication [2]. Among these the *Charu* (Juice) and *surasam* (Decantent) is commonly used. *Charu* is defined as the juice extracted from fresh plant parts like leaves, root, barks, flowers, fruits, etc by grinding, crushing, smashing or baking and then filtered. For Eg., *Charu* Obtained by pounding (*Inji*), grinding (*Karuveppilal*), Steaming (*Thulas*), piercing (*Venpoosani*), indirect heating (*Poond*), flaming (*Marul*) and adding astringents (*Kumar*) [3]. *Surasam* is prepared from different parts of the plant like leaves, roots, barks, flowers, rhizomes, fruits etc. By crushing, the juice is expressed and subsequently boiled [4]. For Eg., *Surasam* obtained from bark juice (*Notchi*), flowers (*Mathulampoo*), fruits (*Naratthal*), leaf juice (*Omavalli*) and from rhizome (*Inji*) [3]. So far there is no scientific study regarding *Injisurasam*. So, considering the purview, the study is selected to compare the *Injisurasam* and *Inji Charu* through the Gas Chromatography Mass Spectrum analysis.

Objective

To evaluate qualitative and quantitative analysis of the *Inji Charu* (Ginger Juice) and *Inji Surasam* (Ginger Decantent).

MATERIALS AND METHODS

Preparation of the *Inji Charu* (Ginger Juice) and *Inji Surasam* (Ginger Decantent).

Samples preparation methods

Collected Ginger was measured weighed and the outer layer of ginger was peeled. It was crushed in stone motor to get juice. The juice was kept for few minutes to settle down the suspended particles and the supernatant juice was filtered and the volume was measured. Then the juice was divided into two equal parts. One half of the juice was Stored in an airtight glass container and labelled as A [4]. The mud pot was heated in stove until the “sur” sound heard on sprinkling a few drops of water in it and then the stove was turned off. Then second half of the juice was poured into the heated mud pot. After that juice was filtered and the volume was measured. Finally, the juice was stored in air tight glass container labelled as sample B [4]. Samples were analyzed by GCMS.

GCMS instrumentation and condition

Gas chromatography (GC) analysis was carried out using Agilent 6890N gas chromatography equipped with photon multiplier tube as detector coupled to front injector type 1079. The chromatograph was fitted with HP 5 MS capillary column (30 m × 0.25 mm i.d., film thickness 0.25 μm). The injector temperature was set at 250°C, and the oven temperature was initially at 70 °C hold for 4 mins then programmed to 200°C at the rate of 10°C/min and finally held at 200 °C for 13 min. Helium was used as a carrier gas with the flow rate of 1.5 ml/min. 0.2 microliter of the sample (diluted with methanol 1:10) were injected in the spitless mode. The percentage of composition of the sample was calculated by the GC peak areas. GC–mass spectrometry (GC–MS) analysis of sample was performed using Agilent gas chromatography equipped with JEOL GC MATE-II HR Mass Spectrometer. GC conditions were the same as reported for GC analysis and the same column was used. The mass spectrometer was operated in the electron impact mode at 70 eV. Ion source and transfer line temperature was kept at 250°C. The mass spectra were obtained by centroid scan of the mass range from 50 to 600 amu. The compounds were identified based on the comparison of their retention indices (RI), retention time (RT), mass spectra of WILEY, NIST library data of the GC-MS system and literature data (Adams, 2009).



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RESULT AND DISCUSSIONS

GC MS chromatogram of *Inji Charu* (Ginger Juice) as shown in Figure 01 detects 4 peaks of the Chemical compounds. GCMS analyzed results of the methanol diluted *Inji Charu* (Ginger Juice) which include the active principles with their retention time, peak area, percentage of peak area, chemical compound, molecular formula and molecular weight shown in Table 01. The total number of chemical compounds identified in the methanol diluted *Inji Charu* (Ginger Juice) was 04.. The results showed the presence of major compounds, Octadecanoic acid, 4 hydroxy-, methyl ester (32.67%), Nonanedioic acid, bis (2 methyl propyl) ester (30.89%) and Pentadecanoic acid, methyl ester (29.26%). But 10-Octadecenoic acid, methyl ester (07.17%) were identified in minor amounts. GC MS chromatogram of *Inji Surasam* (Ginger Decantent) as shown in Figure 06 detects 5 peaks of the Chemical compounds. GCMS analyzed results of the methanol diluted *Inji Surasam* (Ginger Decantent) which include the active principles with their retention time, peak area, percentage of peak area, chemical compound, molecular formula and molecular weight shown in Table 02. The total number of chemical compounds identified in the methanol diluted *Inji Surasam* (Ginger Decantent) was 05. The results showed the presence of major compounds, Octadec-9-enoic acid (39.4%) and Pentadecanoic acid, methyl ester (32.4%). But 10-Octadecenoic acid, methyl ester (12.36%), 9-Hexadecenoic acid (10.7%) and Oxirane-2-carboxylic acid,3-[3,4,5-trimethoxyphenyl]-, methyl ester (06.0%) were identified in minor amounts. The analysis results were shown in table 03. Pentadecanoic acid, methyl ester and 10-Octadecenoic acid, methyl ester compounds were identified in *Inji Charu* (Ginger Juice) and *Inji Surasam* (Ginger Decantent). Nonanedioic acid, bis (2 methyl propyl) ester and Octadecanoic acid, 4 hydroxy-, methyl ester compounds were identified in *Inji Charu* (Ginger Juice). Octadec-9-enoic acid, 9-Hexadecenoic acid and Oxirane-2-carboxylic acid,3-[3,4,5-trimethoxyphenyl]-, methyl ester compounds were identified only in *Inji Surasam* (Ginger Decantent).

CONCLUSION

The preliminary GCMS analysis of the *Inji Charu* (Ginger Juice) and *Inji Surasam* (Ginger Decantent) contain different bioactive ingredients. Nonanedioic acid, bis (2 methyl propyl) ester and Octadecanoic acid, 4 hydroxy-, methyl ester compounds and octadec-9-enoic acid, 9-hexadecenoic acid and oxirane-2 carboxylic acid, 3- [3,4,5,5-d] -, methyl ester compounds were identified in *Inji Charu* and *Inji Surasam* respectively. Further research can be conducted by examining the activities of the samples so that the therapeutic usage of these processes can be established.

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Table 01: Image of the GC MS chromatogram data interpretation of *Inji Charu* (Ginger Juice)

No.	Retention Time	Peak Area	Area %	Name of Compounds identified with NIST Library	Formula	Molecular weight (g/mol)
1	14.80	93741	30.89	Nonanedioic acid, bis (2 methylpropyl) ester	C ₁₇ H ₃₂ O ₄	300.43
2	16.45	88799	29.26	Pentadecanoic acid, methyl ester	C ₁₆ H ₃₂ O ₂	256.42
3	17.40	21775	07.17	10-Octadecenoic acid, methyl ester	C ₁₉ H ₃₆ O ₂	296.49
4	18.00	99146	32.67	Octadecanoic acid, 4 hydroxy-, methyl ester	C ₁₉ H ₃₈ O ₃	314.50

Table 02: Image of the GC MS chromatogram data interpretation of *Inji Surasam* (Ginger Decantent).

No.	Retention Time	Peak Area	Area %	Name of Compounds identified with NIST Library	Formula	Molecular weight (g/mol)
1	16.60	99142	32.14	Pentadecanoic acid, methyl ester	C ₁₆ H ₃₂ O ₂	256.42
2	17.50	38112	12.36	10-Octadecenoic acid, methyl ester	C ₁₉ H ₃₆ O ₂	296.49
3	18.20	121534	39.40	Octadec-9-enoic acid	C ₁₈ H ₃₄ O ₂	282.46
4	20.20	31070	10.07	9-Hexadecenoic acid	C ₁₆ H ₃₀ O ₂	254.40
5	22.55	18531	06.00	Oxirane-2-carboxylic acid,3-[3,4,5-trimethoxyphenyl]-, methyl ester	C ₁₃ H ₁₆ O ₆	268.26





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Table 03: Compare the functional compounds of *Inji Charu* (Ginger Juice) and *Inji Surasam* (Ginger Decantent) using GCMS analysis.

No	Name of Compounds identified with NIST Library	Chemical structure	Inji Charu (Ginger Juice)	Inji Surasam (Ginger Decantent)
1	Nonanedioic acid, bis (2 methyl propyl) ester		Present	Absent
2	Pentadecanoic acid, methyl ester		Present	Present
3	10-Octadecenoic acid, methyl ester		Present	Present
4	Octadecanoic acid, 4 hydroxy-, methyl ester		Present	Absent
5	Octadec-9-enoic acid		Absent	Present
6	9-Hexadecenoic acid		Absent	Present
7	Oxirane-2-carboxylic acid,3-[3,4,5-trimethoxyphenyl]-, methyl ester		Absent	Present



Figure 1: Preparation steps of *Inji Charu* (Ginger Juice)

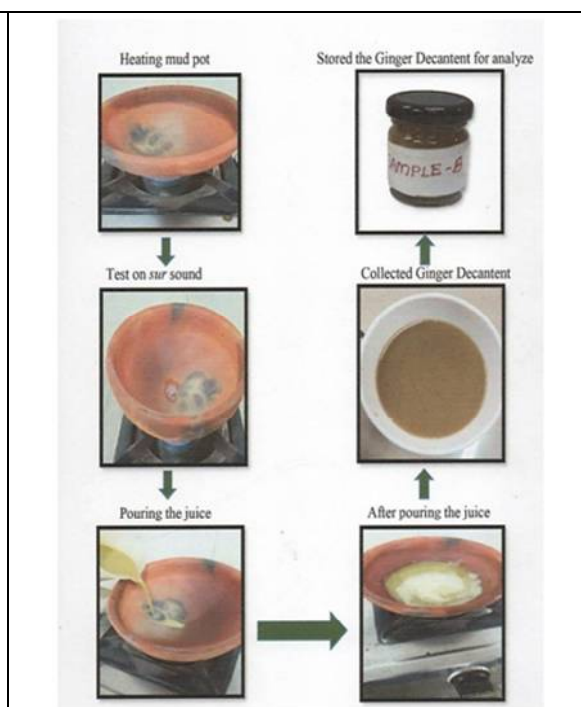


Figure 2: Preparation steps of *Inji Surasam* (Ginger Decantent)





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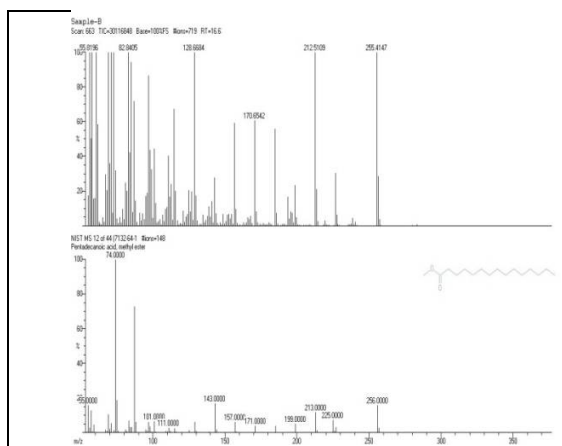


Figure 09. Structured of Pentadecanoic acid, methyl ester presents in *Inji Suranam* (Ginger Decantent) with RT – 16.60

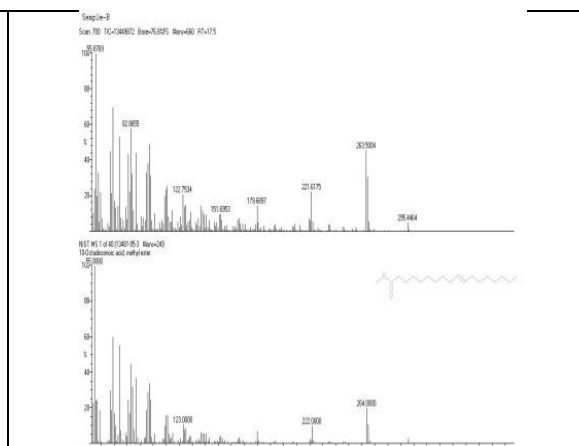


Figure 10. Structured of 10-Octadecenoic acid, methyl ester presents in *Inji Suranam* (Ginger Decantent) with RT – 17.5

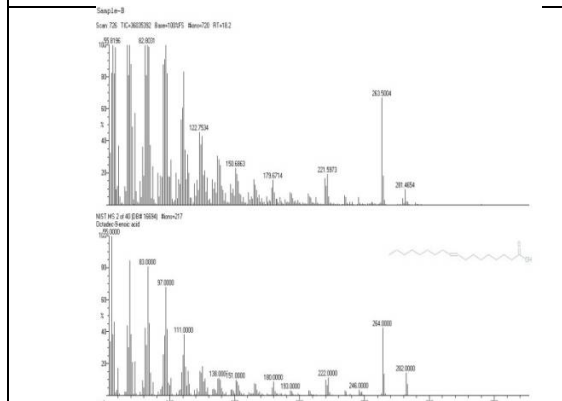


Figure 11. Structured of Octadec-9-enoic acid presents in *Inji Suranam* (Ginger Decantent) with RT – 18.2

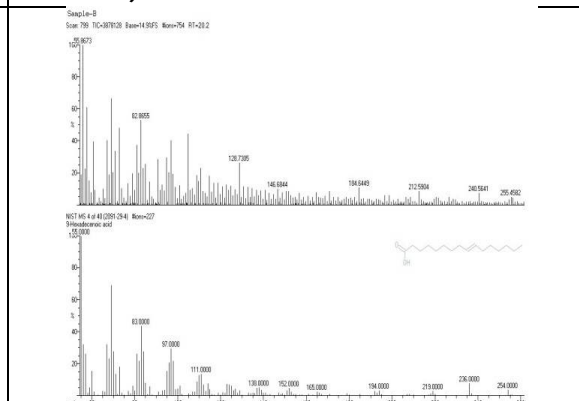


Figure 12. Structured of 9-Hexadecenoic acid presents in *Inji Suranam* (Ginger Decantent) with RT – 18.2

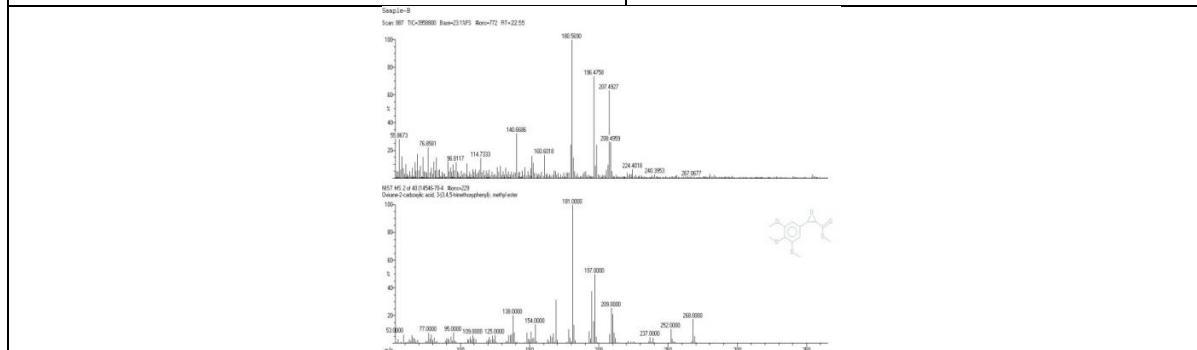


Figure 13. Structured of Oxirane-2-carboxylic acid, 3-[3,4,5-trimethoxyphenyl]-,methl ester presents in *Inji Suranam* (Ginger Decantent) with RT – 20.2





Nanoformulations of Antiepileptic Drug: Characterisation, and *In vitro* Evaluation

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ABSTRACT

The sequence of seizures or unusual behaviour is “Epilepsy” that affects predominantly the brain activity. That may lead to loss of sensations and awareness. There are several antiepileptic drugs available amongst them Lamotrigine is selected as the drug candidate for the present study. The prominent aim of the current work is to improve the solubility and brain penetration of the Lamotrigine, in a nanoparticle formulation with suitable polymers are prepared and evaluated. Formulation of nanoparticles with polymers such as chitosan and alginate in different proportions was prepared. Twenty such formulations were prepared out of a few of them were selected as the ideal formulations based on their evaluation parameters. Parameters such as size of the particles, Polydispersity, surface charge determination, drug content, drug entrapment efficiency, TEM, and *In vitro*-release study were carried out. The resulting outcome of these evaluation parameters revealed that Lamotrigine-loaded nanoparticles are the best option for epileptic treatment. This study suggests that nanoparticles of Lamotrigine are the ideal option to enhance the efficacy, bioavailability of the drug in epileptic treatment.

Keywords: Lamotrigine nanoparticles, NPS, Lam NPS, antiepileptic drug formulation.





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INTRODUCTION

The development of dosage form is a recent advancement. To improve patient compliance effective therapeutic response with appropriate release has become a mandate. Nanotechnology is gaining traction as a potentially useful instrument for the 21st century. Pharmaceutical nanotechnology is the branch of research that studies the use of nanoscience in the pharmaceutical setting. Nanomedicine, such as liposomes, niosomes, nanospheres, dendrimers and polymeric micelles, have made significant contributions to the detection and treatment of different illnesses at the molecular level. More recently, carbon nanotubes and quantum dots have made significant contributions as well. 1 When it comes to drug delivery methods, nanoparticle-based technologies have had a significant influence on virtually every discipline of medicine. Pulmonology, cardiology, ophthalmology, endocrinology, oncology, immunology, and other specialties are included. Also suitable are highly specialised fields such as gene delivery, targeting to specific organs or tissues such as the brain, targeting tumours, oral vaccination formulations, and so on. 2 Improved therapy through increased efficiency and drug activity duration, rise in the patient compliance through lowered dosing pattern and more efficient route of administration, and improvement in drug targeting for a specified site to lower unwanted adverse effects are just a few of the benefits that novel drug delivery systems can bring about 3 in both the pharmaceutical and pharmaceutical delivery industries, the goal is to distribute both present and developing medication technology in a way that maximises advantages to the patient. To attain a steady-state level in either blood or tissue that is both effective and nontoxic for an extended length of time, a unique drug delivery mechanism can be stated to be the goal. Novel medication delivery methods based on nanotechnologies are reshaping the field of medicine in the years to come. Nanoparticles of various types like Solid-lipid, lipid, gold, silver, metallic, magnetic, albumin, fullerene, polymeric, carbon nanotubes, nanocrystals, mesoporous silica nanoparticles, nanosponges, and other drug delivery systems are all examples of nanoparticle drug delivery systems.

Nanoparticles are colloidal particles with a size ranging between 10 and 1000 nanometers (nm) in diameter. According to conventional nanotechnology, the dimension of an individual particle ranges between one and one hundred nanometers (nm). The size of the nanoparticles being studied for drug delivery of therapeutic and imaging agents can range from 2 to 1000 nm in diameter. It is possible to divide them into two categories, such as Nanospheres, which are defined as solid core spherical particles with a nanometric dimension, and Microspheres, which are defined as micrometric particulates with a solid core. They include pharmaceuticals that are either incorporated inside the matrix or adsorbed onto the surface of the matrix. When a medication is enclosed inside a core volume that is surrounded by an embryonic continuous polymeric sheath, this is referred to as nanocapsule formation. They belong to the vesicular system. 4 Nanoparticle formulation provides protection for drug molecules that are prone to many sorts of degradation and denaturation in acidic or alkaline phases, as well as the ability to extend the duration of drug exposure by elevating the retention of the formulation using bio adhesions, among other benefits. The treatment of epilepsy is extremely difficult because of the distinctive protective hurdles that exist inside the CNS. The most difficult obstacle for efficient medicine administration is to breach or circumvent the omnipresent tight barrier that exists in all environments. These are necessary for the maintenance of homeostasis and the correct functioning of the brain⁵. Antiepileptic medications can exert their effects by directly interfering with certain ion channels, neurotransmitters, or receptors in the brain. Among the most significant inhibitory neurotransmitters and excitatory neurotransmitters are GABA and glutamate, which are both found in high concentrations. Lamotrigine is a medication that is used to treat seizures in people who have certain forms of epilepsy⁶. The drug, on the other hand, might cause unpleasant side effects in some people. If the adverse effects are significant, they can lead to the withdrawal of anti-epileptic treatment with the drug. The central nervous system is implicated in a number of adverse effects, some of which are connected with a lower tolerance to the drug⁷. During the course of this investigation, Lamotrigine-loaded nanoparticles are synthesised, characterised, and assessed for a number of different criteria.





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MATERIALS AND METHODS

Lamotrigine was received as a gift sample Swarnoop chemicals pvt.Ltd. in India for research purposes.

Formulation of Lamotrigine nanoparticles

Accurately weighed 100 mg of drug and dissolved in 45 ml of ethanol and 2 mg Polyethylene glycol. Then acetic acid solution (1%) was prepared. Sodium Alginate and Chitosan were added slowly under a mechanical stirrer to the prepared acetic acid solution, continued the stirring for about 15-20 min. The solution was placed in a rotary vacuum evaporator at 55-65°C and stirred for 20 min. The preparation was subjected to Homogenization (High-speed Homogenizer) for 10 min at 5000-6000 RPM. Further, the sample was subjected to probe sonication for about 5-15 min (15 sec ON & OFF interval). Finally stirred the sample under mechanical stirrer for 30 min for uniform distribution of particles. Lyophilized the sample and stored in desiccators in a container until further use^{8,9}.

Characterization of Lamotrigine Loaded Nanoparticles

Particle size

With the use of Photon Correlation Spectroscopy, the size of the Nanoparticle was measured (PCS). All of the samples were dissolved with ultra-purified water before testing. When measuring at a scattering angle ranging from 25 degrees to 90 degrees, the analysis was carried out for a total of 180 seconds in order to capture all of the information. Calculating the mean diameter and mean hydrodynamic diameter for each sample was accomplished by cumulative analysis performed in triplicate.

Polydispersity studies

The equation $D(0.9) - D(0.9)$ was used to calculate the polydispersity (0.1). D is for polydispersity (0.9) The particle size which is above 90 percent of the sample is represented by D(0.9), whereas the particle size which is above 50 percent of the sample is represented by D(0.5). In this case, D (0.1) corresponding to a particle size that is directly over 10% of the sample⁸.

Surface Charge determination

With the help of a Zeta Sizer 4, we were able to determine the zeta potential of the nanoparticles. ZETA potential estimation was performed in an automated manner with an aqueous dip cell, which was used for the experiment. In order to conduct potential energy analysis, the generated nanoparticulate samples were dissolved with ultrapure water and maintained in the measuring cell for a period of time after their positions were changed and a suitable position was fixed⁹.

Determination of Drug Content/efficiency of entrapment:

A measured amount of nanoparticles that are freeze-dried in triplicate was taken and dissolved them in a known amount of methanol. The quantity of Lamotrigine present was determined using a Spectrophotometer, which measured the absorbance at 307 nm¹⁰ wavelength.

External Morphological Studies (TEM)

TEM was used to determine the external morphological characteristics of nanoparticles (TEM). The specs were for a Phillips EM-CM 12 with a 120 kr price tag. One drop of material was deposited on a copper grid and dried under vacuum pressure before being examined using a transmission electron microscope¹¹. The following is the formula for calculating entrapment efficiency. DEE percent is equal to the amount of drug that is really present multiplied by 100.





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In vitro Drug Release Studies

Through the use of the dialysis bag technique, the in-vitro release of drug studies of chosen formulations was examined. As a dissolving medium, phosphate buffer (900 mL) and saline (pH 7.4) were employed. Placement of the produced nanoparticles into the dialysis membrane (cellulose, 25 mm wide) was accomplished by attaching a piece of string to the paddle of the dissolving equipment. The disintegration test was performed at a speed of 100 rpm and a temperature of 37 ± 0.5 C. In order to maintain the integrity of the receptor compartment, samples were removed at predefined intervals and replaced with new medium. With the use of a UV-Spectrophotometer operating at 307 nm¹²⁻¹⁴, the amount of medication dissolved was determined.

RESULTS AND DISCUSSION

Lamotrigine-loaded nanoparticles were prepared by using sodium alginate and chitosan as polymers in the solvent evaporation method.

Particle size

Nine experiments and 1 additional centre block for studying significant effects. Initial the process started with Homogenization for 13-15 min yielded greater particle size. Hence reducing the homogenization time to 10 min resulted in reduced Particle size. However, RPM remained the same around 5000. Probe sonication for 15 min yields greater particle size and PDI. Hence the time of sonication reduced to 5 min yielded better results. However stirring time maintained constant 30 min. Hence based on the above preliminary trials particle size, PDI, and % CDR were selected as responses and tabulated in Table-1.

CHARACTERISATION AND EVALUATION STUDY OF LAMOTRIGINE

The evaluation parameters such as Polydispersity studies, Drug Content (% yield) Drug entrapment efficiency of Lamotrigine loaded nanoparticles and their results are tabulated in Table-2.

The findings revealed that the drug content and entrapment effectiveness of nanoparticles held at $400C \pm 20C$ were lower when compared to nanoparticles stored at $250C \pm 20C$. This might be caused to drug leakage from the polymer core when the temperature is raised to $400C \pm 20C$. Because of the drug's high phase transition temperature and poor penetrability, this may be characterised as confined leakage of the medication. The optimised nanoparticles showed no change in appearance after being stored, and they retained 99.15 percent of their claimed drug content. The flat surface of the formulation, as shown in the photos, indicates that the solvent has been completely removed from the formulation.

The release kinetic study of lamotrigine has been conducted by studying the dissolution mechanics. The kinetics studies were evaluated by the following of the equation that is mentioned below.

Zero-order: $M_t = M_0 + K_0 t$

First-order: $\ln M_t = \ln M_0 + K_1 t$

Higuchi model: $M_t = K_H \sqrt{t}$

Korsmeyer–Peppas model: $M_t/M_0 = K_k t^n$

Where as

In this equation, M_t is denoted as the amount of drug that has been dissolved in time t , M_0 is the initial amount of the drug, K_1 is the constants of first-order release, K_0 is the constants of zero-order release, K_H is the constants of Higuchi rate, K_k is the constants of Korsmeyer–Peppas model release, and n is the diffusional release exponent that indicates which release mechanism is in operation. To determine which of the models were best-fitting, the correlation coefficient (R^2) value was calculated for each of the models under consideration.



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According to the findings of the previous study, Lamotrigine-loaded nanoparticles (Biodegradable nanoparticles) with hydrophilic surfaces have been created to circulate in the bloodstream for extended durations of time^{15,16}. These systems allow for the regulated release of the medication, which prolongs the duration of the therapeutic impact, as well as the targeting of the drug to specific locations in order to maximise its effectiveness. Polymeric nanoparticles have become particularly appealing carriers for oral drug administration due to their physicochemical variety and biocompatibility, as well as their capacity to increase the oral bioavailability of drugs¹⁷⁻²³.

CONCLUSION

Given the high systemic blood concentration, it is clear that administration of antiepileptic medications by the usual route results in significant side effects such as skin rashes, liver damage, and nephrolithiasis, among other complications. The distribution of these medications presents a significant problem to the researcher in this case. According to the findings of this investigation, novel administration of lamotrigine may reduce the chance of crossing BBB. Hence It is possible to make lamotrigine-loaded nanoparticles using a standard technique. The formulations of nanoparticles had the correct particle size, high entrapment efficiency, and percentage drug release, all of which were desirable characteristics. A drug's concentration and the presence of polymers were discovered to have an effect on the particle size, entrapment effectiveness, and percentage drug release of Lamotrigine-loaded nanoparticles, according to the findings. These findings suggest that Lamotrigine-loaded nanoparticles may be successful in delivering regulated drug release over a long length of time, and that they may be useful in the treatment of epilepsy over a long period of time.

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Table-1 Particle size

Std	Run	Factor 1 A:SA: CSN mg	Factor 2 B:sonication min	Response 1 PS nm	Response 2 PDI	Response 3 % CDR %
4	1	100	10	476.8	0.618	85.5
8	2	200	15	648.1	0.639	83.1
9	3	300	15	826.1	0.948	80.2
6	4	300	10	482.4	0.655	85.8
1	5	100	5	326.2	0.245	95.4
5	6	200	10	464.9	0.732	85.4
3	7	300	5	242.6	0.312	98.9
2	8	200	5	325.6	0.557	99.6
10	9	200	10	449.1	0.624	86.9
7	10	100	15	507.2	0.446	85.2

Table-2 Characterisation And Evaluation Study Of Lamotrigine

Formulation	Polydispersity	Drug entrapment efficiency (%)	Percentage yield (%)	Drug content (%)
F1	0.098	79.23±1.10	87.73±1.16	85.07±2.72
F2	0.094	78.19±1.23	91.64±0.12	86.21±1.73
F3	0.106	82.29±1.16	92.97±1.58	90.12±0.69
F4	0.104	83.80±1.12	90.42±0.6	91.58±2.92
F5	0.123	87.87±1.17	91.22±0.14	86.32±1.61
F6	0.103	84.81±2.10	89.47±1.43	90.40±0.93
F7	0.098	79.13±1.11	87.48±1.89	93.37±2.56
F8	0.097	69.32±2.41	72.82±0.51	92.76±1.82





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F9	0.095	71.49±1.27	75.56±2.07	88.17±0.78
F10	0.0131	88.81±3.31	90.47±1.35	90.21±1.71
F11	0.124	72.27±2.11	77.54±1.09	93.41±1.71
F12	0.116	75.70±1.97	79.13±0.27	91.47±0.58
F13	0.121	82.21±1.82	85.36±1.07	87.78±1.78
F14	0.131	81.20±2.18	86.16±1.07	91.63±1.77
F15	0.124	89.49±1.04	91.22±0.38	94.51±1.07
F16	0.098	91.19±2.09	94.07±0.19	93.23±1.32
F17	0.099	94.19±1.97	96.21±1.19	96.14±2.13
F18	0.093	86.29±1.26	91.27±1.28	91.12±1.16
F19	0.164	83.18±1.10	88.14±1.23	90.40±0.93
F20	0.17	81.49±1.12	85.16±1.07	87.17±1.78

Table:3 Drug release (In vitro) kinetics – Lamotrigine nanoparticles

Time (Hr)	Cumulative drug released %	% of drug remaining	Square root of time	log Cumulative drug remaining %	log of time	log Cumulative drug released %	Drug released%	Cube Root of drug Remaining(Wt)
0	0	100	0.000	2.000	0.000	0.000	100	4.642
10	0	100	3.162	2.000	1.000	0.000	0	4.642
20	3.1	96.9	4.472	1.986	1.301	0.491	3.1	4.593
30	5.2	94.8	5.477	1.977	1.477	0.716	2.1	4.560
45	9	91	6.708	1.959	1.653	0.954	3.8	4.498
60	14.8	85.2	7.746	1.930	1.778	1.170	5.8	4.400
75	18.9	81.1	8.660	1.909	1.875	1.276	4.1	4.329

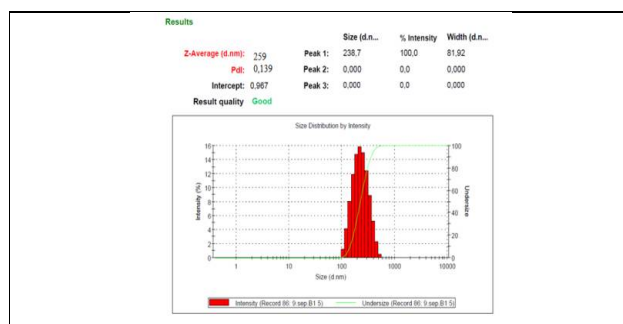


Fig:1 Particle Size and PDI

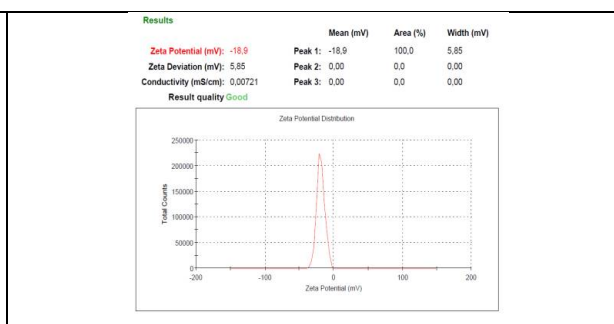


Fig:2 Zeta potential

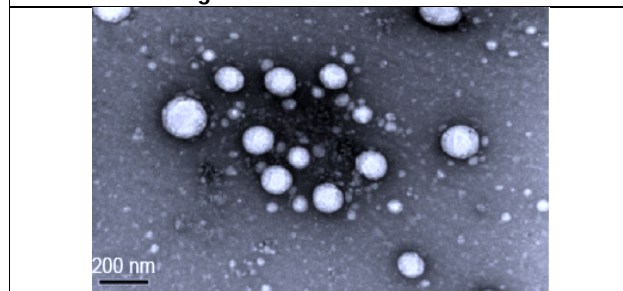


Fig:3 TEM ANALYSIS of optimized batch of Nanoparticles

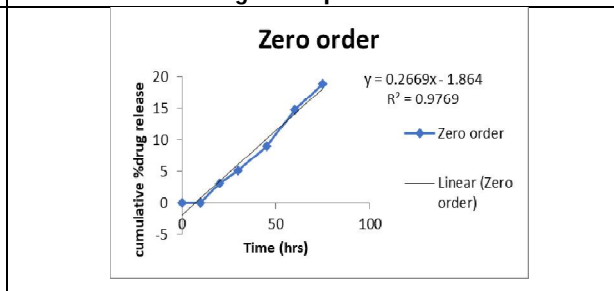


Fig:4 Zero order release





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<p>Higuchi</p> <p>Y = 2.2295x - 4.2525 R² = 0.81</p> <p>Legend: Higuchi, Linear (Higuchi)</p>	<p>First order</p> <p>Y = -0.0013x + 2.0097 R² = 0.971</p> <p>Legend: First order, Linear (First order)</p>
<p>Fig: 5 Higuchi release</p>	<p>Fig:6 First order release</p>
<p>Kors-peppas</p> <p>Y = 7.1225x - 3.6121 R² = 0.58</p> <p>Legend: Kors-peppas</p>	<p>hixson</p> <p>Y = 0.0044x - 0.0322 R² = 0.9734</p> <p>Legend: hixson, Linear (hixson)</p>
<p>Fig: 7 kors-peppas release</p>	<p>Fig: 8 Hixson crowell release</p>





Importance of Bio Control Agents and Chemical Pesticides on the Yield of Crops in Shivamogga District

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ABSTRACT

Biological control agents is defined broadly because the "use of plant or modified organisms, genes, or gene merchandise" to reduce the consequences of pests and illnesses. Chemical insecticides are artificial ones used to govern the pests. Physical control is using tillage, open-subject burning, heat treatment, and other physical strategies, normally to do away with pests or separate them from the crop. Chemical control is using synthetic chemical insecticides to dispose of pests or lessen their consequences. Anchal Sharma reported that many approaches to biological manage can be categorized conventionally as regulation of the pest population, exclusionary systems of protection (a living barrier of microorganisms on the plant or animal that deters infection or pest attack) and systems of self-defense. The agents of organic manipulate include the pest- or disease-agent itself, antagonists or plant enemies, or the plant or animal managed or manipulated to protect itself. Principles of plant health care are presented, understand the production limits of the agro-environment, rotate the vegetation, maintain soil natural grasp, use easy planting material, plant properly-tailored, pest resistant cultivars, decrease environmental and dietary stresses, maximize the effects of useful organisms and shield with pesticides as essential.

Keywords: Plant diseases, fungi, bacteria, Chemical pesticides, bio-control agents.

INTRODUCTION

The problems of insects-pests are one of the major constrains for achieving higher production and better income. Problems are there for all crops and especially acute in commercial crops. India loses about 30% of its crops due to pests and diseases every year. The use of pesticides has certainly contributed in crop protection thus, minimizing yield losses with the introduction of intensive cropping, the use of insecticides and pesticides have increased manifolds to control harmful pests such as insects, nematodes, disease, needs etc. during the past 3-4 decades,





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practically pesticide applications don't follow any scientific recommendation and quiet of on the indiscriminate and unscientific use has adversely affect ecological balance. Resulting in pest resurgence, development of resistance in pest species and environmental pollution. However, excessive use of pesticides not only leave residues in soil, water and air but also have adverse effect on the non-target organisms, such as pollinators, parasitoids, predators and wild animals. (bio-pesticides and bio controlling agent producing unit). Bio-control agents are living organisms, including parasites, predators and diseases causing fungi, bacteria and viruses. Here are the natural enemies of pests, which can intervene the life cycle of insect pests or such a way that the crop damage is minimized. They are both less toxic and more flexible than chemical pesticides. Biological control induces a wide range of approaches, from natural predators to biologically produced molecules. Micro-organisms, including viruses, bacteria, fungi and protozoan, cause disease or poison their targets through toxic production. These bio-agents can be conserved, preserved and multiplied under laboratory condition for field release once these bio-agents are introduced in the field of build their population considerably; they are capable of bringing down the targeted pest population below economic threshold level.

The primary techniques of pest control may be grouped into 3 classes of (1) physical manipulate, (2) chemical manage and (3) biological manage. These large categories, in flip, may be blended into integrated pest management (IPM), integrated crop and pest management (ICPM), or, as can be used in this newsletter. Biological manage is the manage of one organism via every other (Beirner, 1967). This manage can be expressed as both an extended populace of the pest (DeBach, 1964) or as a limit or prevention of the severity or prevalence of pest harm without regard to the pest populace (Cook and Baker, 1983). Biological control depends on information of organic interactions at the environment, organism, mobile, and molecular levers and regularly is extra complex to manipulate compared with physical and chemical methods. Biological manage is likewise in all likelihood to be much less wonderful than most bodily or chemical controls however is generally also greater stable and longer lasting (Baker and Cook, 1974). In spite of organic controls having been used in agriculture for hundreds of years, as an industry biological manipulate remains in its infancy. Biological control is now being considered for more and more plants and managed ecosystems as the number one technique of pest control. (Anchal Sharma et al., 2013). The objectives of this study are to study about different kinds of bio-control agents. To know about significance of bio-control agents and also to study about yield of crops after using bio-control agents and chemical pesticides.

Review of Literature

Biological control changed into located by trial and error after which practiced in agriculture long before the term itself got here into use (Baker and Cook, 1974). One example is the ancient exercise of not growing the identical crop species inside the equal area greater regularly than each 2nd or 0.33 12 months or maybe longer. Such crop rotation lets in time for the pest or pathogen population in soil to lower beneath a few monetary threshold due to the predatory, aggressive, and different adversarial consequences imposed through the associated microflora and fauna. In other phrases, crop rotation permits time for the plant soil microbiota to sanitize the soil, specifically in regards to the greater specialised plant parasites and insect pests which can be incredibly dependent on their host crop to preserve their populations (Anchal Sharma et al., 2013).

The generation of modern biological manage, related to the planned switch and advent of natural enemies of insect pests, turned into released one hundred years ago with the successful introduction of the beetle from Australia to California (Baker, 1987). DeBach (1964) described organic manipulate as "the motion of parasites, predators, or pathogens in maintaining every other organism's population density at an extended average than might arise of their absence." This definition covers a few incredibly a success organic controls of insect pests with natural enemies, but it does now not accommodate a few different surprisingly a hit controls prevalent in different disciplines as examples of biological control. For example, citrus tristeza virus is managed in Brazil through inoculating the citrus trees with a moderate virus, which then protects the timber in opposition to the greater severe strains (Costa and Muller, 1980). "Cross protection" was first proven with the aid of H. H. McKinney in 1929 to have capacity for biological manipulate of plant viruses. Plant pathologists check with pass protection for control of plant viruses as biological manage. Need



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for Biological Control in India The manufacturing of meals grain ought to boom to 250 million tones by way of the yr 2020 with a purpose to meet the wishes of the developing population. Beyond proper agronomic and horticultural practices, growers regularly rely closely on chemical fertilizers and insecticides.

However, the environmental pollution as a result of excessive use and misuse of agrochemicals, in addition to worry mongering by means of a few opponents of insecticides, has led to extensive adjustments in people's attitudes towards the usage of pesticides in agriculture. A concomitant growth in the share of pests and diseases resulted in the improved use of poisonous chemical for his or her control. The range of species proof against pesticides and fungicides is expanded. In current years after signing of the overall settlement of trade and tariff of world change enterprise extra emphasis is given to using ecofriendly pesticide for crop production in view in their least toxic nature, low stages of disorder resistance and coffee residue troubles. However, Biological controls should be incorporated with other manipulate measures due to the fact different methods are powerful at extraordinary instances and locations below varying conditions (Anchal Sharma et al.,2013).

Naik (2019) worked on the disease of fruit rot or mahali disease, which is serious threat during rainy season in the hilly region of malnad area. Karnataka during the study period they observed the severe loss in yield of areca nut. Due to this disease in this connection they adopted bio controlling in measures for the disease by using trichoderma anizium and all these bio controlling agents most effective in reducing the disease. Rai et al. (2019) worked on the disease caused on ginger such as soft rot of ginger. This disease causes the loss of 50% of ginger crop. The species which cause this disease is caused by pythium and fusarium species. So they used the antagonistic fungi bacteria. Actinomycetes and plants extract. As they are eco-friendly. Maheshwari (2018) they worked on the trichoderma species. Trichoderma are most promising microbes in removing most plant pathogenic fungi in which they collected much rhizospiyarala soil from different part of Shivamogga of different crops. Like areca nut, banana, tomato and resulted in 20 trichoderma SPS isolates among them tasperellum found in predominate form they can be effectively utilized potato. Dextrose agar medium for their growth.

Nagaraja. UASD (2013) worked on sheath blight of rice caused by rhizoctonia saloni [Kuhn] is the major pathogen in causing rice blight. They served different parts of tunga bhadra project (zone) area of north eastern zone of Karnataka. The result is major causative agent of sheath blight of rice are rhizoctonia SPS. They were studied the different chemical, biological, physical features of these rhizoctonia SPS and finally found that the fungicides, bio agents, hexaconazole, validamycin and carbendazim, trioune. P. Fluorescence was found effective in managing sheath blight. Veraganti (2016), they studied on the disease purple blotch of onion caused by alternaria porri. In which the onion is one of the most staple food [vegetable crop] all over the world one of the most serious disease is purple blotch this disease cause extensive disease to bulbs and hinder sold production. Among different bio control agents tested against alternaria porri, trichoderma harziomum. Record highest inhibition of mycelia growth 83.10%.

Study Area

The elevation of the Malavagoppa is 640 meters above the level of Sea in the Western part of the state of Karnataka. The topography of Malavagoppa is plain possessing semi-deciduous vegetation appearing occasionally. The coordinates of Shivamogga are at 13.9167° north, 75.5667° east. Malavagoppa also consists of some major forms of soil such as non-saline alluvio-colluvial soil, medium deep black soil, red gravelly clay soil, red clay soil, lateritic clay soil, lateritic gravelly clay soil, saline alluvio-colluvial soil and even brow forest soil.

MATERIALS AND METHODS

The primary data was collected by the interview of more than 15 farmers. Using the standard questionnaires. We individually visited the agricultural field and collect the data with the proper questionnaires. The secondary data were collected from sanjeevini organic manure minerals. They provided the data of how to prepare the compost having bio control agents and bio fertilizers. The further data was collected from college of agricultural navile,





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shivamogga. We provided the data about the locally used bio control agents which are in there laboratory and they also provided the information and uses [significance] of bio control agents.

Questionnaire

Name, address and qualification of the farmer.

Total agricultural field they have (in hectares).

Type of the crop

Pesticides they are using.

Fertilizers they are using.

Total annual crop yield per acre

Total annual income per acre.

Diseases caused to crop

Experience in agriculture.

Chemical pesticides used from.

RESULT AND DISCUSSION

A survey is carried out to access the importance of bio control agents against the chemical pesticides in the management of different diseases like rice blast, bud rot, foot rot, inflorescence die back, rhizome soft disease in comparison with different chemical pesticides. The comparative study was carried on bio controlling agents and chemical pesticides which are used to control different diseases caused by different pathogens in the crops such as, areca, paddy, ginger crops in Machenahalli, Malavagoppa, Ottighatta villages etc. the result obtained thus revealed that application of bio control agents significantly reduces the disease occurrence in the affected crops. While a chemical pesticides reduces some percentage of disease causing to the crops. But the yield which obtains by the usage of bio control agents is more when compared with the chemical pesticides. The disease management by a bio control agents is traditional and the bio controlling agents only predate and decreases the targeted pathogens while chemical pesticides is non-selective in their activity and also decreases the microorganisms which helps in the growth of the plant. Since the bio control agents are cost effective, cheaply available and eco-friendly. It helps in increase in soil fertility and promotes the growth of other microbes which are helpful for plant growth. And it also increases the crop yield. But chemical pesticides available comparatively higher market price. It is nonselective, it is not eco-friendly, it will decrease the soil fertility and it is the reason for soil, water and air pollution. It decrease the crop yield as compared to the bio control agents. After revealing these data, the bio control agents are more effective in controlling selective or targeted pest, Rather than chemical pesticides.

Significance of bio control agents

1. By using bio control agents we could suppress the development of soil born plant pathogen
2. Bio control agents are used for the production of antibiotics. Such as *Streptomyces rimosus*, penicillium by *Penicillium natatum* fungus.
3. By using bio control agents we can decrease the disease caused by some micro-organisms such as bud rot, root rot, inflorescence die back, rice blast, rhizome soft, leaf rust etc.
4. Since the bio-control agents are selective in controlling particular disease causing pathogens they are more effective than chemical pesticides.
5. Bio control agents are used to suppress the phytoneumatodes they are listed below.
6. Microbes which are used as bio control agents they release the plant growth hormones and decompose the complex organic matter which increases the soil fertility and promotes the plant growth increases the plant yielding.
7. They are eco-friendly in nature. They do not cause harmful effect on environment, but they are helpful in decreasing the soil pollution caused by the chemical pesticides.
8. By using these bio-control agents we can reduce the harmful effect caused by the sprayable chemical pesticides



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- on the honey bees and other insects which are natural pollinator.
9. When compare to the chemical pesticides, bio control agents are less costly and cheaper, which are easily available and which are easily implemented to the agricultural field.
 10. Bio control agents give protection to the crop throughout the crop period.
 11. As compared to the chemical pesticides, the bio control agents do not cause toxicity to the plants and surrounding environment components.
 12. They easily multiply in the soil and leave no residual problem.
 13. They are easy to manufacture.

CONCLUSION

In the present study, concluded that increasing the crop production from the modern farming technics reaching a plateau in the most of country including India and the environmental problems due to excessive use of chemical pesticides and fertilizers becoming a matter of concern so the biological control can be alternate system which may play an important role achieving the goal of agriculture. Application of bio control agents are most effective in controlling the disease caused by the pathogen it has been proved by this study that those farmers who are using bio control agents are getting more yield and income than that of chemical pesticides used farmer. By considering the present situation it is the matter of concern that farmers are converting their agricultural land to waste land by using different type of chemical pesticides and fertilizers, since those chemicals harmful for the organism which influences the plant growth. That leads to decreased crop production, eventually income is also decreases. The farmers who are invested lot of money on chemical pesticides ends their seasonal crop yield with low quantity and low income than they are invested on chemical pesticides. It eventually increases soil pollution, water pollution and air pollution. In this study we conducted interview with those farmers who are using biocontrol agents reveals fact that. Bio agents are eco-friendly, they do not cause any type of pollution, by applying these organisms to the agricultural land they degrade the complex organic matter into simple inorganic elements which acts as plant nutrients. This increases soil fertility, the major significance is that they predate the pathogens which are responsible for the decreased plant yield. And the farmer who are invested on the bio control agents get more profit either economically or by making their agricultural land more fertile

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Table 01: Farmers using Chemical Pesticide

Name, address and qualification of the farmer	Mukesh naik, sugar factory road malavagoppa, shivamogga577222. Uneducated	Suri, post office road, Malavagoppa577222 2 nd standard	Gangamma, malavagoppa shivamogga577222.4 th standard	Rudra naik, chennabasaveshwara temple opposite, malavagoppa , shivamogga-577222. 6 th standard.
Total agricultural field they have.	2 acres	1 acres	4 acres.	1 acre.
Type of the crop	Areca nut	Areca nut	Chrysanthemum, banana plant.	Areca nut
Pesticides they are using	Boric acid, glyphosate.	Dimethyl (45Cu ₃ (OH) ₃ C)	Boric acid, glyphosate, carbondazim 50%.	Carbondazium ,dimethyl 45.
Fertilizers they are using.	NPK, suphola, urea, cow dung.	DIP, Zinc suphola	DAP, urea (prescribed by company)	DIP, NPK, suphola.
Total annual crop yield per acre.	5-6 quintal / acre.	6-7 quintals /acre.	32 quintals/acre.	5 quintal/acre.
Total annual income per acre	2,00,000/acre.	2,00,000/acre	4,80,000/acre.	2,50,000 /acre.
Diseases caused to crop.	Yellow leaf, inflorescence dies back.	Bud rot, fruit rot.	Vascular wilt (fusarium wilt).	Yellow leaf, fruit rot
Experience in agriculture	12 years	10 years	7 years	20 years
Chemical pesticides used from.	8 years	7 years	7 years	16 years





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Table 02: Farmers using bio control agents

Name, address and qualification of the farmer	Krishna naik, opposite sugar factory, Malavagoppa, shivamogga577222 1 st year PUC.	Venkathesh naik, postoffice road, malavagoppa, Shivamogga-577222. Degree	Murthy M V, malavagoppa, Chennabasaveshwar atemple, 1 st cross , Shivamogga-577222. 10 th standard.	Sunil machanalli, Bhadravathi road, Shivamogga-577229. Degree.
Total agricultural field they have.	1 acre.	3 acres	3 acres.	1.75acres.
Type of the crop	Areca nut.	Paddy.	Areca nut.	Areca nut.
Pesticides they are using	Pseudomonous, rhizobium (Biocontrol agents)	Compost having streptomycis species	Sanjeevini suraksha (pseudomonas, trichoderma).	A compost having azospirillum, trichoderma.
Fertilizer they are using.	Compost, neem product Biocontrol agents)	Cow dung, jeevamrutha, gomutra, bio compost.	Organic manure (neemcompost)	Green manure, compost, sanjeevini suraksha.
Total annual crop yield per acre.	8 quintal/acres.	25 quintal/acre.	12 quintal/ acre.	12 quintal/ acre.
Total annual income per acre	3,00,000/acres.	45,000/acre.	4,00,000/acre.	3,50,000/acre.
Diseases caused to crop.	Yellow leaf, budrot.	Paddy blast(benki roga)(kadige roga).	Inflorescence die back, root rot, early falling of bud.	Foot rot(ganoderma), fruit rot(kolle roga).
Experience in agriculture	8 years	17 years.	10 years.	15 years.
Bio control agents used from.	3 years	7 years.	5 years.	6 years.

Table 03: Some selective effect of bio control agents are as follows:

Sl.No	Bio control agents	Common Diseases
1)	<i>Trichoderma harzianum</i>	Kole roga [fruits rot]
2)	<i>Pseudomonas fluorescens</i>	Rice blast
3)	<i>Trichoderma virens</i> <i>Trichoderma viridae</i>	Inflorescence die back
4)	<i>Trichoderma harzianum</i>	Bud rot
5)	<i>Trichoderma viridae</i> <i>Streptomyces</i>	Foot rot [anabae roga]
6)	<i>Antagonistic fungi</i> <i>Trichoderma species.</i>	Soft rot of ginger
7)	<i>Pseudomonous fluorescence</i>	Sheath blight of rice
8)	<i>Trichoderma harzianum</i>	Purple blotch of onion
9)	<i>Bacillus subtilis P.</i> <i>fluorescence</i>	Wilt of chickpea





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Table 04: Non-selective activity of chemical pesticides

SI.No	Chemical pesticides	Non- selective organisms	Selective organisms
1)	Boric acid	Spiders, mites, algae, mouldsand fungi	Pest [Fusarium].
2)	Moncozeb	Nitrifying bacteria Denitrifying bacteria	Fungus.
3)	Score	Plant growth Stimulating microbes	<i>Alternaria septoria.</i>
4)	Kavach [chlorothalonil]	Plant growth Stimulating mocrbes	Anthrachnose.
5)	Amistar top	Mites, algae, spiders, fungi, moulds	<i>Ascomycetes, basidiomycetes.</i>

Table 05

SI. No	Bacteria	Plant nematodes
1)	Rhizo bacteria	<i>M.ethiopica, xiphinema index.</i>
2)	Bacillus subtilis	<i>Aphelenchoides besseyi, ditylenchusdesdructor, bursaphelenchus,xylophilus, M.javanica.</i>
3)	Nitrogen fixing bacteria Phosphate solubilizing bacteria Potassium solubilizing bacteria	<i>M.incognita.</i>
4)	<i>Paeni bacillus polymyxa, Plentimorrbus</i>	<i>M.incognita.</i>
5)	<i>Pasteuria penetrans</i>	<i>Meloidogyne spp.</i>
6)	<i>Bacillus thuringiensis</i>	<i>M.incognita.</i>
7)	<i>Pseudomonas fluorescece</i>	<i>M.incognita, M.javanica.</i>
8)	<i>Actinomycites</i>	<i>M.incognita.</i>
9)	<i>Enterobacter asburiae</i>	<i>M.incognita.</i>
10)	<i>Stenotrophomonas, moltophilia,chromo bacterial species</i>	<i>G.rostochiensis.</i>

(Christian joseph et al 2015)



Figure 1: Study area map



Figure 2: Azatobacter, Pseudomonas and Organic manure used by the framers of Malavagoppa





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Figure 3: Interview with farmers to collect information about bio control agents and chemical pesticides

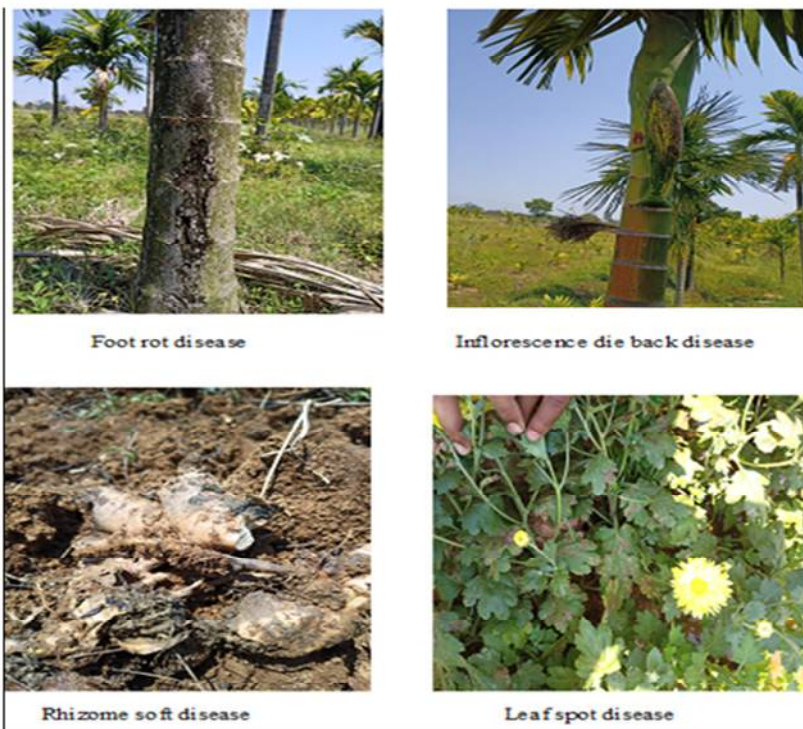


Figure 4: Different diseases of plants





Analysis and Implementation of Artificial Intelligence Based Power Electronic Converter in Wind Grid Tied System using ANN

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ABSTRACT

Distributed-generation systems are one of the major developing field in the past decade. Renewable energy power generation and near-consumer power generation is more critical than traditional power generation systems. Power delivery systems involves small distributed power sources, such as fuel turbine, wind turbines, battery devices, Wind, etc. The electrical energy from the wind can be separated utilizing wind based wind generation system. This energy can be amplified if the associated load variations coordinate with that of the wind system. In each of the ideal coordinating between the wind and the load obstruction, The MPPT Maximum Power point Tracking Methods offers extensive potential for DC-DC converter. This Research paper means to show how the displaying cycle of a productive Wind power framework with a DC Load can be accomplished utilizing a Artificial Neural Network (ANN) Controller. This is applied through an inventive procedure, which detects the wind speed of the wind turbine and delivers an ideal worth of obligation apportion for the DC-DC converter to get the MPPT. The coefficients of this regulator have been refined dependent on past information data's utilizing the wind speed. Gradient descent algorithms utilized to work on the boundaries of the ANN Controller to accomplish an ideal reaction. The legitimacy of the Wind generation system utilizing the MPPT procedure dependent on the ANN Controller is additionally exhibited by means of a progression of test tests at various surrounding conditions. The recreation results show how the MPPT strategy based on the ANN Controller is more viable in keeping optimal power values compared with conventional techniques.

Keywords - ANN, Artificial Neural Network, Perturb and Observe algorithm (P&O) and incremental inductance, boost converter; fuzzy neural network controller; gradient descent algorithm; maximum power point tracking; Wind system.



**Balamurugan and Selvam****INTRODUCTION**

Expanding the energy interest all throughout the planet has zeroed in consideration on the need to foster inexhaustible economical sources with insignificant ecological effect. Of the multitude of expected sustainable wellsprings of energy, that got from wind based force keeps on filling in unmistakable quality as it tends to be used to produce electrical force without contamination and is promptly accessible all throughout the planet. Most altogether, albeit the expense of establishment is as yet restrictive [1,2], when functional, the expense of the activity and upkeep is generally low and monetarily serious with other accessible force sources. A vital part of the wind based turbine is that it is a not-fixed voltage or current source, and consequently relies on the variety in illumination, wind, and burden. Hence, the general productivity of the wind light based exhibit can be significantly low because of these varieties. To enhance the productivity of the wind based turbine, the greatest force point following (MPPT) method is used to upgrade the yield. This procedure can acquire the greatest conceivable force from a shifting source by utilizing a controlled DC-DC converter with a one of a kind following calculation presented between the Wind exhibit and the heap. Numerous MPPT strategies have been introduced in the writing [1,3,4] including: Incremental Conductance (IC), Perturb and Observe (P and O), and the Feedback Linearization Method. Be that as it may, the majority of them have restrictions because of the non-direct attributes of wind turbine. All the more as of late, astute strategies utilizing neural organization and fluffy rationale are introduced as a successful way to deal with follow the greatest force from the wind turbine equivalent with changing barometrical conditions [5–8]. Such clever strategies dependent on MPPT give the office to accomplish a quicker reaction with more noteworthy exactness contrasted and traditional methods. In this paper, a Artificial neural Network (ANN) regulator dependent on the MPPT procedure has been planned and executed to control the obligation pattern of a lift converter and to evoke the greatest force from the wind turbine. The coordinating of fluffy rationale with a neural organization is more helpful for MPPT contrasted and regular regulators by conquering the constraints of the individual methods. Specifically, this offers higher precision with the non-straight conduct of wind power system. The boundaries of the ANN regulator are additionally refined utilizing a slope plummet based back-proliferation calculation to acquire the ideal outcomes.

RELATED WORKS

The shows of chosen inductor by High lift and buck converters have been investigated in Park et al. (2005) and Yao et al. (2005). Current amendments guarantee the case of tapped inductor in high lift converters Fohringer et al. (2006), Vazquez et al. (2007) and Lee et al. (2011). In Fohringer et al. (2006), it is uncovered that the lift converter with the tapped inductor has a higher exchange proportion on relating with the conventional move forward circuit design for the same obligation relationship. The converter in Fohringer et al. (2006) additionally has lesser voltage pressure through the obstruction capacitor, however a more prominent current tension on the source sidestep capacitor. In Vazquez et al. (2007), an incredible move forward utilization of tapped-inductor move forward arrangement is assigned and analyzed, right now it was likewise settled that for clarifying remarkable move forward necessities, the converter as an upstanding decision.

Windlight based photograph voltaic frameworks with the solicitation of tapped inductor circuit arrangement has been thought in Yris et al. (2010) and Lee et al. (2011). In Yris et al. (2010), a stage down-move forward circuit setup through tapped inductor is thought of, highlight to picking the arrangement which is proper for a durable windlight based photograph voltaic inverter, which is valuable for homegrown utilization through connecting to a 1ϕ organization. In this examination work, regardless of whether the improvement of the progression down-move forward through tapped-Inductor was progressed than the addition achieved through the conventional advance down-move forward setup was affirmed. It was besides settled in Yris et al. (2010) that in a minor 1ϕ inverter inside wind based structures crossed to the matrix organization, the utilization of the progression down-move forward through tapped inductor lacking ground is likewise reachable.

Second rate power than the cluster rating is circulated because of contradiction misfortune, David et al. (2015). On coordinating a profoundly efficient DC-DC design with greatest working point following capacity the force





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misfortunes are unfavorably consolidated. To ensure the ideal abuse of wind oriented photograph voltaic units, numerousmost extreme force following calculationsarrangements are created Efram et al. (2017), Jain et al. (2017) and Wasynczuk et al. (2013). The identifying of the yield current and voltage of wind oriented photograph voltaic modules are normally convoluted in the applications, and to take advantageof force stressed from the wind based photograph voltaic modules, the data"s are utilized by the most extreme force point following strategies as introduced.

Geoffrey et al. (2004) depicted that the more elevated levels of direct current voltage can be accomplished by interfacing the wind boards in series way with lower current levels and higher efficiencies. the bury association of wind boards areknown as wind exhibits. at the point when the windboards are associated in series is called as strings. Yet, the extended strings of photograph voltaic boards have an enormous number of challenges especially when the string is working under non- uniform conditions of radiation.

Falling of two DC-DC high move forward converterscan be the one of conceivable technique forexpanding the voltage extension (acquire) of a windbased photograph voltaic cluster. The setup is introduced in Figure 2.2. As proposed in Geoffrey et al. (2004), to shape a string, each board takes its individual converter, and the boards through their connected converters are as yet situated in grouping.It was on the other hand chosen in Geoffrey et al. (2004) that this game plan doesn't have any capacityto convey the total measure of yield power in every one of the occasions starting at a mix of out of the wind (concealed) boards and those providing full force. This is for the explanation that if a windlight based photograph voltaic board is out of the wind or concealed, its present drops and the current in the entire string must destruction to the worth of the lowermost

Some dynamic braced circuit designs are proposed to decrease the exchanging voltage stress brought about by the stream or spillage inductance voltage in Yanget al. (2010), Duarte et al. (2002), Roh et al. (2004), Tseng et al. (2004) and Wu et al. (2008). These further developed circuit arrangements are recuperates the stream energy with ostensible voltage stress through the switch and results bigger yield voltage. On the other hand, these further developed dynamic cinch setups experiences a few disadvantages as follows circuit involvedness, significant expense and misfortunes attributable to the hold circuit plan. A disappointment might happen because of the covering of preeminent and dynamic cinch switch entryway drive signals guaranteed by Lee et al. (2003).

Different stage move forward converters designs with intertwined which is referenced as interleaved exchanging in a large portion of the writing have recognized significant consideration in wind oriented photograph voltaic applications guaranteed by Yanget al. (2010) and Li et al. (2007). In such intertwined/interleaved converters, move forward converters are associated equal way to expand energy proficiency through dropping the amount of responsive force fatigued as of the source. .

Dhople et al. (2019) portrayed the different coherent constructions of two-stage move forward converters through entwined exchanging in lieu of windlight based photograph voltaic applications particularly under consistent state working conditions. The inspected technique in Dhople et al. (2019) contained the flawed attributes and set up a technique to take advantage of the force yield of the windlight based wind source dependent on the exchanging plan which are related on voltage and current flaw association

The Implementation of This Research paper is given below.

- The framework associated mixture sustainable framework is acknowledged by discrete voltage source converters and battery reinforcement framework in order to infuse nonstop capacity to the matrix.
- Free and strong controls of MPPT of the introduced sustainable sources are performed by basic ANN regulator.
- A bidirectional converter constrained by ANN regulator is utilized to keep up with steady voltage at the PCC.
- The state-space model of the exchanged Modular Resonant Cell converter is created to examine the framework dependability, and the reenacted viability of the general framework is approved by fostering the model of the framework.





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All the above converters and control strategies work just the energy accessible in WIND and twist, individually. Other than the variety in accessible energy during daytime and wind blowing period, there might be some time that both the sources neglect to deliver power. To keep away from such no availability of force, a battery reinforcement is executed in the network associated framework. A shrewd dispatch framework is needed to control the force dispatch from battery unit [26]. As the heaps associated with the network are dubious and are at risk to fluctuate, customary battery the board conspire can't be used to oversee power stream among the battery and matrix. The current regulators supply the whole force of the battery to the framework if the heap esteem increments and the battery might empty out totally. In the event that this interaction proceeds, the battery life expectancy limited which thus causes blackout and diminishes the dependability of whole framework. In this manner, it is fundamental for carry out brilliant regulators for effective administration of battery framework [27,28,29,30]. The yields of converters of WIND and wind sources and battery are associated at the normal coupling point where a consistent DC voltage is kept up with the proposed framework. This voltage is coupled to the network through 3 ϕ voltage source inverter (VSI) and channel circuits. As staggered inverter [31, 32] and Modular Resonant Cell inverter [33, 34] business makes the circuit unpredictable and exorbitant and diminishes the framework effectiveness, a customary VSI with LC channel is carried out in our framework. Also, half breed framework works with coherence in power stream, along these lines further developing the unwavering quality [35, 36]

MODELING OF GRID CONNECTED WIND

The turbine generator transfers the torque produced from the turbine blades to the rotor of the generator by which alternating electrical energy is produced. This generator is associated with a rectifier circuit to give a DC power equivalent to the one generated from the wind system. The rectifier output is controlled to extricate optimum power from the breeze turbine as per the accompanying standards. The basic condition which governs the mechanical power of rotor edges and by which the electrical power is driven is given by

$$P = \frac{1}{2} \rho A C_P V^3 \quad (1)$$

where ρ is the density of air (kg/m^3), A is the territory covered by the blades of the turbine (m^2), V is the velocity of wind (m/s) and C_p is the coefficient of power. Consequently, if the density of air, the region covered by wind and speed are kept as constant, then the power output will vary with its coefficient. The breeze turbine is typically characterized by its C_p -TSR, where the TSR is the tip-speed proportion and is expressed as:

$$\omega_{\text{opt}} = \frac{\text{TSR}_{\text{opt}} V}{R} \quad (2)$$

R and ω_m are the radius of turbine blade and the rotational angular velocity. The maximum value of power coefficient is expressed if the tip-speed ratio value is optimum, TSR_{opt} which brings about maximum efficiency, and thus the maximum power is absorbed by the turbine.

As observed from (1), the maximum power output is varying wind and rotor speeds. As the wind speed is not controlled, the rotor speed ought to be controlled to follow the TSR_{opt} . This is accomplished by implementing a speed control mechanism in the system so that the rotor runs at high speed when wind speed is high and runs at low speed as wind speed lowers. The speed control of the rotor is employed to control and maximize the TSR and the power coefficient.

Using (1), the maximum rotor speed is calculated as

Combining Eqs. (1) and (3), the output torque corresponding to maximum power is





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$$T = \frac{1}{2} \frac{\rho A C_{P \max}}{\omega_{opt}} \left\{ \frac{R \omega_{opt}}{TSR_{opt}} \right\}^3 \quad (3)$$

PROPOSED SWITCHED RESONANT CELL MODULAR CONVERTER

shows the proposed medium voltage step- up converter, where the input DC side consists of 8 switches that are arranged so that two pairs of two switches are connected to the input of the LCL resonant circuit. One switch in each pair turns on for the interval dTs while the other switch in the same pair turns on during the interval $(1-d)Ts$. Hence, the switch voltage is equal to a quarter of the input DC voltage (V_i). In the two resonant circuits, the series capacitors ($Cs1$ & $Cs2$) block the DC component in $vs1$ and $vs2$ and form the resonant circuit with the series inductor ($Ls1$ & $Ls2$) and the magnetizing inductors ($Lm1$ & $Lm2$) of the two transformers. The resonant inductors ($Lm1$ & $Lm2$) can be integrated with the transformers to further reduce the number of magnetic components in the circuit. By operates the resonant currents ($ires1$ & $ires2$) slightly lagging behind the input voltages ($vs1$ & $vs2$), ZVS turn-on is achieved for all the switches. Snubber capacitors ($Cds1 - Cds8$) are added across each of the transistors to minimize the turn-off switching losses. Due to the use of LCL resonant circuits, a simple capacitive output filter can be used in the high frequency rectifier..

OPERATION PRINCIPLES

The operating principles of the proposed converter can be discussed according to the operating waveforms in Fig. 4. The operating principles of the circuit can be explained by four operating stages within a switching period (T_s), as shown in Fig. 5. In this converter, switches ($S1, S4, S5, S8$) and ($S2, S3, S6, S7$) operate in complementary fashion. ($S1, S4, S5, S8$) turn on during the interval dTs whereas ($S2, S3, S6, S7$) turn on during the interval $(1-d)Ts$. It should be noted that the dead-time between the turn-on of all the switches is ignored in the following analysis.

[$t_0 < t < t_1$]: At t_0 , the gate signals are applied to $S1, S4, S5$ and $S8$, due to the negative resonant current in both LCL resonant circuits, the anti-parallel diodes of $S1, S4, S5$ and $S8$ are forced to turn on. During this time, the voltage across $S2, S3, S6$ and $S7$ are all clamped to $V_i/4$.

[$t_1 < t < t_2$]: At t_1 , the negative resonant currents in the previous stage become positive, and $S1, S4, S5$ and $S8$ are turned on under ZVS

$$V_{C1} = V_{C2} = V_{C3} = \frac{D}{1-2D} V_i \quad (4)$$

$$V_0 = V_i + V_{C1} + V_{C2} + V_{C3} = \frac{1+D}{1-2D} V_i \quad (5)$$

The output voltage gain

$$G = \frac{V_0}{V_i} = \frac{1+D}{1-2D} \quad (6)$$

MODE 2

[$t_3 < t < t_4$]: At t_3 , the gate signals are applied to $S2, S3, S6$ and $S7$, the positive resonant current in both LCL resonant circuits flow through the anti-parallel diodes of $S2, S3, S6$ and $S7$. During this time, the voltage across $S1, S4, S5$ and $S8$ are all clamped to $V_i/4$.





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[$t_4 < t < t_5$]: the resonant currents in this stage become negative, and S_2, S_3, S_6 and S_7 are now turned on under ZVS.

When S is opened, D_1 and D_2 are closed, D_3 is in reverse blocking state, capacitances C_1 and C_3 are charged via L_1 and L_2 , and C_2 gets charged as V_i and L_1 are in series with L_2 , and the current flows through the load R_L via capacitor C_0 . The resultant steady-state equations are:

$$V_{L1} + V_{C1} = 0, V_{L2} + V_{C3} = 0, V_{L1} + V_{C1} = 0, V_{L2} + V_{C3} = 0 \text{ and } V_i = V_{L1} - V_{C3} + V_{C2}$$

According to volt-time balance condition of the inductance, the average voltage across the inductance in the steady state is '0.' The duty proportion of switch is defined as, $D = T_{on}/T_s$, where T_{on} is the conduction period of switch S , T_s is the total switching time. Thus,

$$V_{C1} = V_{C3} = \frac{D}{1 - 2D} V_i \quad (7)$$

$$V_{C2} = V_i + V_{C1} + V_{C3} = \frac{2 - D}{1 - 2D} V_i \quad (8)$$

From (8) and (9), the output voltage V_0 can be derived as

$$V_0 = V_i + V_{C1} + V_{C3} = \frac{2 - D}{1 - 2D} V_i \quad (9)$$

The gain (G) in voltage of the SZS converter can be obtained as:

$$G = \frac{V_0}{V_i} = \frac{2 - D}{1 - 2D} \quad (10)$$

MODELLING OF CONVERTER

The energy management of the proposed work is performed by battery units and a bidirectional converter so that the potential at PCC will be at the optimum level of 230 V which is more than the maximum storage capacity of batteries (240 V). The properly connected low-voltage battery series eliminates the voltage equalization problem found in single-turbine battery. Thus, the optimum DC link voltage is maintained at the PCC with increased battery life cycle. At first the ON time of the pulse period is maintained at 50% and the converter will neither work in step up nor step down mode and there will not be power stream between battery and grid. The contrast between the PCC voltage amplitude and terminal voltage level of batteries varies the obligation pattern of the converter using the ANN controller.

At the point when the output of the sustainable sources is beneath the battery voltage level, the bidirectional converter operates in a boost mode and the power from batteries is extricated to the PCC. Also, when the PCC potential is more than the battery voltage, the converter converts its mode to buck and the power starts to flow from the PCC to battery and thus battery gets charged.

Additionally to decrease the tension at the PCC and to ensure a stable power flow, batteries are included at the PCC. To guarantee ideal planning, it is critical to have precise breeze determining and the information on SOC of





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the battery. SOC provides the data with respect to how much power available in the battery, and it is depending on inward boundaries, wind and aging of the batteries. The exact estimation of SOC is yet at research. Among the various techniques to quantify SOC, estimation using ampere hour tallying is utilized in most of the applications. SOC at 't' is gotten by utilizing (11) where Q is to the battery limit, $SOC(0)$ is the underlying SOC, $I(t)$ is the charging or releasing current of the

$$SOC(t) = SOC(0) - \frac{1}{Q} \int_0^t I(t) dt \quad (11)$$

It is necessary to keep up SOC of the battery inside the base and most extreme levels for efficient utilization of battery energy and hence for power booking. The favored degrees of battery activity considered are 20–90% of SOC. When the renewable power is not exactly the planned worth, battery gives the rest of the power, and when the power is overabundance than the network request, power is consumed by the battery. Using the ANN controller, the control pulse is produced by contrasting voltage at the PCC with the battery terminal voltage.

MAXIMUM POWER POINT SEARCHING METHOD-ANN

The ANN regulator MPPT is used to follow the MPP. Figure 4 portrays the general square outline of the ANN regulator dependent on MPPT for a WIND framework. The ideal WIND framework comprises of a WIND board, a lift converter with a MPPT calculation, and burden. The fundamental objective of the MPPT calculation is to set the obligation pattern of the lift converter to cause the converter to convey the most extreme capacity to the heap at some random wind and speed. The information impedance of the lift converter (which is the same opposition that accomplishes the prerequisite to extricate the greatest force) is determined utilizing the condition beneath

Keeping yield impedance steady, the obligation cycle is changed utilizing the MPPT procedure until the info impedance seen from the source is equivalent to the ideal burden impedance.

The ANN regulator dependent on MPPT takes the working wind and speed from the WIND board as the info factors. The boundaries of the ANN regulator are preparing and enhanced agreeing to the mean square mistake capacity to obtain a superior yield. The yield of the ANN regulator is contrasted and a high-recurrence transporter sign to get the ideal obligation pattern of the lift converter which harmonizes to P_{max} for some random climate conditions

ARTIFICIAL NEURAL NETWORK

An Artificial neural organization is a computational model emulating the natural neural organization [43]. In a particularly model, a neuron is a handling unit that first straightly gauges the information sources, then, at that point expounds the total through a nonlinear capacity, called initiation work (AF) and, at last, sends the outcomes to the accompanying neurons [44]. The model of a typical neuron is given by the relationship (4), where z is the contention of the AF, as displayed in Fig.4

also, x_1, x_2, \dots, x_M are the M approaching signs, and w_1, w_2, \dots, w_M are the connected neurotransmitters loads. Distinctive AFs have been proposed in writing [45] like edge, direct and sigmoid exchange works; the final remaining one

(5) is utilized for the situation study.





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Fundamentally, the ANN can be addressed by a coordinated chart where the hubs and the edges are, separately, the neurons and the neurotransmitters[46]. Two unique fundamental sorts of ANN's design emerge from the manner in which the neurons are associated with one another: feed- forward neural organization (ANN) [47] and repetitive neural organization (RNN) [48]. The construction of a multi-facet ANN considered in the proposed application is portrayed in Fig. 5, where the neurons of the information layer acts just as cushions for conveying the information signals (VWIND , IWIND). The yield layer has one neuron giving the voltage esteem VEMMPA relating to the EMPPA. The considered ANN has been prepared by utilizing the backpropagation (BP) calculation with the Levenberg-Marquardt enhancement technique [49], which is the most utilized directed learning strategy for ANN. An administered learning technique [50].

$$z = \sum_{m=1}^M w_m x_m + \alpha \quad (12)$$

$$y = \frac{1}{1 + e^{-z}} \quad (13)$$

plan to prepare the ANN by giving it a few mixes of wanted arrangements and the connected worth of the information sources. Right away, the loads are, normally arbitrarily, set. Then, at that point a managed learning strategy is applied to appropriately adjust the loads, to decrease the mistake between each ideal yield design and the arrangement gave by the ANN to the connected info design. In the proposed application, at each phase of the learning cycle, the ideal yield design is the voltage esteem identified with the GMPP and the information designs are the upsides of VWIND , IWIND at the n focuses where the P-V trademark is assessed for a particular arrangement of wind based speed dispersion and boards wind.

The examples with an indistinguishable P-V bend could be assembled to decrease the preparation timeframe, that is the point at which an example creates a bend indistinguishable from an example previously used to prepare the ANN, utilize the bend again could be kept away from to lessen the preparation time. Then again, the more prominent the quantity of examples with an indistinguishable P-V bend, the more noteworthy the likelihood that comparative situations happens, and, therefore, the more noteworthy the likelihood that the ANN needs to meet the genuine GMPP in comparative bends.

$$PQI_1 (\%) = \frac{100}{I} \sum_{i=1}^I \left(\frac{EMPP_i}{GMPP_i} \right)$$

$$PQI_2 (\%) = \frac{100}{I} \sum_{i=1}^I a_i$$

$$PQI_3 (\%) = 100 \frac{\sum_{i=1}^I \left[a_i \left(\frac{EMPP_i}{GMPP_i} \right) \right]}{\sum_{i=1}^I a_i}$$

$$PQI_4 (\%) = 100 \frac{\sum_{i=1}^I \left[(1 - a_i) \left(\frac{EMPP_i}{GMPP_i} \right) \right]}{I - \sum_{i=1}^I a_i}$$





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The ANN ought to have the option to track down the genuine GMPP particularly for the more likely situations to amplify the put away energy. Subsequently, the utilization, all things considered, to prepare the ANN expects to make it more appropriate to accurately distinguish the genuine GMPP in WIND bends much of the time happening, albeit this methodology involves a more prominent preparing time. The capacity of the whole technique (ANN + PS) to effectively recognize the genuine GMPP relies upon the learning cycle just as on the ANN's construction. The more noteworthy the quantity of couples (VWIND, IWIND) at which the P-V trademark is assessed the more prominent the likelihood that the EMPP approaches the genuine GMPP. Then again, a high number of estimations (VWIND, IWIND) to be assessed infers a more intricate organization and, particularly, includes a high an ideal opportunity to follow the GMPP varieties. The presentation of the whole strategy must be registered for various ANN structures, by utilizing consistently a similar PS technique, to help chiefs in the decision of the quantity of ingoing couples (VWIND, IWIND), the quantity of covered up layers and neurons per layer, which are appropriate to give the best tradeoff between the exhibition of the whole strategy and its computational weight. In this viewpoint, the accompanying Performance Quality Indices (PQIs) are considered to survey the decency of the arrangement given by the whole MPPT technique just as by the ANN alone

where I is the quantity of tests executed to survey the exhibition, $GMPP_i$ is the worldwide MPP when the I -th test is thought of, $EMPP_i$ is the worldwide MPP regarded by the general framework when the I -th test is thought of, $EMPP_{Ai}$ is the worldwide MPP regarded simply by the ANN when the I -th test is thought of (that is, before the PS is applied); simulated intelligence is a consistent equivalent to 1 if $EMPP_{Ai}$ falls inside similar slope of the $GMPP_i$ when the I -th test is thought of, else it is equivalent to 0 (see Fig. 4). The file PQ11 gives a proportion of the integrity of the EMPP furnished by the whole technique as for the genuine GMPP esteem

The more noteworthy PQ11 the better the normal capacity of the whole strategy to meet the genuine GMPP, for example PQ11 equivalent to 100 implies that worldwide MPP regarded by the general framework is consistently equivalent to the genuine one in completely executed tests. PQ12 is the level of times the EMPPA falls inside the slope of the GMPP. The more prominent PQ12 the better the normal capacity of the ANN to give to the PS a beginning stage (VEMMPA, PEMMPA), falling in the equivalent "slope" where the genuine GMPP is found. The more prominent PQ12 the lower the PS exertion and, therefore, the time spent to arrive at the GMPP. The record PQ13 gives a proportion of the integrity of the EMPPA considering just when it falls inside the slope of the GMPP. The more noteworthy PQ13 the better the normal capacity of the ANN to give to the PS a beginning stage (VEMMPA, PEMMPA) near the genuine GMPP, when this beginning stage falls inside a similar GMPP's "slope". An ANN doesn't work as expected when it gives a beginning stage outside from the GMPP's "slope". Then again, if the pinnacle of the slope where the PS works has a comparative abundancy than that where GMPP is found, the deceptive arrangement given by the ANN has a somewhat adverse consequence on the presentation of the whole technique. In such manner, PQ14 gives a proportion of the decency of the EMPP accomplished by the whole technique considering just when it falls outside from the slope of the GMPP. PQ11 and PQ14 permit to in a roundabout way analyze the ANNs since they give a proportion

of the decency of the whole MPPT strategy. Specifically, PQ11 is the most huge since it gives data about the exhibition of the whole MPPT strategy when every one of the reenactments are thought of, while just a particular subset of recreations are considered for PQ14. PQ12 and PQ13 straightforwardly measure the decency of the ANN based MPPT strategy alone, yet they need on an outline on the presentation of the whole MPPT technique. Then again, an enhancement for PQ12, PQ13 and PQ14 decidedly influences PQ11. Truth be told, PQ11 incorporates overall every one of the perspectives accounted by the other files, so it gives the most complete data about how the presentation of the whole strategy changes when the ANN's design changes. Consequently, PQ11 must be utilized to distinguish the best ANN's design. Then again, the other PQIs are helpful in any case, since they empower the creator to get a handle on how much the various issues influence the capacity of the whole strategy to meet the genuine GMPP. The quantity of tops in the P-V trademark, their sizes, and the general idea of the WIND bend is completely subject to the wind of every module creating the WIND framework, the insolation level, the concealing example, and the exhibit arrangement [41]. The greatest number of slopes in the P-V bend is identified with the





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quantity of WIND modules series associated, demonstrated in the accompanying as nos. From this point forward, the base number of couples (VWIND , IWIND) is picked equivalent to nos, accordingly the base number of info neurons is 2nos. In reality, the quantity of information couples (VWIND , IWIND) is an exhibition boundary (target work), since the more noteworthy this number, the more prominent the time expecting to gather the info upsides of the ANN. Subsequently, the quantity of couples (VWIND , IWIND) is both an enhancement variable and an exhibition boundary. As an outcome, 2nos is the best arrangement as far as reaction time, and it is relied upon to be the most exceedingly terrible as far as precision in the GMP assessment. As MPPT is a multimodal enhancement issue, it includes to manage a nonlinear capacity and, as it is notable, an ANN without covered up layer can't as expected locationa nonlinear capacity [51]. Thus, the ANN needs something like one secret layer. A typical technique

to measure the secret layer is to average the quantity of data sources and yields [52]. In this manner, the base number of neurons in the secret layer is picked nos + 1 (by gathering together). By considering the base number of ANN's bits of feedbacks and one secret layer, the base number of neural connections mns is given by The exhibition of the proposed whole technique is relied upon to upgrade by expanding the quantity of info couples (VWIND , IWIND) and could likewise improve by expanding the size and the quantity of covered up layers, including the need on more computational assets. Henceforth, the quantity of neurotransmitters is likewise picked as execution boundary (target

Thought of, for example PQI1, and the bend identified with the quantity of neural connections and info couples are likewise thought of, then, at that point a Pareto front can be done. A point on a particularly front is a tern made by: PQI1 The quantity of ANN's feedback couples and neurotransmitters.

work), subsequently mns can be considered as the best arrangement according to the computational weight perspective, yet it is presumably the most exceedingly awful as far as MPPT strategy exactness as it could give the least PQI1. By tuning the advancement boundaries, that are the quantity of information couples (VWIND , IWIND), the size and the quantity of covered up layers, a bend can be completed for every exhibition boundary, that are the PQIs, the quantity of neural connections just as the quantity of (VWIND , IWIND) couples. At the point when the bend identified with a particular PQI is As it is notable, there isn't a point in a Pareto front better compared to another; indeed, when two places of this front are analyzed, everyone has something like one target work esteem preferable and one more awful over the.

It is worth to take note of that the quantity of ANN's feedback couples and neurotransmitters give a period based correlation when no particular equipment arrangement is thought of. The general framework reaction time will rely upon the embraced equipment arrangements and in this way on the connected expense the leader needs to confront. Subsequently, the leader picks among these focuses the one that better consents to the particulars.

The WIND system with an ANN controller based on MPPT has been implemented in the Matlab/Simulink software package, as shown in Figure 12. The Simulink model of the WIND module is developed according to the mathematical Equations (1)–(5). The BPSX 150S WIND module has been used which consists of 72 multi-crystalline silicon solar turbine, and its characteristics are shown in Table 1. The Simulink model of the boost converter and ANN controller are shown in Figures 6 and 7, respectively. The values of inductance and capacitor of the boost converter are 8 mH and 2200 μ F respectively, whilst the output load value is 20 ohm. Inventions 2019, 4, x 6 of 12 Figure 11. Block diagram of the wind system with an ann controller based on mppt. 6. simulation results the wind system with an ANN controller based on MPPT has been implemented in the Matlab/Simulink software package, as shown in Figure 5.

The Simulink model of the wind module is developed according to the mathematical equations (1–5). the bpsx 150s wind module has been used which consists of 72 multi-crystalline silicon solar turbine, and its characteristics are shown in Table 1. The Simulink model of the boost converter and ANN controller are shown in Figures 6 and 7, respectively. The values of induce



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The effectiveness of the proposed ANN searching method has been evaluated by considering a wind array consisting of two strings of three series (nos = 3) connected modules (2 3). This configuration could be installed on the roof of an electrical vehicle. The technical specifications of WIND modules under standard test conditions are reported in Table 1. Without loss of generality, the shading phenomenon on a WIND module is modeled in Matlab by considering on it an uniform lower speed with respect to unshaded modules. In order to evaluate the performances of the ANN based MPPT method, different ANN structures have been investigated. In particular, Table 2 reports the variation ranges related to the number of input P-V couples, the number of hidden layers and neurons in the first hidden layer (HL1); hence 216 ANN structures have been investigated (exhaustive search). The number of neurons in the hidden layers following the first one is chosen equal to half of neurons number in the previous one (by rounding up).

State of charge (SOC), current and voltage of multilayer neural network solar MPPT drive lead- acid battery

For evaluating the proposed converter performance, it is compared with the other existing high step up converters. The proposed converter characteristic curve and the comparison of the voltage gains normalized voltage stress, normalized switch and normalized diode stress of the conventional existing converter

Around ten quantities of 12 V batteries are sequentially associated to obtain a yield voltage of 120 V. With the underlying power of 500 W, the board clusters keep up a normal of 800 W over the reenactment time. In spite of the fact that the adjustments in the WIND isolation and wind speed are just step variations that never occur in the down to earth because of the changing condition conditions. The scopes of significant worth are chosen to transform from the usable least and most extreme operational scopes of the WIND cluster and wind framework in order to approve the exhibition of the framework for these changes. 300 V and the voltages across C_1 and C_2 are 350 V and 300 V

Using the ANN controller, the SOC is balanced effectively and the power is found to be continuously flowing to and from the battery. Initially, the SOC is assumed at 70%. Based on the change in output of WIND converter and PWM rectifier, the SOC will get varied. The controller maintains the constant voltage at the PCC within the time period of 0.2ecs and the battery settles at this voltage. Thus, the controller shows the exturbineent tracking and learning ability. It is understood that an efficient energy management has been acquired by which a stable PCC voltage is maintained irrespective of change in source variations.

CONCLUSION

In this paper, in view of the incline of the wind turbine mechanical force versus turn speed, a clever MPPT calculation utilizing neural organization compensator is proposed to keep away from the wavering issue and impact of unsure boundaries in wind-turbine age frameworks. Normally, the qualities of the breeze turbine revolution speed is controlled by the breeze speed and air thickness conditions, accordingly the innovations of changing the area of the greatest force point should be created in the uses of most extreme force point-following (MPPT) control to make the breeze turbine generator get the ideal effectiveness from wind energy at various working conditions. In this examination, the vulnerabilities in wind-turbine age frameworks are remunerated by a neural organization furthermore, the obligation pattern of the lift dc/dc converter is dictated by a ANN controller, the advantages of a clever execution of a worldwide MPPT calculation, featuring its viability and reasonableness when applied to little wind frameworks introduced, for example, on the top of electrical vehicles. In future works, test trial of the proposed MPPT could feature which equipment arrangements are more reasonable likewise considering the conservative speculation perspective. Specifically, the compromise among execution expenses and energy misfortunes could be examined.





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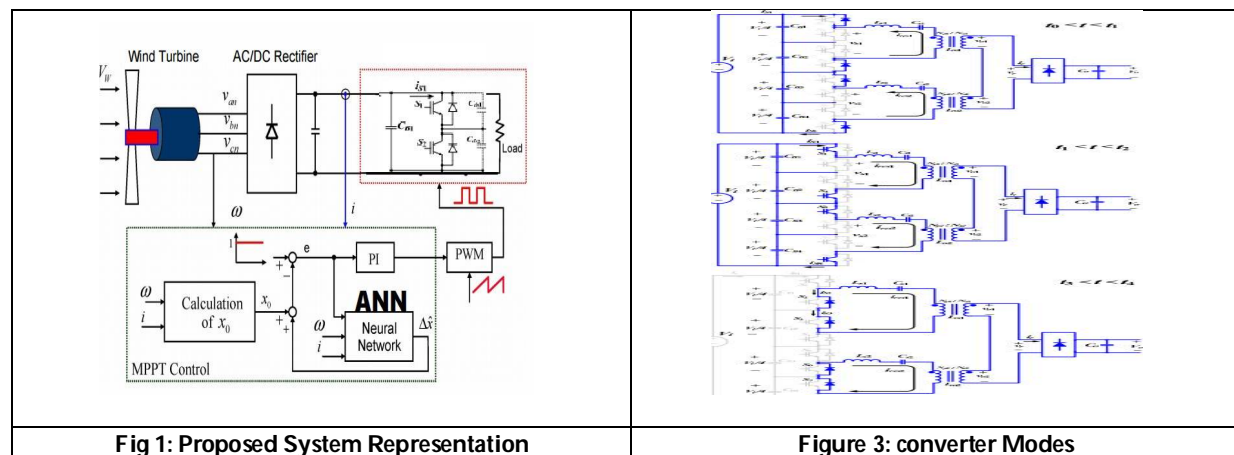




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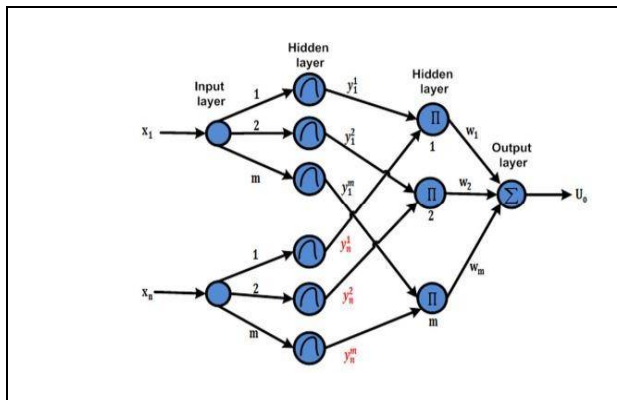


Figure 3: Basic Structure of ANN

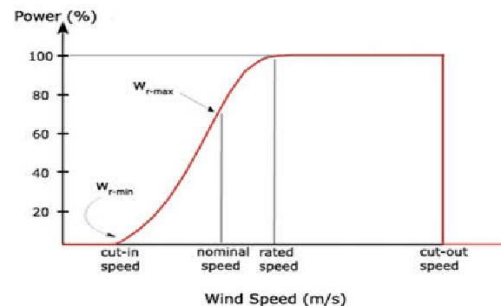


Figure 4: Characteristics of P-V

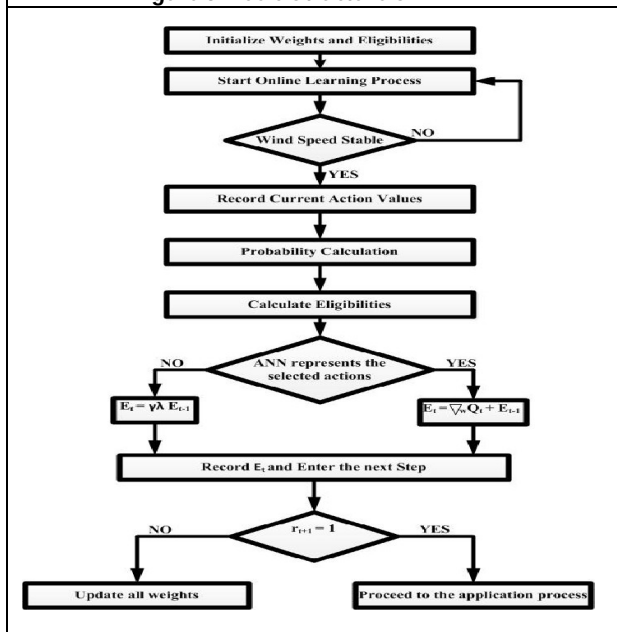


Figure 5: Flow Diagram of ANN MPPT

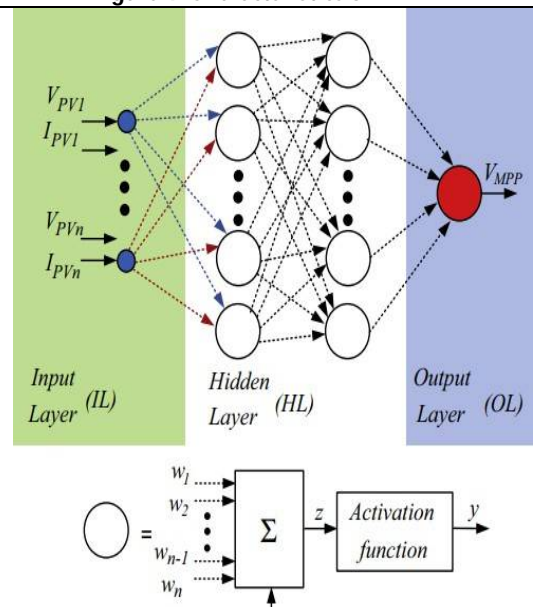


Figure 6: Forward Layers of ANN

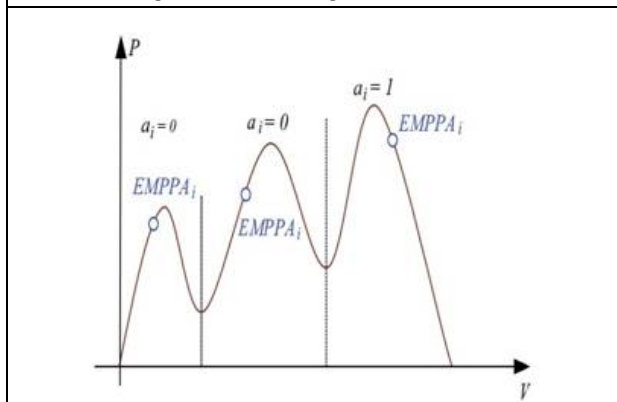


Figure 7: Evaluated Maximum power point value

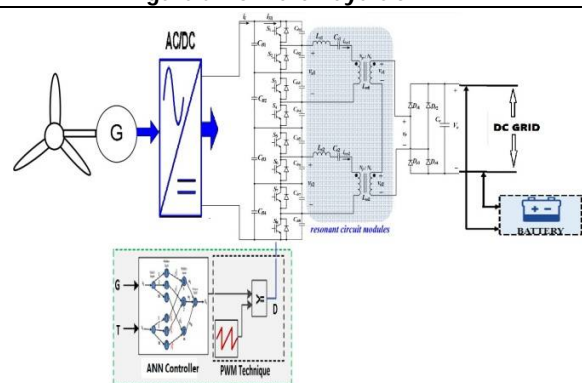


Figure 8: Over All Diagrammatic Implementation Of Wind System With Ann Based Controller





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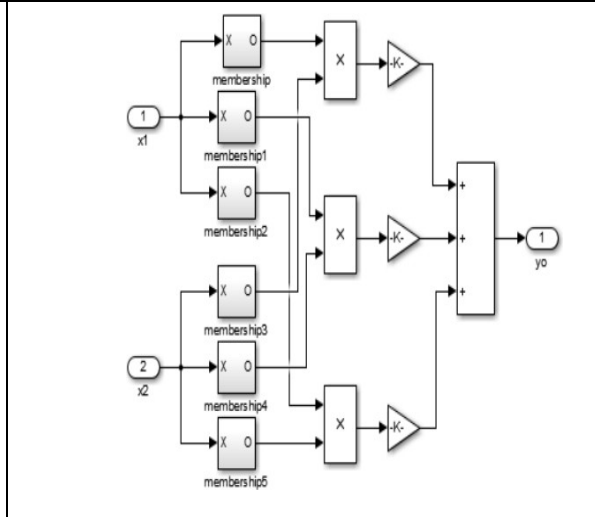
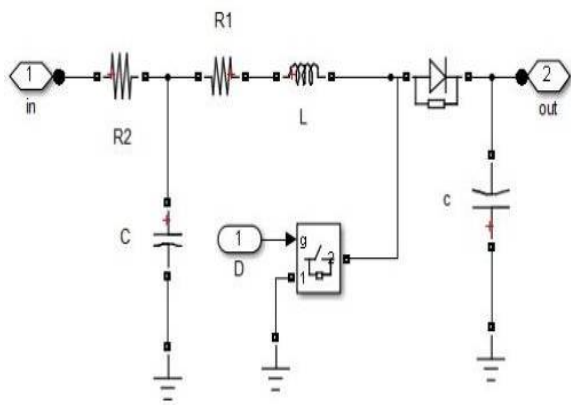


Figure 9: Model of SZC converter

Figure 10: membership function of ANN

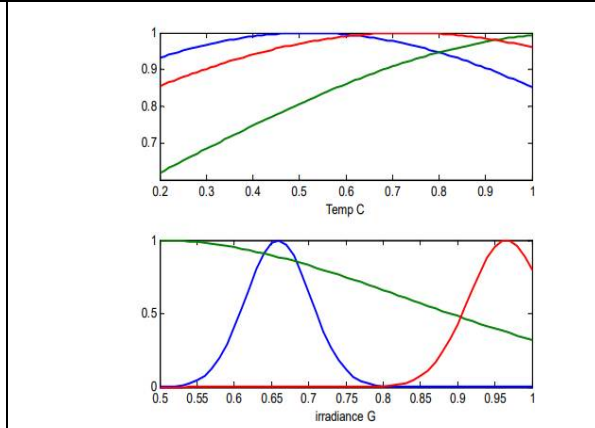
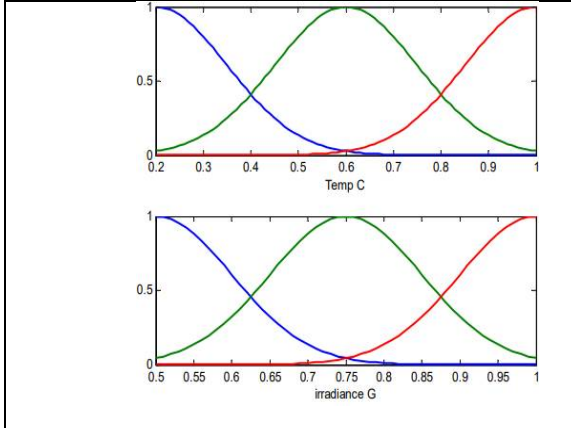


Figure 11: Input Data of ANN

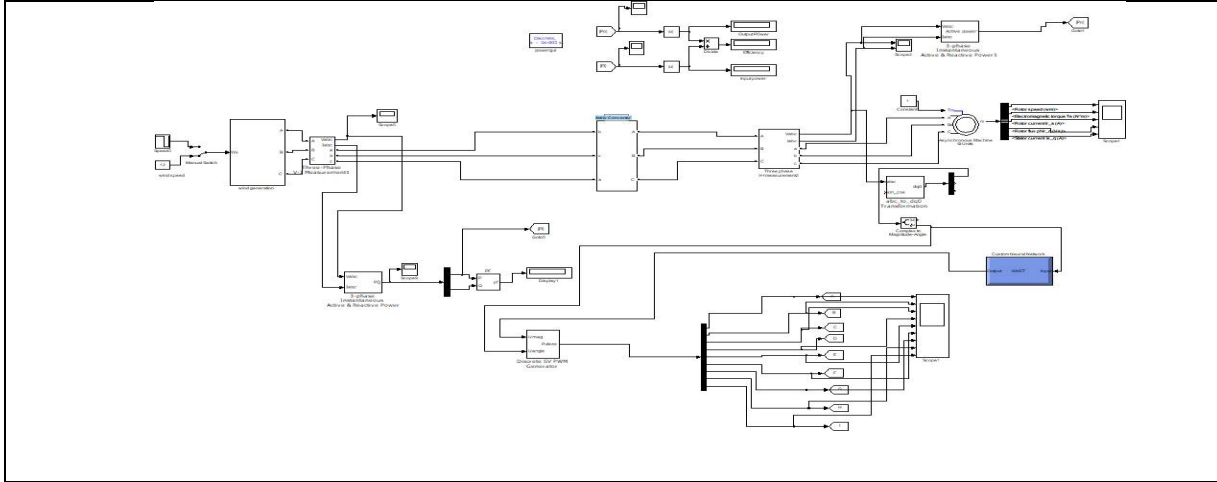


Figure 12: Simulation Model of Our System





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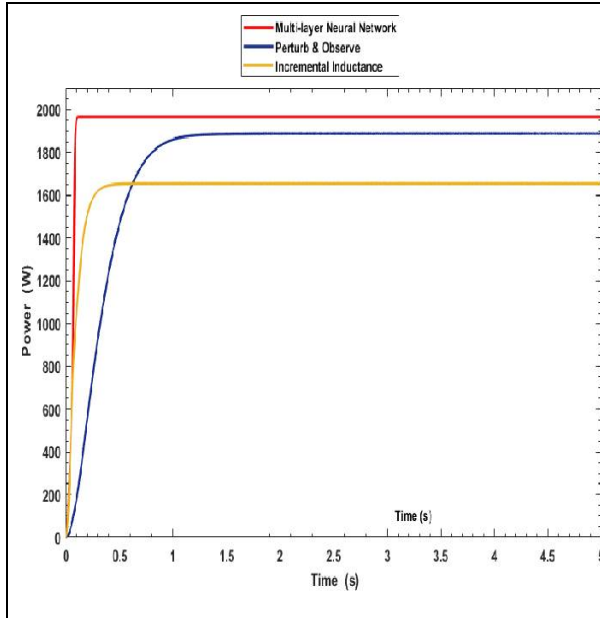


Figure 13: output power comparison

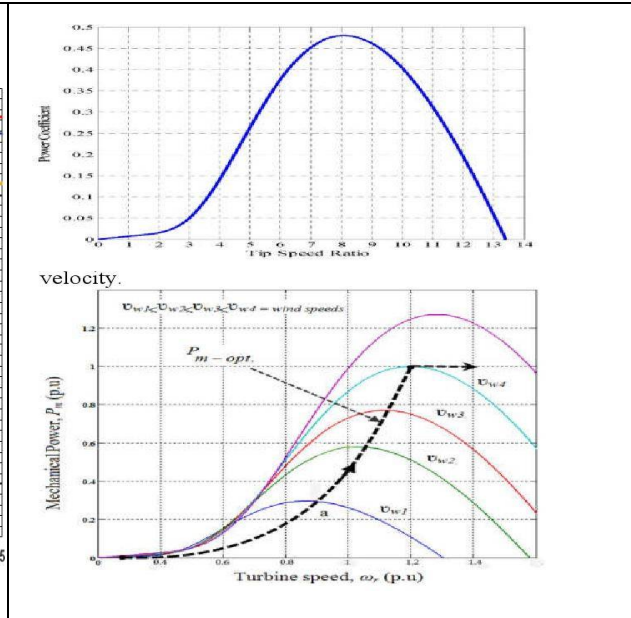


Figure 14: Power VS speed VS velocity VS mechanical power

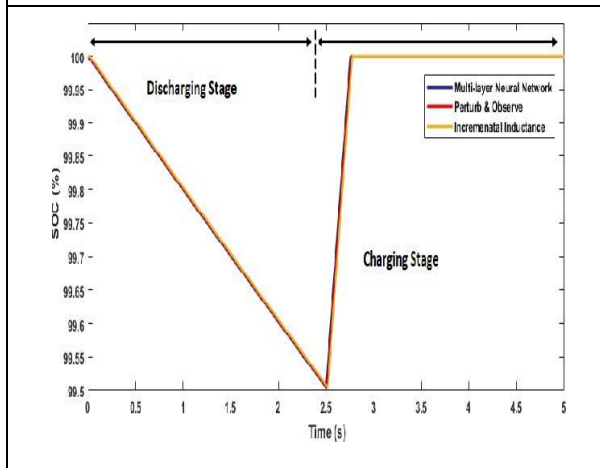


Figure 15: Comparison of state of charge of multi-layer neural network, perturb and observe and incremental inductance solar MPPT driven battery

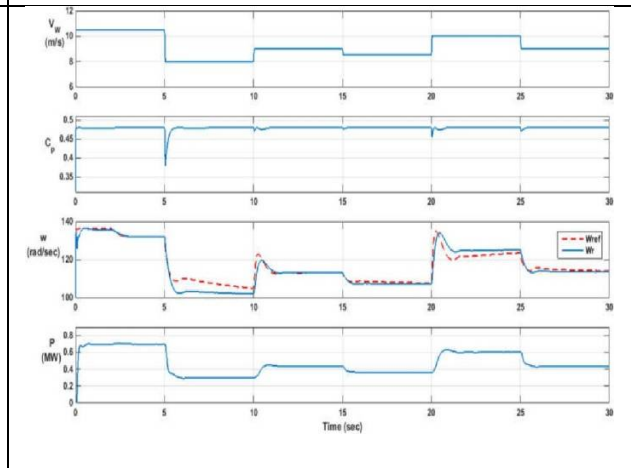


Figure 16: 9. Simulation results of changes in load vs wind speed





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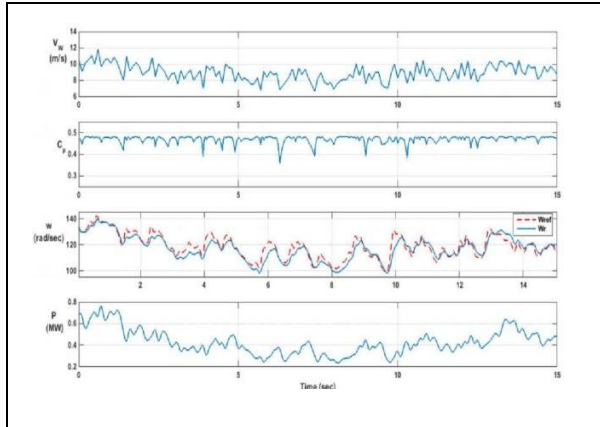


Figure 17: 9. V_w , C_p , W and P plots in the case that the noisy wind velocity applied

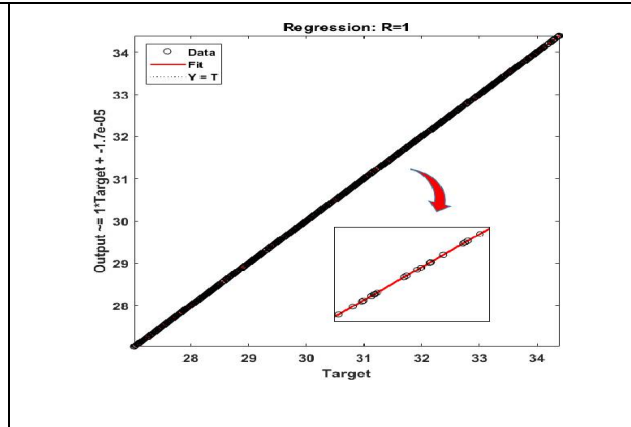


Figure 18: Regression result of the trained neural network

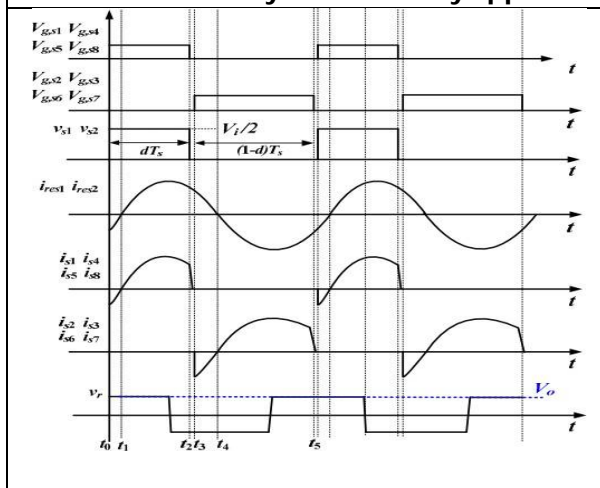


Figure 19: PWM VS Voltage waveforms

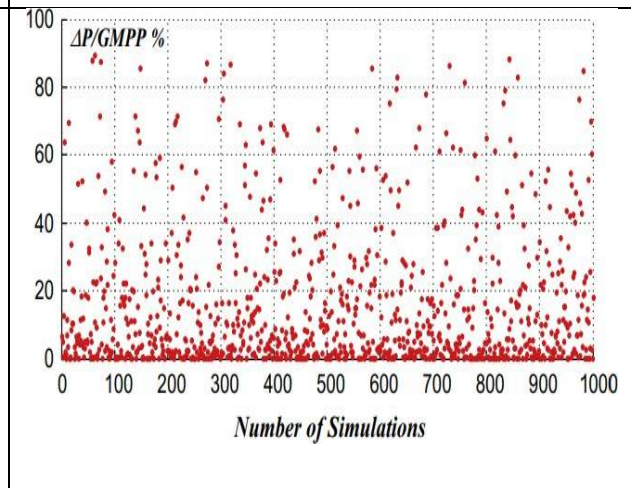


Figure 19: Power error between MPPT

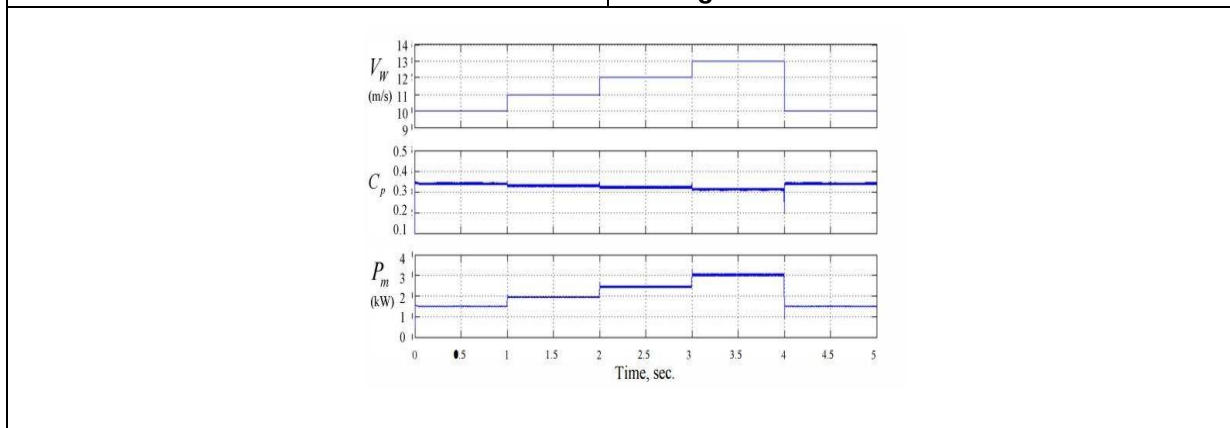


Figure20: Load power tracking





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Table 1: Parameters of WIND module

Parameter	Value
Rated power	1.5 MW
Rated stator voltage	575/995 V (D/Y)
Synchronous speed	1200 rpm
Nominal wind velocity	12 m/s
Maximum C_p	0.48
Optimal λ	8.1

Table 2: Boost converter parameters

Sr. No	Parameters	Values
1	Input voltage	145 V
2	Output voltage	260 V
3	Current	11 A
4	Inductor	1 mH
5	Capacitor	333 μF
6	Switch frequency	5 kHz
7	Diode Internal Resistance	1 m Ω

Table 3: Best and worst PQIs values provided by the entire MPPT method or by considering only the ANN

PQI (extreme)	Value (%)	Input couples	Number of HLs	Size of HL ₁
PQI ₁ (Best)	98.47	10	3	12
PQI ₁ (Worst)	69.30	3	1	20
PQI ₂ (Best)	96.40	10	3	12
PQI ₂ (Worst)	67.94	3	1	16
PQI ₃ (Best)	98.97	10	3	12
PQI ₃ (Worst)	73.44	3	1	20
PQI ₄ (Best)	94.50	9	3	12
PQI ₄ (Worst)	42.96	9	1	8





The Effect of FIFA 11 + Warm-up Programme for Static and Dynamic Postural Stability in Volleyball Players: An Interventional Study

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ABSTRACT

Volleyball athlete's capability to control the movement of COG over the BOS during dynamic athletic activities may be compromised due to lack of postural stability. Insufficient postural stability lead to increase the risk of lower limb musculoskeletal injuries. To investigate the effect of FIFA's 11+ injury prevention programme for postural stability in volleyball players was the main focus of this study. 40 volleyball players were participated in this study based on inclusion and exclusion criteria. Players were randomly divided into experimental group A and control group B. The FIFA 11+ was given to experimental group (3days/week, 8 weeks). Control group continued their regular warm-up. The static and dynamic postural stability were assessed by Balance Error Scoring System (BESS) and Star Excursion Balance Test (SEBT). Data was analyzed using SPSS version 22. Paired sample t-test for BESS and SEBT shows significant results ($p < 0.05$) in both groups. Independent t-test shows that eight week of FIFA 11+ warm-up programme had a significant effect on BESS and SEBT scores ($p < 0.05$) in volleyball players involved in Group A. The FIFA 11+ warm-up programme increases athletic performance by improving static and dynamic postural stability in volleyball players. Therefore, it was suggested that volleyball players use this injury prevention programme to improve their on-field performance and to reduce risk of musculoskeletal injuries.

Keywords: Postural stability, Volleyball players, Musculoskeletal injuries, FIFA 11+ warm-up





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INTRODUCTION

Postural stability is characterized as an individual's capacity to control the body position in space over the Base of Support (BOS) with the end goal of static or dynamic stability development and equilibrium. Postural stability is mandatory for maintaining a static posture and to assisting body co-ordination in dynamic posture. It can be categorized into two terms such as: static and dynamic [1]. Statically it can be defined as the ability to remain upright at rest or during minimal movement. Dynamically, it can be defined as an individual's ability to maintain stable position while performing a task from static to dynamic state[2]. Dynamics which prevent the body mass from falling to the surface or the body's BOS and the COG, which can be define as balance[3]. Vestibular system, visual system, sensory input and motor output, these all are responsible factors which affect the balance [1].In the dynamic postural stability, arthrokinetic responses and muscular reflexes are play an important role, as muscle spindle and Golgi Tendon Organ (GTO) provide constant feedback about muscle length. Dynamic balance is considered when soft tissue and joints acting on the body for neutralization of external forces[1]. To be expertise in complex movements and improving on field performance, dynamic balance is a key element [3]. For establishing an equilibrium between destabilizing and stabilizing force, postural stability requires sensory input from body movement, integration of information within CNS and execution of motor responses [4].

To perform versatile skills and to defend the neuromuscular (NM) system from musculoskeletal injuries, all sports branches require discrete level of sensor motor processes [2]. Attentive and considerable research has been done on various NM control. Prior mentioned differences in NM control may be directly affected by various postural stability strategies[1]. Developing the physical characteristics required for a particular sport in a continuous harmony in order to improve the performance of sportsman, is the aim of every sports branch [5]. Depending upon game type, athlete's requires balance control for their better performance [6]. In 1895, the volleyball game was invented by William G. Morgan. Morgan created a game which can be played by players of both genders of various ages and skill levels. Now a day, volleyball has been recognized as a highly competitive and popular international sport by federation international de volleyball (FIVB) [7]. It depends on 220 allied national federations (FID 2016) in that 800 million players who play volleyball. Like other sports volleyball is also linked with musculoskeletal injuries, but being definitely beneficial to physical, mental and social well-being [8]. In volleyball sports, keeping the vertical position of COG within BOS, is a crucial ability for maintaining postural balance [9]. Volleyball players are at risk of musculoskeletal injuries, because sports specific tasks (i.e. high volume of jump, spiking, blocking, and serving) performed at high intensities [10]. For lower limb stability and injury prevention, joints of both lower extremities, an equal muscle strength between prime movers and antagonist are more important in the players. Lower extremity muscle strength directly affects the balance performance [11]. To present the demands of athletic maneuver, task of dynamic postural stability is considered better because, lower extremity muscle strength directly affects the balance performance.

Volleyball-specific task demands a lot from musculoskeletal system [12]. If the postural stability or balance is not achieved in a short time, athlete will not be able to give the desired performance. Hence during the match, it is required to restore the sudden change occurred in the distortion of balance as soon as possible [11]. The balance ability of trained athletes may get influenced as the sensory-motor systems are effectively challenged by environmental demands and skill requirement of volleyball sports [2]. In early childhood insufficiently developed postural control result in a poor general control of voluntary movements and that lead to decrease other co-ordination skills [9]. To be fit in the game environmental, athletes have to perform various movements in jump-landing sport like volleyball. The influence generated in jump phase by one or both lower extremities, which is absorb by one lower extremity in U/L landing task of volleyball. Therefore, risky bio-mechanical pattern occurs due to these types of landings. As a result, the athlete may suffer from sports injury [7]. It has been reported that ankle injuries and lower limb injuries are more frequent in case of inadequate static and dynamic postural stability respectively [1]. Most of injuries of knee and ankle are occur during competition rather than practice. When a player is landing from a blocking or spiking maneuver, knee internal derangement and acute ankle sprain injuries frequently occurs and due to repetitive jump landings, patellar tendonitis type of overuse injuries can develop [7]. In





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volleyball, rate of musculoskeletal injury is ranged from 1.7 to 10.7 injuries per 1000 player hours according to the recent review (Kilic, Maas, Verhagen 2017). A review (Bahr and Bahr, Resser, 2003) has shown that ankle and knee injuries are most common in volleyball players [10]. Hence; volleyball athletes are at risk for musculoskeletal injuries [12]. So, to improve the team performance, coaches have to be aware about the importance of balance training [13]. The FIFA Medical and Research Centre (F-MARC) in the collaboration with OSLO Sports Injury and Research Centre, has developed "11+" warm-up program to prevent injury in soccer player. 27 exercises with a set of balance exercises have been included in 11+ program which is an advanced version of 11[14]. In volleyball sports, some preventive measures must be taken to maximize the performance and minimize the chances of injuries. So, athletes should have to participate in a pre-exercise warm up prior to training or competitions. To investigate the effect of FIFA's 11+ injury prevention warm-up programme for static and dynamic postural stability in volleyball players was the main focus of this study.

MATERIALS AND METHODOLOGY

Participants

The research was an interventional study, in which 40 volleyball players were selected from LJ Commerce College, Ahmedabad based on inclusion (i.e. Age group 15-24 years, Both Male & female, Willingness of participation, Volleyball players with minimum 3 years of on field experience of Taluka, district or state level competitions) & exclusion criteria (i.e. H/o of musculoskeletal injuries in last 6 months including lower limb fractures, ligaments injuries, menisci tear, surgery etc. , Players with visual problems or vestibular impairments, H/o head injury in last 6 months, Players involved in martial arts such as judo, karate or dancing, Lack of involvement in 2 following sessions). The players were randomly selected and assigned to the experimental group A (n=20, 6=female, 14=male) and control group B (n=20, 7=female, 13=male). All the players who randomized in experimental group, were given video training and explanations about the intervention program in a training workshop before starting the intervention program. Researcher supervised all the training sessions to ensure compliance with the programs. All the players gave their written consent also before initiation of the procedure. The study was approved by the Institutional Ethical Committee for Human Research-Sainath Hospital, Ahmedabad (IECHR-SAINATH HOSPITAL). Prior to intervention, subjects attended one test session that include demographic data and leg length assessment. The static and dynamic postural stability was assessed using Balance Error Scoring System (BESS) & Star Excursion Balance Test (SEBT) respectively before and after intervention programme. Measure the distance (millimeter) with measure tap between ASIS to medial malleolus for both legs to assess leg length [15]. Ask the player to kick the ball to determine the leg dominance.

Equipment

The BESS was described by Riemann et al. to assess static postural stability which has high intertester reliability (interclass correlation coefficient- 0.78 to 0.96) and fair to good validity ($r= 0.42$ to 0.72) [16]. For assessment, 52×40×8 cm foam balance pad and low pile carpeting were used as unstable and stable surface respectively. The SEBT was described by Gribble and Hertel to assess dynamic postural stability which has high intratester reliability (intraclass correlation co-efficient= 0.78 to 0.96) and co-efficient for validity are not available for them [17]. Standard white athletic tape was used to identify 8 lines. Each line consisted of 120 cm in length extending from 45° angle on firm surface. Ask the player to place the stance foot over the centered of 8 grids during testing. To make scoring easier put mark of 1 cm increments from the center outward on the grid.

PROCEDURE

BESS

For BESS test assessment, 3 position (for example: double-leg position with feet together, single-leg position on test leg with opposite knee in 90° of flexion, and tandem stance with foot of the test leg in front of the foot of opposite leg) were involved for both limb on stable and unstable surface. During testing, each position was held for 20 seconds in term with eyes close and hands on hips. By recording mistakes, scoring was determined. Scoring was



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noted by calculating the errors (for example: a) eyes opening, b) hands lifting from hip, c) touchdown of non- stance foot, d) hop, step or other movements of the stance foot or feet, e) lifting heel or forefoot, f) moving hip into more than 30° of abduction or flexion, g) remaining out of position for longer than 5 seconds). 10 separate BESS errands were randomly assigned based on different stances, surfaces and limb conditions. The double leg stance condition was performed only once for dominant (D) and non-dominant (ND) limbs [2].

SEBT

For SEBT assessment, players have to maintain stance leg position with test leg and ask them to reach for maximal distance with the other leg in each of the 8 directions. Without using the reach leg for support, players were asked to execute a touchdown. The trial was repeated, assuming the steady BOS was compromised and the reach limb was utilized for support. Order to reach direction and the limb tested (dominant, non-dominant) were arbitrarily chosen prior to testing. With double leg stance position, 5 second rest was expected between each attempt. For each limb, 3 trials were performed with 120 seconds rest period between each trail, resulted in 6 trials for all directions. Prior to testing, players were asked to practice for approach in each out of 8 lines and 180 seconds were given to introduce themselves with the 8 lines. To performing trials in posterior line, players were instructed to reach behind the test leg. To reduce visual cues (i.e. objects on the floor) and auditory influences (i.e. people not involved in the study), they were removed from examination area. Throughout testing, no further instruction or encouragement was given to the players. As the athletic tape corresponded to the site of touchdown, researcher marked the reach distance with chalk on the floor. Researcher measured the distance between point of touchdown and center of grid using a tape measure, rounded off to the nearest millimeter. After each reach, the chalk mark was removed in order to reduce the visual cues [2].

INTERVENTION**EXPERIMENTAL GROUP**

FIFA 11+ warm-up programme was given to the players included in experimental group. 27 exercises with a set of balance exercises have been included in 11+ program which is an advanced version of 11. It consists of three parts, specially designed to prevent injuries in players. Part □ includes running exercise. Part □ having 6 exercises with 3 level of increasing difficulty. Part □ includes advanced running exercises (table 1). It only took 20-25 minutes to complete the intervention. All exercises emphasize on NM control, plyometric, core strength, balance, eccentric hamstring, LE strength and agility [14]. The □part of FIFA 11+ programme has 3 level of increasing difficulty. The total duration of this intervention was 24 session (8 weeks, 3 times/week). During 1-8 session level 1 exercises, 9-16 sessions level 2 exercises and 17-24 session level 3 exercises of part □ were given in the progression.

CONTROL GROUP

The players of control group were educated to proceed with their ordinary preparation and warm-up with no limitations for the correlation reason.

STATISTICAL ANALYSIS

For BESS test, error scores were summed for dominant and non-dominant limb. In SEBT test, scores of reach distances (cm) for each direction were averaged over 3 trials and calculate % of leg length (% LL= reach distance/leg length × 100). % of LL in each direction were summed for dominant and non-dominant limb. After gathering the pre-test and post-test data from all players, data was analyzed using statistical package of social science (SPSS) version 22. The Shapiro-Wilk test was used to check the normalization of distribution. For within group comparison and between group comparisons paired samples t-test and independent samples t-test were used respectively. Confidence interval at 95% and significant level ($p < 0.05$) were set for statistical results.





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RESULTS

Shapiro-Wilk test indicates normal distribution for BESS and SEBT variables. The demographic data (age, height, weight, BMI, dominant leg length-DLL, non-dominant leg length-NDLL) of the players were presented in table 2. For within group comparison Paired sample t test showed that the BESS scores in both groups were significant ($p < 0.05$) in table 3. Group A ($p = 0.001$, dominant $t = 16.41$, non-dominant $t = 18.53$) and Group B ($p = 0.001$, dominant = 9.62, non-dominant = 9.46), the BESS scores at post-test significantly decreased compared to pre-test. For within group comparison Paired sample t test showed that the SEBT scores (% of LL) in both groups were significant ($p < 0.05$) in table 3. Group A ($p = 0.001$, dominant $t = -36.6$, non-dominant $t = -39.9$) and Group B ($p = 0.001$, dominant = -14.4, non-dominant = -13.2), the SEBT scores at post-test significantly increased compared to pre-test. Results of independent t test showed that p value ($0.001 < 0.05$) was significant for both groups in table 4. BESS scores were significantly lower in Group A than in Group B ($p = 0.001$, dominant $t = -4.755$, non-dominant $t = -5.755$). SEBT scores was significantly higher in Group A than Group B ($p = 0.001$, dominant $t = 15.6$, non-dominant = 17.1). Graph 1 shows number of errors for dominant and non-dominant limb of players involved in both groups. Indicates that Group A had fewer errors compared to Group B in dominant and non-dominant limb. Graph 2 shows % of leg length for dominant and non-dominant limb of players involved in both groups. Indicates that there was more improvement (% of LL) in the player of Group A compared to Group B in dominant and non-dominant limb. Group A had significant improvement in A, AL, M, AM direction in dominant limb compared to non-dominant limb. The significant effect showed in both groups but according to mean Group A had superior effect compared to Group B. Results of the present study showed that eight week of FIFA 11+ warm-up programme had a significant effect on BESS scores and SEBT scores in volleyball players involved in Group A.

DISCUSSION

The findings of the present study showed that 8 weeks of FIFA 11+ warm-up programme had a significant effect on improving static and dynamic postural stability in volleyball players. A significant difference was found in the score of BESS ($p < 0.05$) and SEBT test ($p < 0.05$) in dominant and non-dominant limb of the players. Both the group have significant effect but, Group A has superior effect compare to Group B to improve postural stability. Balance training to improve stability may lead to task-specific (i.e. static and dynamic task) neural adaptations. During static and dynamic postural task, these neural modifications may defeat the spinal reflex hyperactivity (i.e. muscle stretch reflex) leading to decrease unstable motion and thus postural stability improved [14]. Body temperature and viscoelastic properties was estimated by muscle tissue with increased oxygenation during warm-up, will results in improved kinesthetic and mechanoreceptor sensitivity (Kuto Y., Amiri-Khorasani M., 2011) [18]. LE muscle strength and balance performances would be improved as a result of increased muscle co-ordination, muscle motor unit contraction rate and increased synergies of extensors & flexors muscles [11]. Consistent with the findings of the present study, Subasi et al. showed the positive effect of warm-up on balance and knee proprioception at 15°, 30°, and 60° flexion. They concluded that warm-up programs have potential to improve balance and knee proprioception [19]. Judge et al. concluded that, multifarious exercise, which includes postural stability, strength, balance components had improved 17% mean displacement of COP in static balance in 21 years older women [20]. Mehmet Ali Eylen et al. found that 8 week of different strength training had significant effect on leg strength values in volleyball players. They found that different strength training has potential to improve static and dynamic balance in volleyball players. Increased muscle strength could be the reason for these improvements as it led to increase working capacity of intramuscular and intermuscular muscle groups [5]. Celenk et al. (2015), showed that increased quadriceps muscle strength had positive effect on balance performance, but increased hamstring muscle strength had no effect on balance performances. According to them, decreased constrains placed on the sensory-motor system is the one mechanism for this improvement as a result of balance training [11]. Strength training which is a part of FIFA 11+ programme could be the main reason behind outcome of programme as the significant difference was achieved in % of leg length and BESS scores of dominant and non-dominant legs of players. An existing literature showed effect of balance exercise for 8 weeks in athletes. They showed significant effect of intervention on lower extremity muscle





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strength and balance ability (Siriphorn et al., 2015) [5]. According to Sandrey M. et al. 6 weeks of balance and strength training can increase SEBT reach distances in healthy male and female [21]. Balance training had positive effect to improve reach distances (A, PM and PL directions) in patient with CAI (McKeon, Schaefer et al.) [22]. Injuries prevention and exercise performance can be improved through a stable control of the trunk area by strengthening the abdomen, lumbar spine, pelvis, and buttocks muscles. Hence development of balance becomes necessary for the stabilization of core region. Improvement in agility, speed and reduction in the gap between muscle strength and muscle power can be achieved through plyometric training as it results in rapid shortening of contraction after elongation which is the principle behind isotonic contraction. Buong-o Chun, Sang-Hyup et al. found that 8 week of core balance and plyometric training had significant effect on balance, core strength, muscle strength and anaerobic power in young taekwondo athletes [23]. Myer et al. (2006) found that 7 week of plyometric training lead to decrease their medio-lateral center of pressure in high school female volleyball players [24]. Significant lower limb NM control is necessarily required while reaching in specific directions with the opposite limb, player has to perform multiple single limb squats as it is the requirement of each reach direction of SEBT. Hence sufficient lower limb NM control becomes necessary in order to complete each of these tasks successfully. According to Benis et al. (2016) 8 week of NM training enhanced the scores on Y balance test in postero-lateral and postero-medial directions but not in the anterior directions. MV Paterno, GD Myre et al. suggested that 6 week of NM training program design to decrease ACL injuries, had significant effect on single-limb stability in young female athletes [25]. The main reason for this significant effect of FIFA 11+ warm-up programme on static and dynamic postural stability of volleyball players, could be the subsistence of □ part of training as its emphasis on balance training, central stability, NM control, plyometric and LE muscle strength (M. Shah et al. 2019) [26]. Different levels of difficulty involved in the program made it more effective and also resulted in adapting the program individually by the coaches and players. We hypothesized that volleyball players who performed FIFA 11+ structured warm-up programme had significantly better static and dynamic postural stability compared to regular warm-up.

CONCLUSION

According to the findings of the present study, it seems that the FIFA 11+ warm-up programme increases athletic performance by improving static and dynamic postural stability in volleyball players as this intervention include balance, strength, plyometric, core stability and NM training. Therefore, it was suggested that volleyball players use this injury prevention programme to improve their on-field performance and to reduce risk of musculoskeletal injuries. BESS and SEBT variables may be considered limitation of this study as they are not gold standard techniques for static and dynamic postural stability compared to others. Players were selected from LJ Commerce College, Ahmedabad, thus results can't be generalized to all volleyball players. Short term effects of the training should be evaluated through further studies. Player should observe the caution before implementing FIFA 11+ for warm-up before matches as it may result in decrease the on-field performances.

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TABLE 1. THE FIFA 11+ INTERVENTION PROTOCOL

PART	□	□	□
TYPE OF EXERCISE	RUNNING EXERCISE	BALANCE, STRENGTH AND PLYOMETRIC	ADVANCED RUNNING
EXERCISE	Running straight ahead, Hip out (open gait), Hip in (close gait), Circling partner, Shoulder contact, Quick forward and backward	<p>The bench: Static bench, Alternate legs, One leg lift and hold</p> <p>Sideways bench: Static, Raise and lower hip, With leg lift</p> <p>Nordic hamstring: Beginner, Intermediate, Advanced</p> <p>Single-leg stance: Holding the ball, Throwing the ball to a partner, Testing your partner</p> <p>Squats: With toe raise, Walking lunges, One-leg squats</p> <p>Jumping: Vertical jump, Lateral jump, Box jump</p>	Across the pitch, Bounding, Plant and cut exercises
REPETITIONS	2 sets, each exercise	3 sets, each exercise	2 sets, each exercise
DURATION	8 minutes	10 minutes	2 minutes

TABLE 2. DEMOGRAPHIC DATA OF PLAYERS.

VARIABLE	GROUP A (FIFA 11+) (MEAN ± SD)	GROUP B (CONTROL) (MEAN ± SD)
Age (years)	18 ± 2.55	20.3 ± 1.65
Height (cm)	168.35 ± 4.06	172.25 ± 8.70
Weight (kg)	59.65 ± 6.19	63 ± 7.02
BMI (kg/m ²)	21.06 ± 1.93	21.27 ± 1.74
DLL	91.34 ± 3.4	92.76 ± 4.7
NDLL	91.315 ± 3.5	92.735 ± 4.6

TABLE 3. WITHIN GROUP ANALYSIS OF GROUP A (FIFA 11+) AND GROUP B (CONTROL) FOR BESS AND SEBT VARIABLES(MEAN ± SD).

GROUP	SITE	TIME	NO. OF ERRORS	% OF LL	DF	T VALUE BESS	T VALUE SEBT	P VALUE
GROUP A	D	Pre-test	21.65 ± 5.5	609.20 ± 37.62	19	16.41	-36.6	0.001
		Post-test	4.25 ± 2.33	888.24 ± 48.12				
	ND	Pre-test	23.4 ± 4.9	596.19 ± 36.76	19	18.53	-39.9	
		Post-test	6.2 ± 2.30	864.81 ± 47.14				
GROUP B	D	Pre-test	17.05 ± 4.18	593.54 ± 40.38	19	9.62	-14.4	
		Post-test	10.2 ± 5.08	644.42 ± 50.39				
	ND	Pre-test	19.2 ± 3.92	565.18 ± 35.19	19	9.46	-13.2	
		Post-test	12.3 ± 4.80	615.10 ± 44.75				

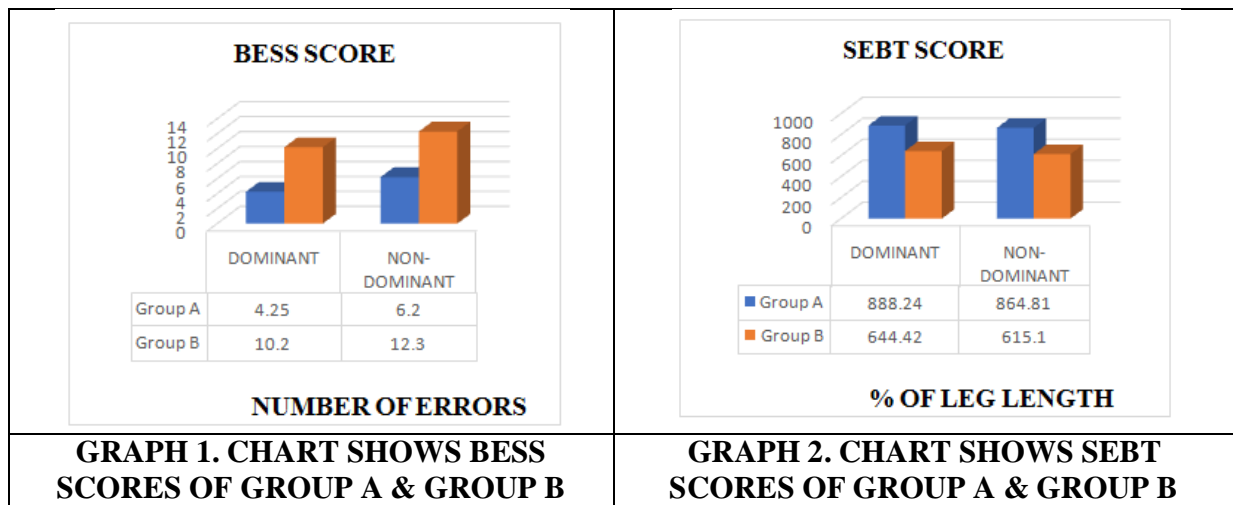




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TABLE 4. BETWEEN GROUP ANALYSIS OF GROUP A (FIFA 11+) AND GROUP B (CONTROL) FOR BESS AND SEBT VARIABLES.

VARIABLE	SITE	GROUP A	GROUP B	DF	T VALUE	P VALUE
BESS	D	4.25 ± 2.33	10.2 ± 5.08	38	-4.755	0.001
	ND	6.2 ± 2.30	12.3 ± 4.80	38	-5.755	
SEBT	D	888.24±48.12	644.42±50.39	38	15.64	
	ND	864.81±47.14	615.10±44.75	38	17.16	





Agriculture Productivity Trends in and around Coimbatore with Respect to Selected Crops

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ABSTRACT

The present study examines the growth performance of area, production and yield of selected cereal crops in the Coimbatore district. Using the data from 2006-07 to 2015-16, the Compound Annual Growth Rate (CAGR) of area, Production and yield for the selected cereal crops. The largest in the Coimbatore district were estimated for each period to study the growth performance of area of cultivation, Production and yield of these crops. In Coimbatore district, the sugarcane holds good performances in absolute terms, among the other cereal crops are concerned. But the compound Annual growth rate reveals that the maize was found to be positive and records a highest growth rate among other cereal crops in terms of area of cultivation, production and yield in Coimbatore district over the study period. Despite the fact that maize was found to acquire highest in terms of area of cultivation, production and yields among other cereal crops, it cannot serve the purpose of livelihood for majority of the population in the Coimbatore district. Hence, the importance had given to the sugarcane cultivations. Besides, the study suggests that the farmers can also cultivate Maize for the money making purpose in the Coimbatore district that suits for the climatic conditions of Coimbatore district as well.

Keywords: Maize, Coimbatore, population, yield, Growth.



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INTRODUCTION

Agriculture forms the back bone of the Indian economy and despite concerted industrialization in the last four decades; agriculture occupies a place of pride. Being the largest industry in the country agriculture is the livelihood for over 70 percent of population in the country. It contributed 57 percent of the national income in 1950-1951 but contributes now around 32 percent of the national income. Agriculture provides employment to around 65 percent of the total work force. Agricultural growth has direct impact on poverty eradication. Many of the industries still depend on the agricultural sector for raw materials as well as for market. Agriculture provides employment to around 65 percent of the total workforce in the country. It has been the source of supply of raw materials to our leading industries such as cotton and jute, textile industries, sugar, vanaspathi and plantations. It is the main support for India's transport system. Agriculture growth is also an important factor in containing inflation, raising agricultural wages and for employment generation.

The present study examines the growth performance of area, production and yield of selected cereal crops in the Coimbatore district .Using the data from 2006-07 to 2015-16, the Compound Annual Growth Rate (CAGR) of area, Production and yield for the selected cereal crops in the Coimbatore district were estimated for each period to study the growth performance are of cultivation, Production and yield of these crops. In Coimbatore district, the sugarcane holds good performances in absolute terms, among the other cereal crops are concerned. But the compound Annual growth rate reveals that the maize was found to be positive and records a highest growth rate among other cereal crops in terms of area of cultivation, production and yield in Coimbatore district over the study period. Despite the fact that maize was found to acquire highest in terms of area of cultivation, production and yields among other cereal crops, it cannot serve the purpose of livelihood for majority of the population in the Coimbatore district. Hence, the importance had given to the sugarcane cultivations. Besides, the study suggests that the farmers can also cultivate Maize for the money making purpose in the Coimbatore district that suits for the climatic conditions of Coimbatore district as well.

Objective of the Study

To analyze the growth performance of selected crops in Coimbatore district.

To examine the instability of selected crops in Coimbatore district.

To know the relationship between total production and yield of selected crops.

MATERIALS AND METHODS DATA BASE

The agriculture data has been collected from thebook entitled 'Season and Crop Report' publishedby the Department of Economics and Statistics,Chennai and Statistical Hand Book of Tamil Nadu.

The data consists of cultivated Area, Production andYield of various crops in various districts for thetime period of Fifty years (from 1965-66 to2015-2016).

Five mostly cultivated crops are chosen for thisresearch.

ANALYTICALTECHNIQUES

- Selected crops were categorized into 3 groups - Area, Production and Yield.
- Regression Analysis
- Comparison between area of production and total production and yield of selected crops using SPSS

RESULTS AND DISCUSSIONS

The present study examines the growth performance of area of cultivation, production and yield of selected cereal crops in the Coimbatore district. Table 1 reports the total area under cultivation of cereal crops for the period of 2006-07 to 2015-16. It reveals that 415103 hectares of land was under Cholan in 2014-2015 followed by 391201 hectares



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under sugarcane, 118699 under Ragi 380429 under Maize, 186693 under cotton. The trend of area under hectares cultivation of Cholan is seems to be volatile over the study period. During the last four years periods 2011 to 2015. While in case of Cholan, the table shows the consistent trend among other crops over the study period. Table 2 Reports the total production of selected cereal crops in Coimbatore district during 2000-01 to 2015-2016. Table results reveals that maize is found have consistent positive trend over the study periods. In case of cotton and Ragi the production trend seems to be decline. While in case of Cholan, the production seems to be highly volatile but seem to have downtrend in the following years. Maize looks upswing and downswings, but Sugarcane found to hold its first place in production as compare with other cereals. (Figure 2) also provides the similar pattern for all the cereal crops over the study period. Table 3 Reports the yield of selected cereal crops in Coimbatore district during 2000-01 to 2015-2016. It reveals that all the selected cereal crops of Coimbatore district are found to follow the similar trend over the study periods. But yield of Maize looks to be solid in terms of yield among the others. (Figure 3) was provided for clarity and clear indication over the study period and it reveals the similar pattern.

Most importantly Table 4 depicts the Compound Annual Growth Rate (CAGR) of Area, Yield and Production of selected Cereal crops in Coimbatore District for the years 2008-09 to 2015-16. Table results shows that, among cereal crops, Maize have recorded the positive and highest growth rate of 12.34 % per annum, which was evidently contributed by the high profitability from Maize in the Coimbatore district.

It was found to be statistically significant at one percent level. Other selected cereal crops recorded decline in area as evident from negative rate of growth per annum. The largest decline in area has been recorded by sugarcane at the rate of -1.28% per annum followed by Ragi. In the case of yield selected Cereal crops, the table result reveal that sugarcane recorded the negative growth rates per annum and found to be statistically significant. However, in the case of growth performance of production, still sugarcane recorded negative production rates per annum. However, in the case of growth performance of production, Maize has recorded the positive and highest growth rate of 15.90% per annum which was evidently contributed by the high profitability from Maize in the Coimbatore district. The largest decline in production has been recorded by Sugarcane at the rate of -0.15% per annum followed by Ragi, Cholan, Cotton. The state government has taken several efforts during the study period in order to increase the yield and production in the case of the major cereal crops by mechanization of production by wide utilization of farm machinery in agriculture at subsidized prices and granted loans investment in agriculture infrastructure, supplying inputs such as fertilizers, pesticides and seed and pricing policy for several main crops. But the analysis of our study for the Coimbatore District shows that the maize has recorded the positive and highest growth rate per annum in terms of area and Production.

Interpretation 1

The above table shows about the future trend prediction for production of Cholan from the financial year 2018-2051. Based on the past data it was found out that the production rate can drop down from 21669.29 tonnes (2018) to -250764.43 tonnes in the year 2051. Based on the prediction the productivity may go worse to negative from the year 2030.

Interpretation 2

The above table shows about the future trend prediction for total yield of Cholan from the financial year 2018-2051. Based on the past data it was found out that the yield can increase 1119 kg/ha (2018) to 1416.07 kg/ha (2051) which shows a good sign towards increasing the productivity in future.

Interpretation 1

The above table shows about the future trend prediction for production of Ragi from the financial year 2018-2051 in Coimbatore. Based on the past data it was found out that the production rate can drop down from 192023.82tonnes (2018) to 70434.36tonnes in the year 2051.



**Selvanayaki et al.,****Interpretation 2**

The above table shows about the future trend prediction for total yield of Ragi from the financial year 2018-2051. Based on the past data it was found out that the yield can increase 2438.14kg/ha (2018) to 3572.73kg/ha (2051) which shows a good sign towards increasing the productivity of Ragi in Coimbatore district in future period of time.

Interpretation 1

The above table shows about the future trend prediction for production of Maize from the financial year 2018-2051. Based on the past data it was found out that the production rate can increase from 1146541.67tonnes (2018) to 2346612.08tonnes in the year 2051.

Interpretation 2

The above table shows about the future trend prediction for total yield of Maize from the financial year 2018-2051. Based on the past data it was found out that the yield can increase 4261.01kg/ha (2018) to 7452.20 kg/ha (2051) which shows a good sign towards increasing the productivity in future in Coimbatore district.

Interpretation 1

The above table shows about the future trend prediction for production of Sugarcane from the financial year 2018-2051. Based on the past data it was found out that the production rate can increase from 27991382.29tonnes (2018) to 55356191.70tonnes in the year 2051 with is a good sign for the commodity.

Interpretation 2

The above table shows about the future trend prediction for total yield of Sugarcane from the financial year 2018-2051. Based on the past data it was found out that the yield can decrease 2298.71kg/ha (2018) to -5625.58kg/ha (2051). Based on the prediction the yield may go worse to negative from the financial year 2030.

Interpretation 1

The above table shows about the future trend prediction for production of Cotton from the financial year 2018-2051. Based on the past data it was found out that the production rate can decrease from 282365.91tonnes (2018) to 199783.44tonnes in the year 2051 with is not a good sign for the commodity.

Interpretation 2

The above table shows about the future trend prediction for total yield of Cotton from the financial year 2018-2051. Based on the past data it was found out that the yield can decrease 282365.91kg/ha (2018) to 199783.44kg/ha (2051).

Instability index based on CAGR**CHOLAM**

Based on the data the percentage of growth rate towards area of cultivation was positive in the first decade and got decreased in the next 3 decades respectively -0.38%, -3.11% and -0.84% and got increased in the last decade by 0.86%. The production rate got decreased from first decade to 4th decade from 2.41% to -0.67% and got increased to 6.17% in the last decade which is a good sign for the commodity in near future. The yield towards area cultivated got decreased from -0.01% to -0.67% from first decade to fourth decade and it got increased to 4.22% in the last decade.

RAGI

Based on the data the percentage of growth rate towards area of cultivation was negative for the five decades from -0.11% to -0.02% but the productivity got increased in the last decade when compared to other decades. The production rate got decreased from first decade to 4th decade from 2.72% to -2.07% and got increased to 5.66% in the last decade which is a good sign for the commodity in near future. The yield towards area cultivated got decreased from 2.85% to -1.37% from first decade to fourth decade and it got increased to 4.86% in the last decade.



**Selvanayaki et al.,****Maize**

Based on the data the percentage of growth rate towards area of cultivation was positive in the first decade at 10.32% and got decreased in the second decade to -1.98% and got increased from decade 3 from 6.78% to 8.17% till fourth decade. But the area of production got decreased to 3.13% in the last decades. The production rate of Maize got decreased from first decade to 4th decade from 11.45% to 6.68% and there was a sudden hike in the last decade to 15.90% which is a good sign for the commodity in near future. The yield towards area cultivated got increased from 0.58% to -1.38% from first decade to fourth decade and it suddenly got increased to 12.34% in the last decade.

SUGARCANE

Based on the data the percentage of growth rate towards area of cultivation of sugarcane was positive from the first decade to third decade from 1.89% to 2.83% and got reduced to 1.28% in the last decade. The production rate of Sugarcane got increased from first decade to 4th decade from 2.33% to 20.36% and there was a sudden drop in the last decade to -1.33% which is not a good sign for the commodity in near future. The yield towards area cultivated got decreased from 0.45% to -0.15% from first decade to last decade.

COTTON

Based on the data the percentage of growth rate towards area of cultivation of cotton was negative in the first decade and got increased to 1.73% in the last decade. The production rate of cotton got increased from first decade to 5th decade from -0.34% to 21.94%. The yield towards area cultivated for cotton got increased from 0.73% to 2.84% in the last five decades.

COMPARISON BETWEEN AREA OF PRODUCTION, TOTAL PRODUCTION AND YIELD OF SELECTED CROPS USING MULTIPLE REGRESSIONS**Interpretation**

The above table depicts that there is a moderate correlation between the area of cultivating cholam and total production of Cholam in Coimbatore region (0.592) and there is a low correlation between area of cultivating Cholam and Yield of Cholam (0.060).

COMPARISON BETWEEN AREA OF PRODUCTION AND TOTAL PRODUCTION AND YIELD OF PRODUCTION FOR RAGI**Interpretation**

The above table depicts that there is a moderate correlation between the area of cultivating Ragi and total production of Cholam (0.471) and area of cultivating Cholam in Coimbatore region (0.473).

COMPARISON BETWEEN AREA OF PRODUCTION AND TOTAL PRODUCTION AND YIELD OF PRODUCTION FOR MAIZE**Interpretation**

The above table depicts that high correlation exists between Area of cultivating Maize and Total production of Maize (82.9%) and Yield of Ragi (0.757).

COMPARISON BETWEEN AREA OF PRODUCTION AND TOTAL PRODUCTION AND YIELD OF PRODUCTION FOR SUGARCANE**Interpretation**

The above table depicts that there is a moderate correlation between the area of cultivating sugarcane and total production of sugarcane (0.432) and low relation exists between area of cultivating sugarcane and Yield of Sugarcane in Coimbatore region (0.211).



**Selvanayaki et al.,****COMPARISON BETWEEN AREA OF PRODUCTION AND TOTAL PRODUCTION AND YIELD OF PRODUCTION FOR COTTON**

Interpretation

The above table depicts that there is a moderate correlation between the area of cultivating cotton and total production of cotton (0.431) and moderate relation exists between area of cultivating cotton and Yield of cotton in Coimbatore region (0.361).

It was found to be statistically significant at one percent level. Other selected cereal crops recorded decline in area as evident from negative rate of growth per annum. The largest decline in area has been recorded by sugarcane at the rate of -1.28% per annum followed by Ragi. In the case of yield selected Cereal crops, the table result reveal that sugarcane recorded the negative growth rates per annum and found to be statistically significant. However, in the case of growth performance of production, still sugarcane recorded negative production rates per annum. However, in the case of growth performance of production, Maize has recorded the positive and highest growth rate of 15.90% per annum which was evidently contributed by the high profitability from Maize in the Coimbatore district. The largest decline in production has been recorded by Sugarcane at the rate of -0.15% per annum followed by Ragi, Chulam, Cotton. The state government has taken several efforts during the study period in order to increase the yield and production in the case of the major cereal crops by mechanization of production by wide utilization of farm machinery in agriculture at subsidized prices and granted loans investment in agriculture infrastructure, supplying inputs such as fertilizers, pesticides and seed and pricing policy for several main crops. But the analysis of our study for the Coimbatore District shows that the maize has recorded the positive and highest growth rate per annum in terms of area and Production.

CONCLUSION

The present study examines the growth performance of area, production and yield of selected cereal crops in the Coimbatore district. Using the data from 2006-07 to 2015-16, the Compound Annual Growth Rate (CAGR) of area, Production and yield for the selected cereal crops. The largest in the Coimbatore district were estimated for each period to study the growth performance of area of cultivation, Production and yield of these crops. In Coimbatore district, the sugarcane holds good performances in absolute terms, among the other cereal crops are concerned. But the compound Annual growth rate reveals that the maize was found to be positive and records a highest growth rate among other cereal crops in terms of area of cultivation, production and yield in Coimbatore district over the study period. Despite the fact that maize was found to acquire highest in terms of area of cultivation, production and yields among other cereal crops, it cannot serve the purpose of livelihood for majority of the population in the Coimbatore district. Hence, the importance had given to the sugarcane cultivations. Besides, the study suggests that the farmers can also cultivate Maize for the money making purpose in the Coimbatore district that suits for the climatic conditions of Coimbatore district as well.

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Table 1: Area under cereal crops in Coimbatore during 2006-07 to 2015-2016[In Hectares]

Year	Cholam	Ragi	Maize	Sugarcane	Cotton
2006-07	294376	95478	197782	391201	100339
2007-08	283526	93701	223428	354022	99335
2008-09	258876	90079	286639	308800	114516
2009-10	238476	82335	244159	293329	104095
2010-11	243465	75650	230489	315961	120765
2011-12	197696	82805	280629	346350	135805
2012-13	210893	70294	291052	348379	133215
2013-14	347131	118699	380429	313343	150963
2014-15	415103	104426	321952	263066	186693
2015-16	339166	89986	355064	252272	148087

Table 2: Production of cereal crops in Coimbatore during 2006-07 to 2015-2016[In Hectares]

Year	Cholam	Ragi	Maize	Sugarcane	Cotton
2006-07	293940	148148	759112	45168458	220864
2007-08	247836	175944	810057	38070965	200673
2008-09	213436	169944	1257882	32798888	18763





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2009-10	221960	160939	1138126	29758209	225448
2010-11	246981	171096	1027536	34251796	247930
2011-12	252522	224862	1695467	38974842	381769
2012-13	174966	138011	946363	34014097	255470
2013-14	513313	362343	2245216	32454135	416560
2014-15	868940	349628	2647751	28092784	598939
2015-16	439619	282054	2532330	25508824	326659

Table 3: Yield of cereal crops in Coimbatore during 2000-01 to 2015-2016 [In Hectares]

Year	Cholam	Ragi	Maize	Sugarcane	Cotton
2006-07	999	1552	3838	115	37
2007-08	874	1878	3626	108	34
2008-09	824	1887	4388	106	27
2009-10	931	1955	4661	101	36
2010-11	1014	2262	4458	108	34
2011-12	1277	2716	6042	109	48
2012-13	830	1963	3252	98	32
2013-14	1479	3053	5902	104	46
2014-15	2093	3348	8224	107	54
2015-16	1301	3132	7132	101	37

Table 4: Compound Growth Rates of Area, Yield and Production of selected Major cereal crops in Coimbatore district (2006-07 to 2015-16) in percentage

Crops	Area	Production	Yield
Cholam	0.86%	6.17%	4.22%
Ragi	-0.02%	5.66%	4.86%
Maize	3.13%	15.90%	12.34%
Sugarcane	-1.28%	-1.33%	-0.15%
Cotton	1.73%	21.94%	2.84%

Table 5. Instability index based on CAGR - CHOLAM

		Area	Production	Yield
Decade 1	1966-76	0.45%	2.41%	-0.01%
Decade 2	1977-86	-0.38%	1.06%	1.24%
Decade 3	1987-96	-3.11%	-3.84%	-0.77%
Decade 4	1995-07	-0.84%	-1.59%	-0.67%
Decade 5	2008-16	0.86%	6.17%	4.22%





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Table 6. RAGI

		Area	Production	Yield
Decade 1	1966-76	-0.11%	2.72%	2.85%
Decade 2	1977-86	-2.30%	-1.37%	0.63%
Decade 3	1987-96	-2.29%	-1.34%	0.91%
Decade 4	1995-07	-0.89%	-2.07%	-1.37%
Decade 5	2008-16	-0.02%	5.66%	4.86%

Table 7. Maize

		Area	Production	Yield
Decade 1	1966-76	10.32%	11.45	0.58%
Decade 2	1977-86	-1.98%	1.12%	3.69%
Decade 3	1987-96	6.78%	5.48%	-0.61%
Decade 4	1995-07	8.17%	6.68%	-1.38%
Decade 5	2008-16	3.13%	15.90%	12.34%

Table 8. SUGARCANE

		Area	Production	Yield
Decade 1	1966-76	1.89%	2.33	0.45%
Decade 2	1977-86	2.20%	2.74%	0.44%
Decade 3	1987-96	2.83%	2.55%	-0.27%
Decade 4	1995-07	0.64%	20.36%	-9.18%
Decade 5	2008-16	-1.28%	-1.33%	-0.15%

Table 9. COTTON

		Area	Production	Yield
Decade 1	1966-76	-2.04%	-0.34	0.73%
Decade 2	1977-86	1.43%	4.88%	2.71%
Decade 3	1987-96	0.44%	-0.92%	-8.28%
Decade 4	1995-07	-3.37%	-1.78%	1.15%
Decade 5	2008-16	1.73%	21.94%	2.84%

Table 10. Comparison between Area of Production and Total Production and Yield of Production for Cholam

	Total production of cholam (in tonnes)	Percentage of relationship	Yield of cholam (kg/ha)	Percentage of relationship
Area of cultivating cholam (in ha)	0.592	59.2%	0.060	6.0%





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Table 11. Comparison between Area of Production and Total Production and Yield of Production for Ragi

	Total production of Ragi (in tonnes)	Percentage of relationship	Yield of Ragi (kg/ha)	Percentage of relationship
Area of cultivating Ragi (in ha)	0.471	47.1%	0.473	47.3%

Table 12. Comparison between Area of Production and Total Production and Yield of Production For Maize

	Total production of Maize (in tonnes)	Percentage of relationship	Yield of Maize (kg/ha)	Percentage of relationship
Area of cultivating Maize (in ha)	0.829	82.9%	0.757	75.7%

Table 13. Comparison Between Area of Production and Total Production and Yield of Production for Sugarcane

	Total production of Sugarcane (in tonnes)	Percentage of relationship	Yield of Sugarcane (kg/ha)	Percentage of relationship
Area of cultivating Sugarcane (in ha)	0.432	43.2%	0.211	21.1%

Table 14. Comparison between Area of Production and Total Production and Yield of Production for Cotton

	Total production of Cotton (in tonnes)	Percentage of relationship	Yield of Cotton(kg/ha)	Percentage of relationship
Area of cultivating Cotton (in ha)	0.431	43.1%	0.361	36.1%

**Fig.1. Ragi****Fig.2. Cholam**



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Fig.3. Maize



Fig.4. Sugarcane



Fig. 5. Cotton

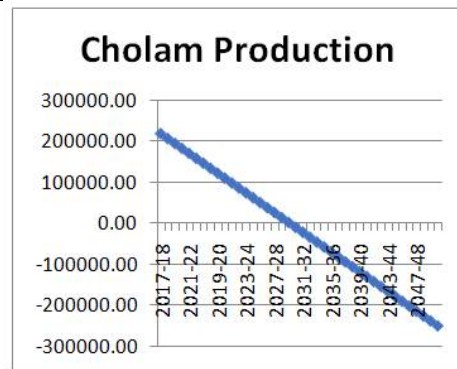


Fig.6. Cholam Production

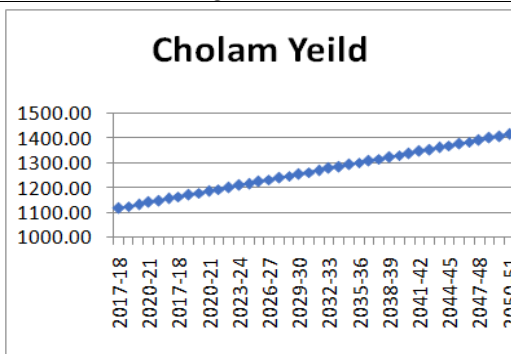


Fig.7. Cholam Yeild

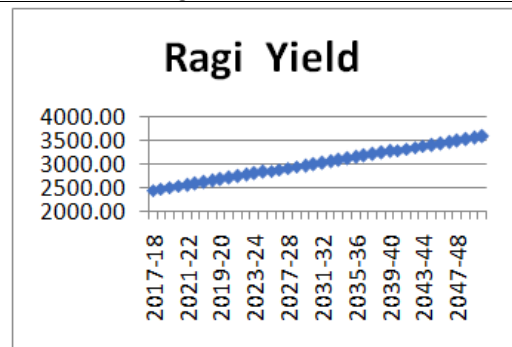


Fig.8. Ragi Yield

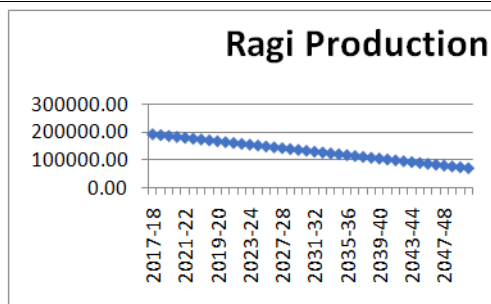


Fig.9. Ragi Production

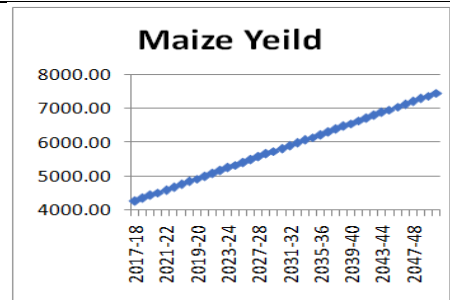


Fig.10. Maize Production





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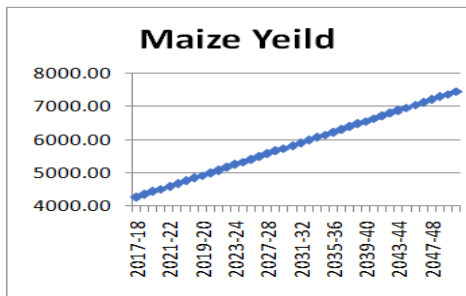


Fig. 11. Maize Yeild

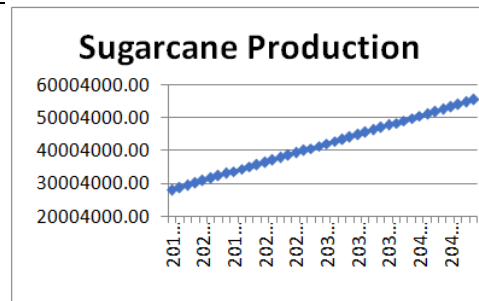


Fig.12. Sugarcane Production

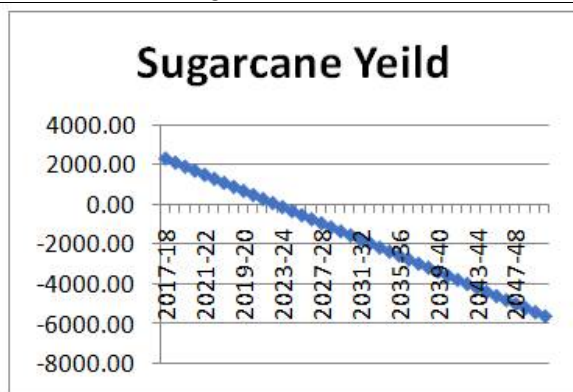


Fig.13. Sugarcane Yeild

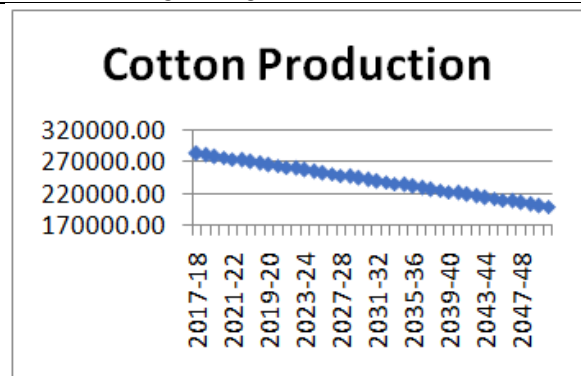


Fig.14. Cotton Production

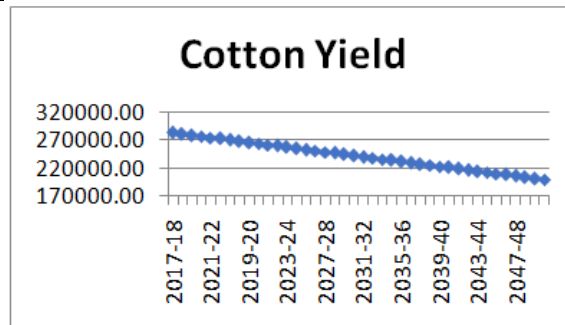


Fig.15. Cotton Yield





A Review on Risk Assessment and Complication of Diabetic Nephropathy

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ABSTRACT

Diabetic nephropathy (DN), often known as diabetic kidney disorder is the most common cause of end-stage kidney disease (ESKD) in the United States or most other developed countries. Diabetic nephropathy, retinopathy, neuropathy, cardiovascular disorder, and peripheral vascular disorder are all severe consequences of diabetes mellitus both type 1 and type 2. Nonproteinuric DN is a growing subset of DN patients who show a loss in kidney function and vascular complications without nonproteinuric (NP-DN) on either side. In the incidence of nonproteinuric diabetic nephropathy, only some of the therapeutic or preclinical researchers have examined the physiological processes that cause this type of DN to be dangerous to one's health. Avoidance of diabetic nephropathy is crucial. The current concepts of renal disease administration will be evaluated in the DN of a few essential research and pathogenesis perspectives that are critical to the methods used in innovative, investigational therapeutic strategies.

Key words: Hyperglycemia, Diabetic kidney disease, Microalbuminuria, Biomarkers; Type 2 diabetes.





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INTRODUCTION

Chronic kidney disease (CKD) is a severe diabetes mellitus (DM) disease that can cause nephrotic syndrome [1]. Hyperglycemia is a chronic disorder that affects 20% to 40% of people globally. Hyperglycemia is the most important factor of ESKD. Each year, the incidence of diabetes kidney disease (DKD) as a cause of ESKD rises [2]. Renal disease is an illness during which diabetics have higher than normal levels of urinary albumin excretion, chronic renal defects, and a lowering in glomerular filtration rate (GFR). Diabetic renal disease is related to high blood pressure, and coronary illness, including death rates; persons having type 1 diabetes mellitus (T1DM) and type 2 diabetes mellitus (T2DM) who acquire DN have significantly lower effects than people who have without. DN is a range that has stress intensity factor therapeutic improvements, given the substantial and increasing number of people affected by these sometimes-devastating effects. In the last four decades, real proof therapy also including renin-angiotensin-aldosterone-system (RAAS) regulation has led to substantial improvements in patient health [3]. It's not liked all people who have diabetes get a diabetic renal disease, although most of us here do, the progression is unpredictable. High blood pressure, blood glucose control, and obesity are the most preventable factors. According to data from the Joslin Diabetic Institute (JDI), Steno Diabetes Centre Copenhagen (SDCC) & Australian Diabetes, considers as well emphatically involve tobacco is a major health concern for diabetic kidney disorders. An important unchangeable risk factor is race, and age including a hereditary profile. People with such a genetic history of the chronic diabetic disease are much more probable to create DN [4]. Diabetic nephropathy is well-known as a leading cause of death and disability in adults with diabetes. Diabetic nephropathy affects about 30 % of insulin-dependent patients and 30–40 %percent of T2DM, and it commonly occurs regardless of blood sugar control. In the United States, DN is the primary cause of end-stage renal disease, responsible for more than half of all new cases. People with chronic conditions having end-stage renal disorder (ESRD) have a poor prognosis due to an increased risk of cardiovascular disease.

Together in conceptual investigations, 24 hereditary variations in Sixteen genes related to diabetic nephropathy were detected heparan sulfate proteoglycan 2 (HSPG2), gremlin 1 (GREM1), Vascular endothelial growth factor A (VEGF), FERM Domain Containing 3 (FRMD3), CysteinyI-tRNA synthetase (CARS), Unc-13 Homolog B (UNC13B), angiotensin I-converting enzyme (ACE), ADP ribosylation factor like GTPase 2 (ALR2), Apolipoprotein E (APOE), Erythropoietin (EPO), Endothelial nitric oxide synthase (eNOS), Carboxypeptidase vitellogeninlike (CPVL)/Chimerin 2 (CHN2), as well as Apolipoprotein C1 (APOC1) are the proteins involved. Engulfment and cell motility 1 (ELMO1), C-C motif chemokine receptor 5 (CCR5), and Carnosine Dipeptidase 1 (CNDP1) was similarly important in a subset of a person with diabetes in Asians. Several conceptual analyzed the role of Adiponectin, C1Q and collagen domain-containing (ADIPOQ), Plasminogen activator inhibitor-1 (PAI-1), Transforming growth factor 1 (TGF1), and Peroxisome proliferator-activated receptor (PPAR) polymorphisms in the pathogenesis of diabetic nephropathy. The level of polymorphic varies depending upon heritage [5]. T2DM as well as its problems have been characterized by a dynamic interplay among genetic as well as natural factors.

In people with diabetes, kidney dysfunction is a major predictor of death from cardiovascular causes. Only substances to inhibit the renin-angiotensin system (RAS) have exhibited substantial renoprotective benefits in randomized, controlled studies, aside from those that reduce glycemia and blood pressure. Individual nephrons are the functioning units of the kidney; each nephron is made up of a glomerulus, which filters fluid from the blood, and a tubule, which alters the filtrate by reabsorbing water and some solutes and secreting others. Hydration, obligatory solute excretion, osmotic load, and other factors all influence the concentration of the final product, urine. The overall number of nephrons in humans is fixed at birth and decreases throughout time due to injury and aging. The glomerular filtration rate (GFR), a dynamic metric based on the single-nephron GFR, is a typical way to express kidney excretory activity the GFR of an individual nephron [6, 7].





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Incidence

Every year, the DN increases at random. It's widely acknowledged as the most common problem among diabetics. Screening programs may be helpful in the preliminary documentation of patients at increased risk of getting DN [8]. The highest prevalence of DN is documented among Americans, Europeans, Indians, Asians, and Mexican Americans. Diabetic patients in Asia are more likely to develop diabetic kidney disorders than diabetic patients in developed nations.

A worldwide international diabetes federation (IDF) predicts a population of 463 million people who have diabetes (DM) by 2019, as well as 700 million after 2045 [9]. Diabetes affects around 537 million individuals (20-79 years) worldwide in 2021. By 2030, diabetes would impact the 643 million population, rising to 783 million by 2045. Diabetes has already claimed the lives of 6.7 million people. Diabetes affects one out of every six live births (21 million), and 541 million adults would be a likelihood of developing T2DM [10].

South Asians include those who live in have ancestry from India, Pakistan, Bengal, Sri Lanka, Nepalese, Bhutan, and also the Philippines. They number about 2 billion people worldwide who have T2DM especially in children. They also have a low body mass index (BMI) [11].

Stages of diabetic nephropathy

Stage 1: GFR is either normal or enhanced. After the initiation of diabetes, it lasts about 5 years. Despite an absence of albuminuria and hypertension, the kidneys have grown approximately 20% in size and renal plasma flow has increased by 10% to 15%.

Stage 2: Starts 1 to 2 years after the initiation of the disease with basement membrane thickening and mesangial proliferation, as well as a normalization of GFR but no clinical signs of the disease. Many patients stay during this phase for such rest of their lives.

Stage 3: Urine albumin 30 to 300 mg/day is the first clinically identifiable symptom of glomerular dysfunction. It normally happens 5 to 10 years after the commencement of the disease, whether or not hypertension is present. This stage is reached by about 40% of patients.

Stage 4: Irreversible proteinuria (>300 mg/day), GFR <60 mL/min/1.73 m², and chronic hypertension are all symptomatic of chronic kidney disease (CKD).

Stage V: ESKD is diagnosed when the GFR <15 mL/min/1.73 m² [12, 13].

Pathophysiology of DN

The first pathological of Kimmel still and Wilson discovered diabetic nephropathy in nodular nature in 1936. DN is a pathological condition indicated by chronic proteinuria these should be evaluated twice divided by about 3 to 6 months, chronic renal tubular filtration rate deterioration, with hypertension [14]. The synthesis and flow of the advanced glycation end and the synthesis of signalling pathways, including hydrodynamic and physiological changes all contribute to the pathogenesis development of chronic nephritis including ESKD in diabetic Mellitus. This releases reactive oxygen species (ROS) and inflammatory mediators. Pathology description of changes DN result included albuminuria and hypertension, along with capillary hyperfiltration, retinal saturation, and renal hyperplasia, including capillary change, will occur. Pathophysiological changes in the kidneys include cell membrane development in the cells and matrix, tubule thickening, cellular abnormalities, and tubular shrinkage are the last common pathways of kidney disorders, all of which lead to endothelial dysfunction and glomerulonephritis. DN initial stage as kidney size increased and also increased weight at the level of 15% as well as to continues to be affected by a significant decrease on kidney dysfunction impaired [15]. In the pathophysiology of DN, the following pattern is observed:





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- High blood sugar (Hyperglycemia)
- Glomerular basement membrane (GBM) of thickening
- Hyperfiltration of glomerular
- Endothelial integrity is impaired
- Increased urine albuminuria
- Blood flow is affected by nitric oxide
- A reduction in GFR

Diabetic nephropathy risk factors

There are 2 types of risk factors for diabetic nephropathy, modifiable as well as non-modifiable ones have been recognized for DN. Hypertension, glycaemic control, and dyslipidemia are examples of modifiable variables [16]. Smoke, genetic profile, age, gestation, and race are all risk factors for modifiable risk of DN. Patients with a genetic history having diabetic nephropathy were more susceptible to chronic disorder [17, 18]. Males were found to have a higher incidence of DN in one study [19]. DN risk factors are showed Figure 1.

Mechanisms of diabetes-related renal injury

Hyperglycaemia, systemic hypertension, glomerular hyperfiltration, renal damage, and nephron loss occur early, with the development of diabetes, and late, with the onset of diabetes. The number of nephrons has decreased. Proteinuria, advanced glycation end-products (AGEs), renal RAS, and lipid abnormalities are all genetic/racial factors. Mechanism of diabetes mellitus to complication of diabetic nephropathy, neuropathy, and retinopathy showed Figure 2.

Diabetic nephropathy potential serum indicators

There are complexity and uncertainty to albuminuria. The need for more effective serum and kidney biomarkers with enhanced sensitivity and specificity has sparked a surge in research in this area and we've put together a comprehensive assessment of the existing literature on relevant biomarkers. In type 2 diabetes, three novel promising biomarkers have recently been identified: beta-trace protein (beta TP), micro ribonucleic acid (miR-130b), and Neutrophil gelatinase-associated lipocalin (NGAL). They determined that patients with type 2 diabetes had considerably higher levels of serum NGAL and betaTP, suggesting that these markers could be employed early on as predictors of markers for glomeruli and renal tubules, etc. Such advancements in physiological morphological characteristics and biomarker assay investigation provide the potential for future multi-parametric risk assessment analysis of renal injury and pharmacological intervention treatment therapies [20, 21]. Tumour necrosis factor (TNF) receptor levels in the blood may indicate the incidence of ESRD and CKD in patients with type 1 diabetes People that are diabetic with type 2. The TNF receptor is overexpressed in patients with type 2 diabetes. The albuminuria level also has predictive relevance [4, 22].

NP-DN diagnostic markers

Renal biopsies are quick and easy to do thorough examination regarding a patient's renal function illness. Infections, haemorrhages, and other vascular issues are all possible complications disease, on the other side, limits its usage by physicians. Kidney biopsies may be insufficient to detect vascular abnormalities in NP-DN and DN patients. Consequently, developing more secure and more diagnostic indicators that are easily available crucial to improving the early detection and treatment of individuals with DN and NP-DN are two types of DN. Ultrasound technology is one alternative that has made it possible to diagnose and track the evolution of DN. Ultrasound technology can be used to assess the structure and function of the kidneys in patients with DN, cirrhosis, and acute renal failure. Recent ultrasonography investigations have added another tool for assessing renal function in people with diabetes mellitus at different phases of the illness. The renal resistive index (RRI) has risen, which is a positive factor that assesses vascular resistance in the kidneys, have already been proven to consistently recognize DN or NP-DN and take care of either development. As a result, ultrasonography sonography is a useful tool for detecting, identifying, and monitoring DN patients' hemodynamic and morphologic changes [23, 24].





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Metabolic factors

ROS and oxidative stress damage deoxyribonucleic acid (DNA) and proteins or act as signaling amplification of activating cellular stress pathways such as protein kinase C (PKC), mitogen-activated protein kinases (MAPK), and nuclear factor kappa B NF- κ B, which are involved in cellular stress response mechanisms [25, 26]. Aldose reductase's conversion of excess glucose to sorbitol and the subsequent conversion of sorbitol dehydrogenases to fructose increases the nicotinamide adenine dinucleotide (NADH)/nicotinamide adenine dinucleotide (NAD⁺) ratio, contributing to oxidative stress [27, 28].

Initiation of fructokinase in the proximal tubule is also part of a recently reported unique mechanism of damage that involves endogenous fructose synthesis [29, 1]. This process can alter protein structure and function, elevate proinflammatory cytokines and growth hormones, and produce oxidative stress [30]

Genetic variables

Diabetic nephropathy is four times more likely to occur in a sibling individual with type 1 diabetes. As well as, in African Americans, relatives of the sufferer with a family of T2DM who have the end-stage renal disease are five times more likely to get ESRD than the general population. A socioeconomic cultural grouping may be revealed by these data, which do not prove that genetics is involved in diabetic kidney disease. Linkage analyses have been undertaken by several researchers using molecular genetic approaches to explain the vulnerability to diabetic nephropathy. A relationship between diabetes and kidney disease has been found on three chromosomes there are 3q, 10q, and 18q [31].

AGEs

Nonenzymatic products of interactions of glucose or other derivatives of saccharides with lipids or proteins give rise to AGEs, which are heterogeneous compounds. Crosslinking between GBM and other vascular membranes by AGEs may major contributor to abnormalities in the kidney [32]. AGE formation is induced by a variety of environmental variables, including smog, fumes high amounts of diets in simple and refined carbohydrates, high calories, high temperature cooked dishes and a sedentary way of life. In these circumstances, Oxidative stress disrupts cell signalling, particularly insulin-mediated metabolic responses, which can result in a significant change in their normal function. In blood and tissues from humans as well as meals, more than 20 distinct AGEs have been discovered.

Emerging treatments

RAS-blocking medicine is the best evidence-based treatment for diabetic nephropathy. This is the first time in 15 years that a new medicine to treat diabetic nephropathy has been approved was given by the united states food and drug administration (FDA). Additional treatment for the prevention of the advancement of DN has been studied. As of 90 days, finer none, a third-generation mineral corticoid receptor antagonist, has reduced albumin urea in a sufferer with DN. The decrease in albuminuria will have success in the long run and can prevent the advancement of DN and the end-stage renal disease is on the rise. Their mode of action inhibits glucose, salt uptakes in the proximal tubule, resulting in nature is and glucosuria [33]

Cell signaling and transcription factors

Glycemic control and PKC- gene transcriptions were found to be closely related to DN. One of the many impacts of PKC activation is an increase in angiotensin II actions, dysregulation of nitric oxide, and NF- κ B activity [34, 35]. Cell signalling is integrated into cell responses by MAPKs, which are intracellular protein kinases. MAPKs activate several nuclear transcription factors, including NF- κ B, which then controls the gene production of chemokines, cytokines, and adhesion molecules. P38p38 MAPK pathway activation is highly related to renal inflammation and disease-nephropathy (DN) [36, 37].





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Proteinuria

Proteinuria is a common complication of most chronic kidney disorders. Diabetic nephropathy is accompanied by proteinuria, either microalbuminuria or macroalbuminuria. Larger proteinuria often means more likelihood of disease progression [38]. If you have glomerular damage that increases the permeability of the glomerular basement membrane, then have proteinuria.

System of renin-angiotensin

It's now widely understood that the kidney has a specific (renal) RAS that is activated. Mesangial cells are found in the proximal tubular epithelial cells of diabetes people have, as well as the podocytes. If the curves of dose-reaction for blood pressure reduction and protein excretion in the urine are different, then intrarenal RAS may explain why greater dosages are required for urine protein excretion in research animals than in human beings.

Vitamin D

Patients with CKD are likely to have a deficiency in vitamin D. Lack of vitamin D is associated with RAS activation and podocyte damage. In addition, vitamin D may inhibit tubular epithelial cells from transforming from epithelial to mesenchymal cells [40]. Experimentally, active vitamin D also reduced oxidative stress by restoring nuclear factor erythroid 2-related factor 2 (Nrf2) levels, important for cellular defense against oxidative harm. This was linked to lower albuminuria and lower NF- κ B activation [41].

Diagnosis

Microalbuminuria (chronic albuminuria at levels 30–299 mg per day) is a symptom of developing nephropathy that is described as the presence of small levels of albumin in the urine. In T1DM, overt nephropathy or macroalbuminuria consistent with albuminuria of 300 mg per day it develops during a time, but it may be present at the time of T2DM diagnosis. A sufferer who develops macroalbuminuria is at a higher risk of developing end-stage renal disease. According to the Australian diabetes investigation of diabetic Mellitus showed a protein in the urine is widespread among people with established diabetes, is present before the development of diabetes and it's becoming more common with increasing tolerance to glucose [44]. About 20 to 40 percent of type 2 diabetics with microalbuminuria will develop overt nephropathy as well as 20 percentage will acquire end-stage renal disease after the formation of overt nephropathy [45]. Urine albumin or protein/creatinine ratio (ACR; normal, 30 mg/g creatinine) from the first morning (recommended) or random specimens. Microalbuminuria (chronic albuminuria at levels 30–299 mg per day) is a symptom of developing nephropathy that is described as the presence of small levels of albumin in the urine.

Biomarkers

Protein in the urine as a biomarker of diabetic nephropathy has restrictions, as many sufferers undergo glomerular filtration rate loss there is no change in albuminuria, as well as normoalbuminuria. Despite normoalbuminuria, severe diabetic glomerular lesions can develop, tubular biomarker discoveries have been conflicting [1].

Treatment of DN

Maintenance of high blood pressure, hemodynamic management, blood glucose levels, and other metabolic issues are the main therapeutic options for DN. Proteinuria and GFR have been reduced with the use of antihypertensive drugs. Non-pharmacological and alternative medications are also investigated. In the treatment of DN, novel medicines, gene therapy, and stem cell treatment are explored [1]. Once a diabetic patient has been diagnosed, blood glucose-lowering or hemostasis, as well as RAS inhibition, are the most alternative drugs showed Table 1.

CONCLUSION

Diabetic nephropathy is one of the world's most complicated disorders, as described in this review. Diabetes affects half a billion people worldwide. Management of its modifiable risk factors may help in decreasing DN in the future.





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Diabetes blood glucose levels maintain hemostasis, control blood pressure 120/80 mmHg, avoid smoking, diet control, and physical activity are to prevent diabetic nephropathy or DKD.

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Highlights

- Hyperglycaemia is the most important factor ESKD
- Diabetic nephropathy is well-known as a leading cause of death and disability in adults with diabetes
- Kidney dysfunction is a major predictor of death from cardiovascular causes
- IDF predicts a population of the 463 million people who have diabetes (DM) by 2019, as well as 700 million after 2045
- Glomerular basement membrane (GBM) of thickening,
- Mechanisms of diabetes-related renal injury

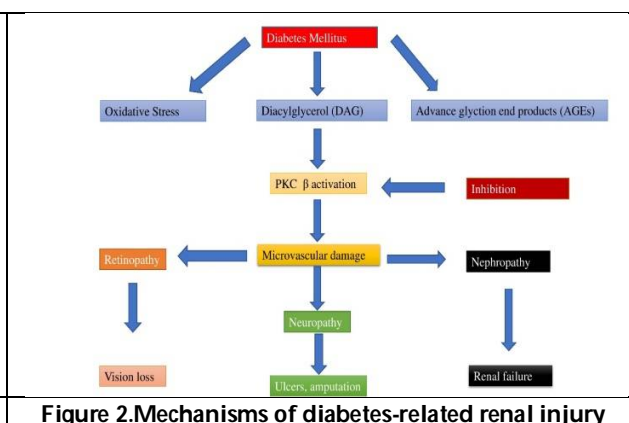
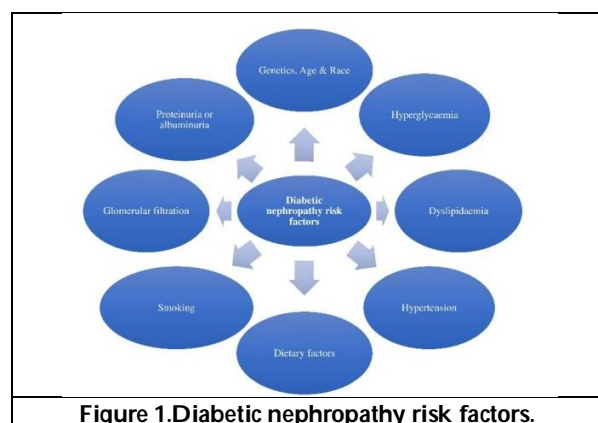




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Table 1. Drugs for DN

Product	Key findings
Thiamine (Benfotiamine)	Thiamine due to the decrease in activation of protein kinase C, protein glycation and oxidative stress [46]
Pimagedine	Inhibiting of advance glycation end product, reduced urinary protein excretion and the decline in GFR in proteinuric [47]
Silymarin	(Daily three times for Silymarin 140 mg3 months reduced albuminuria, urine TNF- α ,urine, and serum malondialdehyde (oxidativestress marker) compared to baseline [48]
Zinc	50 mg elemental zinc for 12 weeks improved glycemic control, lipids, and albuminuria compared to baseline [49]
Turmeric (Curcumin)	500 mg three times daily for 2 months Turmeric capsules reduced albuminuria, TGF- β , and IL-18 levels compared to baseline [50]
Sulfonylureas	Insulin secretagogues control insulin release directly. tolbutamide intake were Sulfonylureas associated with an increase in lethal cardiac events [51]
Metformin or Insulin sensitizers	Enhances glucose uptake into peripheral tissues, such as keletal muscle, by activating 5'-adenosine monophosphate-activated protein kinase (AMPK- α 2). metformin reduces caspase-3- and -8-mediated apoptosis in isolated islets from T2DM patients and protects against lipotoxicity-induced β -cell defects [52,53]





Synthesis, Spectroscopic Analysis, Molecular Docking, Anti-Oxidant, and Anti-Microbial Activities of Novel (E)-4-fluoro-N'-(3-methyl-2r, 6c-diphenylpiperdin-4-ylidene) benzohydrazides

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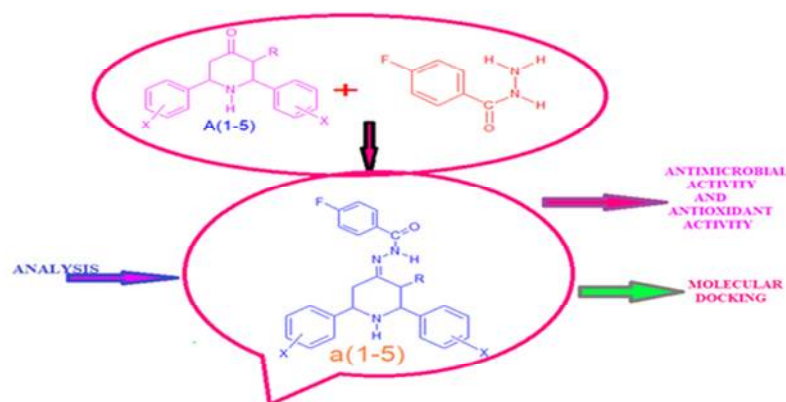
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ABSTRACT

Here, a convenient and well-organized method for the amalgamation, imperative intermediates of piperdin-4-ones, viz. (E)-4-fluoro-N'-(substituted benzylidene) benzohydrazides 1(a-e) from the corresponding fluorobenzohydrazide. Herein, the characterization of the amalgamated derivatives has been done experimentally through the FT-IR, and 1D NMR (H^1 and C^{13}) spectra. All the compounds have been screened for their in vitro anti-oxidant, in vitro anti-fungal, and in vitro anti-bacterial activity in contradiction of various free radicals, and various bacterial and fungal strains respectively. Molecular docking studies of compounds 1b and 1c shows that the various ligand of compounds shows glide score values lying between -7.15 to -7.33 Kcal/mol, among these the compounds 1b showed excellent glide score values. The present study reveals that these amalgams could be an outline for future growth through derivatization to plan more powerful anti-oxidant and anti-microbial agents.

Keywords: Anti-oxidant activity; 4-fluorobenzhydrazide; NMR spectra; Anti-bacterial activity; Molecular docking; Anti-fungal activity



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Graphic abstract

INTRODUCTION

The piperidine-4-one nucleus, a vital class of pharmacophore found in a wider range of natural alkaloids pageants an extensive spectrum of biological activities ranging from anti-cancer to anti-bacterial [1-2]. Many piperidin by-product sown pharmacological activities including anti-microbial, anti-oxidant, and anti-cancer activities, and form an animated part of the molecular structure of imperative drugs [3-6]. Additionally, research over the past several decades has deep-rooted that anti-oxidants play a protective role in multistage carcinogenesis [7-9]. Newly, considerable attention has been focused on identifying synthetic anti-oxidants that target various signing trails that are unusual in cancer. Hydrazide-hydrazone derivatives received the attention of various medicinal chemists as a result of their efficacious biological potencies, viz., anti-microbial, anti-tubercular, and also anti-convulsant activities [2, 11, and 12]. In the current study, a novel series of 4-fluoro-N'-(3-methyl-2r, 6c-diphenylpiperidin-4-ylidene) benzohydrazides **1(a-e)** were blended using a reaction of piperidin-4-one with 4-fluorobenzohydrazide in presence of acetic acid in methanol. The chemical erections were set using IR, ¹H-NMR, and ¹³C-NMR. In addition, we executed structure-activity relationship studies of the recently amalgamated hydrazine derivatives with strong anti-oxidant, anti-fungal, and anti-bacterial activities.

Experimental Details

All the chemicals that were bought were used without further decontamination. All the reported melting points were dignified in open capillaries were uncorrected. FT-IR investigation was done creation a pellet of the compound with KBr. Both one and two-dimensional NMR spectra were noted in the NMR spectrometer. A sample was primed with a 5mm diameter tube using CdCl₃-d₆ solvent (10.0 mg in 0.5 ml). ¹H NMR and ¹³C NMR data were collected in 400.13 MHz and 100.62 MHz functioning frequency, respectively. Chemical shifts (δ) were uttered in ppm to TMS. Splitting patterns were chosen as follows: s-singlet, d-doublet, t-triplet, q-quartet, and m-multiplet.

General procedure

The 3-methyl-2r,6c-diphenyl piperidin-4-one **A (1-5)** were primed by the condensation of appropriate ketones, aldehydes, and ammonium acetate in a 1:2:1 proportion, according to the method defined by Noller and Baliah [21]. A reaction mixture containing 3-methyl-2r,6c-diphenyl piperidin-4-one (1 mmol), and 4-fluorobenzhydrazide (1.5 mmol) was liquefied in the solvent of methanol and acetic acid (2ml) was added as a catalyst. The reaction mixture was refluxed for 4-5 hours. After accomplishment of the reaction the product and were recrystallized with ethanol. The pure compounds **1(a-e)** were attained.





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Reagents and conditions

(a) CH₃COONH₄, C₂H₅OH(b) CH₃OH, CH₃COOH, 4h, 60°C

Sample code R X

1a -CH₃ H2b -CH₃ p-Cl3c-CH₃ p-OCH₃4d -CH₃ p-Br5e -CH₃p-CH₃

Spectroscopic data for compounds 1(a-e) are presented below.

4-Fluoro-N'-(3-methyl-2r,6c-diphenylpiperidin-4-ylidene) benzohydrazide (1a)

Solid, yield: 73%, m.p:179.03°C. IR (KBr, V_{max} Cm⁻¹): 1634.935(C=N), 3211.439(N-H st N-H amide), 3031.616, 2973.7, 2860.3 (C-H st), 1446.326 (C=O).

¹H NMR spectrum (δ, 400MHz, CdCl₃-d₆, ppm): 1.10(d,3H, CH₃ at piperdin ring), 2.01(s,1H, C-5-1Ha), 2.65(m,1H, C3-1H), 3.05(dd,1H,C5-1He),3.55(d,1H,C2-1H),7.17-7.53(m,10H, Ar-H),10.71(s,1H, N-H amide N-H).

¹³C NMR spectrum (δ 400 MHz-CdCl₃-d₆, ppm): 13.88(CH₃ at piperdin ring), 29.7(C-5), 39.7(C-3), 61.8(C-6), 67.7(C-2), 126.8-128.9 (Ar-C), 138.9 and 141.7 (ipso Carbons), 160.10 (C-4), 163.7(NHCO), 166.2(C-4 at benzohydrazide).

Molecular formula: C₂₅H₂₄FN₃O, Exact mass: 401.19, Molecular weight: 401.48, Elemental analysis (found): C=74.79%, H=6.0 % N=10.47%.

4-Fluoro-N'-(3-methyl-2r,6c-bis (p-chlorophenyl) piperidin-4-ylidene) benzohydrazides (1b)

Solid, yield: 75%, m.p:206.0°C, IR (KBr, V_{max} Cm⁻¹): 1637(C=N), 3230(N-H), 3056(C-H st), 1592 (C=O).

¹H NMR spectrum (δ, 400 MHz-CdCl₃-d₆, ppm): 1.17(s,3H, CH₃ at piperdin ring), 2.51(s,1H, NH at piperdin ring),2.21(dd,1H,C5-1Ha), 2.51(s,1H,C3-1H), 6.99-7.45(m,8H,Ar-H), 10.49(s,1H,N-H, amide N-H).

¹³C NMR spectrum (δ, 400 MHz-CdCl₃-d₆): 9.9(CH₃ at piperdin ring), 29.7(C-5), 38.2(C-3), 62.3(C-6), 69.2(C-2), 1238.7-129.9(Ar-C), 132.0(C-5), 136.7 and 147.9(ipso Carbons), 154.5(C-4), 163.7 (NHCO). 166.5(C-4 at benzohydrazide ring).

Molecular formula: C₂₅H₂₂Cl₂FN₃O, Exact mass: 469.11, Molecular weight: 470.37, Elemental analysis (found): C=63.84%, H=4.71%, N=8.93%.

4-Fluoro-N'-(3-methyl-2r,6c-bis(p-methoxyphenyl)piperidin-4-ylidene)benzohydrazide (1c)

Solid, yield: 76%, m.p:163°C, IR (KBr, V_{max}, cm⁻¹): 1633(C=N), 3208(N-H), 3038(C-H st), 1503, 1445, 1418(C=C arom).

¹H NMR spectrum (δ, 400 MHz-CdCl₃-d₆, ppm): 0.78(d, 3H, CH₃ at piperdin ring), 1.69(s, 1H, NH at piperdin ring), 2.00(s, 1H, C5-1Ha), 2.50(s, 1H, C3-1H), 3.70(s, 6H, OCH₃), 6.79-7.71(Ar-H).

¹³C NMR spectrum (δ, 400MHz-CdCl₃-d₆, ppm):11.8(CH₃ at piperdin ring), 68.1(C-2), 55.3(C-6), 40.5(OCH₃), 29.7(C-3), 114.2-129.3(Ar-C), 129.7 and 133.1(ipso carbons), 159.5(C-4), 161.9(NHCO), and 166.1(C-4 at benzohydrazide ring).

Molecular formula: C₂₇H₂₈FN₃O₃. Exact mass: 461.53, Molecular weight: 461.21, Elemental analysis (found): C=70.21%, H=6.11%, N=9.10%.

4-Fluoro-N'-(3-methyl-2r,6c-bis(p-bromophenyl) piperidin-4-ylidene)benzohydrazide(1d)

Solid, yield: 69%, m.p: 225.04°C, IR (KBr, V_{max}, cm⁻¹): 1639(C=N), 3159(N-H), 2963(C-H arom), 1559, 1503, 1485(C=C arom).

¹H NMR spectrum(δ, 400 MHz-CdCl₃-d₆, ppm): 0.75(d, 3H, CH₃ at piperdin ring), 2.00(s, 1H, NH at piperdin ring), 2.48(dd, 1H, C5-1Ha), 2.52(m, 1H, C3-1H), 3.50 (dd, 1H, C5-1He),3.91(d,1H,c6-1H), 7.01-7.33(m, 8H, Ar-H), 1.17(s, 1H, N-H amide NH).





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¹³C NMR spectrum (δ , 400 MHz-CdCl₃-d₆, ppm):10.09(CH₃ at piperdin ring), 40.98(C-5), 56.75(C-3), 60.93(C-6), 67.72(C-2), 126.39-129.41(Ar-C), 140.71-141.58(ipso Carbons), 147.92(C-4), 163.53(NHCO), and 169.72(C-4 at benzohydrazide ring).

Molecular formula: C₂₅H₂₂Br₂FN₃O, Exact mass: 557.01, Molecular weight: 559.27, Elemental analysis (found): C=53.69%, H=3.96%, N=7.51%.

4-Fluoro-N'-(3-methyl-2r,6c-bis(p-methylphenyl)piperdin-4-ylidene)benzohydrazide(1e)

Powder, yield: 71%, m.p.:170.0°c. IR (KBr, Vmax cm⁻¹):1636(C=N), 3216(N-H), 3023(C-H arom), 1504, 1438, 1408(C=C arom).

¹H NMR spectrum (δ , 400 MHz-CdCl₃-d₆, ppm): 1.12(d, 3H, CH₃ at piperdin ring), 2.09(s, 1H, NH at piperdin ring), 2.34(dd, 1H, C5-1Ha), 2.43(s, 6H, CH₃ at phenyl ring), 2.70(m, 1H, C3-1H), 3.60(d, 1H, C2-1H), 5.40(s, 1H-NH), 7.03-7.57(Ar-H),7.98(s,1H), 11.04(s, 1H, N-H, amide).

¹³C NMR spectrum: (δ , 400 MHz-CdCl₃-d₆, ppm): 13.9(CH₃ at piperdin ring), 21.14(CH₃ at phenyl ring), 33.93(C-5), 50.86(C-3), 61.34(C-6), 68.24(C-2), 126.43-129.38(Ar -C), 137.52 and 139.73(ipso carbons), 149.73(C-4), 163.76(NHCO), and 166.19 (C-4 at benzohydrazide ring).

Molecular formula: C₂₇H₂₈FN₃O, Exact mass: 429.22, Molecular weight: 429.53, Elemental analysis (found): C=75.50%, H=6.57%, N=9.78%.

Antioxidant activity

Altered sample concentrations (w/v) were made by dissolving 30, 60, 90, and 120 mg of starch in 1ml of double distilled water followed by sonication for 23 minutes to certify better mixing. The blend obtained was then utilized for determining different anti-oxidant assays.

DPPH radical scavenging activity

The DPPH (1, 1-diphenyl-2, picrylhydrazyl) activity of samples was resolute by the method proposed by Ashwar et al [22] with some adjustments. 5 ml of each sample of varying concentrations (30, 60, 90, and 120 mg/ml) was mixed with a 60 mM solution of DPPH in methanol (5ml).The mixture was vortexed for about ½ of a minute and kept at 25.00°c for 35 minutes in a dark room. The absorbance of the resulting blend was determined at 517nm using a UV-Vis spectrophotometer (U-2900, Hitachi, and Tokyo, Japan) against the blank α -tocopherol was taken as positive control dissolved in double-distilled water. DPPH scavenging potential was measured with the following formula:

$$\text{DPPH scavenging potential (\%)} = (1 - A_s) / A_c * 100$$

Whereas "Ac" is the absorbency of the control and "As" is the absorbency of the sample.

Metal chelating activity

Metal chelation knack was evaluated affording to the method of Shah et al[22]. The absorbance of the resulting mixture was exalted at room temperature against blank at 562nm and related to citric acid (standard). The chelating ferrous ion potential was planned by the formulae:

$$\text{Chelating effect (\%)}: (A_c - A_s) / A_c * 100$$

Whereas "Ac" is the absorbent of the control and "As" is the absorbance of the sample.

Lipid peroxidation activity

This test was measured by the method Shah et al [22]. Starch suspension(1ml) of varying concentrations was added to linoleic acid(1 ml, 0.1% w/v), hydrogen peroxide(0.2ml,30mM), ascorbic acid(0.2ml, 100mM),and ferric nitrate(0.2ml,20mM). This blend was allowed to incubate at 37°c for half an hour. After this, the expiry of the reaction was carried out by adding trichloroacetic acid (1.0 ml, 10 % w/v) and thiobarbituric acid (1.0 ml, 1% w/v). Reaction blend tubes were preserved in a boiling water bath for 20- 25 min monitored by centrifugation at 6000 rpm for





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5.0min. The supernatant was collected and its absorbency was determined at 535 nm against a blank and accompanying with EDTA (standard).

Lipid peroxidation inhibition (%) = $\frac{Ac-As}{Ac} \times 100$

Whereas "Ac" is the absorbent of the control and "As" is the absorbance of the sample.

Molecular Docking studies

A certain technique was used for molecular docking studies. The ligand for docking was set using LigPrep, Schrodinger. The ligand has been geometrically experienced and consigned to an apt protonation state at pH 7.00 ± 2.00 . The strong point of minimization has been carried out using the aid of the OPLS 2005 pressure subject. The target protein *enoylacyl* and *InhA* (Carrier protein reductase) from *Mycobacterium tuberculosis* were downloaded from the Protein Data Bank (PDB id: 2NSD) and the vigorous site was selected. The grid was assigned by picking the ligand as the center of the ligand and then the grid box was spawned by applying default parameters. The docking change has been finished using GLIDE, Schrodinger, and GLIDE XP (extra precision) techniques.

In vitro anti-microbial activity by 2-fold serial dilution method.

Bacterial strains such as *Bacillus subtilis*, *Klebsiella pneumoniae*, *Escherichia coli*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus*. Also, fungal strains such as *C.albicans*, *Rhizopus sp.*, *A.niger*, and *A. flavus* were obtained from the faculty of Medicine, Annamalai University, Annamalaiagar-608002, Tamil Nadu, India, and were used to screen the anti-bacterial and anti-fungal activities of the newly amalgamated compounds 1(a-e). The bacterial and fungal strains were cultured in nutrient broth (NB) at PH 5.6 (Hi-media, Mumbai).

The in vitro strength of compounds 1(a-e) was scrutinized by a two-fold serial dilution method [23]. Stock solutions of 1(a-e) were made in DMSO (1 mg ml⁻¹). Compounds were tested in the meditations of 200, 100, 50, 25, 12.5, 6.25, and 3.12 µgml⁻¹(two-fold serial dilution method) with NB. Then NB was deferred with 100µL of bacterial spores for 24 hours old bacterial cultures on NB at 37± 1° c. The drug standard for anti-bacterial and anti-fungal activities was streptomycin and fluconazole respectively.

RESULTS AND DISCUSSION

The amalgamation of new 4-fluoro-N'-(3-methyl-2r,6c-diphenylpiperidin-4-ylidene) benzohydrazides **1(a-e)** was supported out according to the steps shown in scheme 1. Comprehensive scrutiny of IR, ¹H NMR, and ¹³C NMR spectra data, was made to identify and establish the newly amalgamated compounds **1(a-e)**.

Structural elucidation of compound 1a

In the ¹H NMR spectra for compound 1a, a wide and more downfield D₂O redeemable singlet at 10.716 ppm was characteristic of the NH amide group. Another extensive singlet signal resonated at 2.011 ppm was allocated for the NH proton of the piperidin-4-one ring. Signal broadening is due to the faster exchange of the NH proton with solvent moisture than the resonance time scale. Two doublets were observed in the region 0.825 ppm and 3.025 ppm H-2a and the methyl group of C-3 at the piperdin ring. Three doublets were observed in the region of 2.614 ppm, 2.632 ppm and 2.650 ppm is due to the H-5e, H-5a, and H-6a. In ¹³C NMR of compound 1a, two downfield resonances at 163.75 ppm and 160.18 ppm were assigned to C=N and C=O (=N-NH-CO-) carbons respectively. The carbon resonances were observed around 149.57 ppm and 141.75 ppm were due to ipso carbons. However, there are four signals around 67.78 ppm, 61.86 ppm, 39.36 ppm, and 29.73 ppm which were conveniently consigned to the C-2, C-3, C-5, and C-6 carbons respectively. The ¹³C chemical shift values of two methyl carbons (C-3 at the piperdin ring and C-4 at the benzohydrazide ring) were observed at 13.88 ppm and 14.56 ppm. The signals at 166.25 ppm and 138.97 ppm were also assigned for C-4 and C-5 of the benzohydrazide ring. Taken together all the above annotations substantiate the proposed structure of the 4-fluoro-N'-(3-methyl-2r, 6c-diphenylpiperdin-4-ylidene) benzohydrazide.





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We have established a system that syndicates piperidin-4-one pharmacophore and hydrazones 1(a-e) with the anticipation of several promising anticancer, anti-oxidant and anti-microbial agents unindustrialized. The present study also aimed to investigate the structure-activity relationship for the anti-oxidant activities of amalgam molecules containing the piperidin-4-one pharmacophore and hydrazones moieties. Five dissimilar hydrazone derivatives were amalgamated and assessed for their in vitro free radical scavenging activity against several free radicals. Our outcomes run indication that imitation compounds 1(a-e) displayed a concentration-dependent anti-radical activity ensuing from the reduction of DPPH, Metal chelation, and lipid peroxidation radicals to their non-radical forms. IC₅₀ values scavenging effects of various imitation compounds 1(a-e) are shown in Table 1. It is glowing to notorious that an increase in anti-oxidant activity is detected with the auxiliary of alkyl chains such as methyl, ethyl to phenyl rings due to the electron resonance effect of the phenyl group [13].

Numerous studies have established that organic molecules integrating an electron-donating group (hydroxyl, amino, alkyl, and methoxy) at the para position of the phenyl ring can act as free radical duping agents and are accomplished of differing oxidative challenges [1, 14- 16]. Compounds holding electron-donating methoxy (1c) and methyl (1e) substitutions at the para locations of the phenyl ring attached to the C-2 and C-6 carbons of the piperidin moiety showed brilliant free radical scavenging effects compared to the standard anti-oxidant, a known anti-oxidant used as a +Ve control. These assumptions endorse reports by other workers on the in vitro free radical scavenging effects of organic molecules incorporating an electron-donating group (amine, hydroxyl, methoxy, and alkyl) at the para position of the phenyl ring [14, 15, 16]. These estimable or less free radical scavenging special effects of compounds with fluoro, chloro, Bromo substitutions may be due to the electron-withdrawing inductive effect of halogens. Our consequences are in line with other findings [13, 16-17]. The radical-scavenging effects are signified by the alteration in color from purple to light yellow and reading the absorbance at 517 nm. Samples were analyzed at 4 different meditations (30, 60, 90, and 120 mg/ml) which revealed a significant ($p \leq 0.05$) increase in DPPH scavenging potential with the surge in concentration. The scavenging ability of the amalgamated compounds 1(a-e) is depicted graphically in Fig.1. Research over the past spans has deep-rooted that extreme production of lethal radical species is known to cause lethal changes in DNA, lipid, and protein oxidation. Thus, free radicals may help as a source of mutations that pledge carcinogenesis [18, 19].

In vitro, anti-bacterial activity of the amalgamated hydrazones was carried out against *B.subtilis*, *S.aureus*, *K.pneumoniae*, *P.aeruginosa*, and *E.coli* by the two-fold serial dilution scheme using *Streptomycin* as the standard. The MIC values are obtainable in Table 2. Investigation of *in Vitro* anti-microbial effects of the 4-fluoro-N'-(3-methyl-2r,6c-diphenylpiperidin-4-ylidene)benzohydrazide 1(a-e) revealed a different array of inhibitory activity (6.25-200 μgml^{-1}) against all pathogens excluding compound 1a, which did not show activity against *K.pneumoniae* and *P.aures*, even at a maximum concentration of 200 μgml^{-1} . The compounds deprived of any alternates at the para position of the phenyl groups at the C-2 and C-6 positions of the hetero-cyclic ring (1a) hamper the development of *Bacillus subtilis*, *S.aureus* and *E.coli* at the MIC value 50-100 μgml^{-1} . Substitution of electron-withdrawing Bromo (1d) and chloro (1b) functional groups at aryl groups showed modest anti-bacterial activity against *B.subtilis*, *P.aeruginosa*, *K.pneumoniae*, *S.aureus*, and *E.coli* at MIC values of 12.50 μgml^{-1} parallel to that of standard *streptomycin*.

Numerous studies have predicted that electron-withdrawing substituents like Bromo, Fluoro, and Chloro substituted 2, 6-diphenyl piperidin by-products exerted brilliant anti-bacterial and anti-fungal activities [1, 2, 11, 14, 20, 25]. Compounds 1c and 1e having electron-donating methoxy and methyl substitutions at the para position of phenyl rings devoted to C-2 and C-6 carbons of the piperidin moiety show modest anti-bacterial activity against all the established bacterial strains in the range of 25-200 μgml^{-1} . *In vitro*, anti-fungal action of the synthesized hydrazones was supported out in contradiction of *C.ablicans*, *Rhizopus*, *A. flavus*, and *A.niger* by the serial dilution two-fold method paying fluconazole as the standard. The MIC values are achieved in Table 3. Substitution of electron removing Chloro (1b) and Bromo (1d) functional groups at aryl groups exerted uncertain anti-fungal activity against *C.ablicans*, *Rhizopus*, *A. flavus*, and *A.niger* at MIC values of 6.25- 50 $\mu\text{g/ml}$. Additionally, a phenyl ring with electron contributing OCH₃ and CH₃ groups at the para position hamper the development of all the fungal strains at MIC values 25- 100 $\mu\text{g/ml}$.





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Molecular docking studies

To find an appropriate inhibitor for *Mycobacterium tuberculosis* docking studies [24] were carried out for InhA protein. InhA catalyzes the reduction of lengthy chain trans-2-enoyl-ACP inside the kind II fatty acid biosynthesis pathway of *Mycobacterium tuberculosis* [24]. Inhibition of InhA disrupts the mycolic acids that had been valuable components of the mycobacterial cell wall. Molecular docking studies have been carried out for the compound (1b and 1c). The docking interaction of the compound is shown in Figure 2. The result of the docking study and the interaction energy are shown in Table 4. Analysis of the result shows that the various ligand of the compounds (1b and 1c) shows a high glide score value of -7.15 and -7.33 Kcal/mol. Therefore based on the docking studies, the compounds (1b and 1c) may be appropriate to overcome the drug resistance of *Mycobacterium tuberculosis InhA protein*.

CONCLUSION

Five new (E)-4-fluoro-N'-(3-methyl-2r,6c-diphenylpiperidin-4-ylidene) benzohydrazides (1a-1e) were synthesized in good yield and characterized by FT-IR, 1 D NMR spectral data. All the newly synthesized compounds were also screened for antimicrobial and antioxidant activities. Among the synthesized hydrazones (1c, 1e) and (1b, 1d) exhibit good activity against antioxidants and antimicrobial respectively. The molecular docking study indicated that the compounds (1b, 1c) shows a good score value to the existence of H-bond interaction.

Credit authorship contribution statement

Tanzeer Ahmad Dar: Conceptualization, Methodology, Validation, Formal analysis, Writing – original draft.
Balasankar Thirunavukkarasu, Winfred Jebaraj, S.Amirthaganesan: Conceptualization, Writing – review & editing, Supervision.

Declaration of completing the interest

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome. We confirm that the manuscript has been read and approved by all named authors.

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Table 1. IC₅₀ values for free radical scavenging activity (μ g/ml)

Compound	IC ₅₀ values for free radical scavenging		
	DPPH	Lipid peroxidation	Metal Chelation
1a (H)	4.6476	4.3128	4.5826
1b (P-Cl)	4.0988	4.3128	4.4159
1c (P-OCH₃)	1.2247	1.8974	1.7321
1d (P-Br)	4.6797	4.9295	4.3474
1e (P-CH₃)	1.4491	1.5492	1.6432
Standard Used	1.8166 (Tocopherol)	1.4491 (EDTA)	1.2247 (Citric acid)

Table 2. In vitro antibacterial (MIC μ M/mL) of compounds 1(a-e) of compounds by 2-fold dilution method.

compounds	<i>B.subtills</i>	<i>S.aureus</i>	<i>K.pneumoniae</i>	<i>S.aeruginosa</i>	<i>E.coli</i>
1a	50	200	200	100	100
1b	12.5	12.5	25	25	25
1c	25	25	50	50	100
1d	12.5	25	25	50	50
1e	100	50	100	200	200
Streptomycin	25	12.5	25	12.5	12.5

Table 3. In Vitro anti-fungal (MIC μ M/ mL) of compounds 1(a-e) by two-fold serial dilution method.

Compounds	<i>C. albicans</i>	<i>Rhizopus Sp.</i>	<i>A. niger</i>	<i>A.flavus</i>
1a(H)	30	>200	100	100
1b(p-Cl)	50	12.5	25	6.25
1c(p-OCH₃)	50	100	25	25



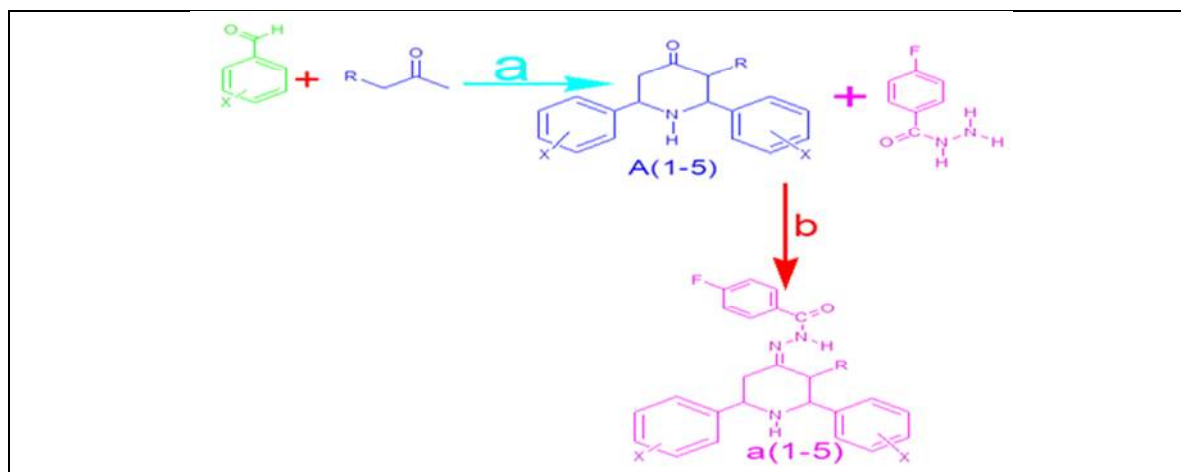


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1d(p-Br)	25	12.5	12.5	25
1e(p-CH3)	50	100	200	>200
Fluconazole	25	12.5	6.25	25

Table 4. Molecular docking result of the compounds with 2NSD

Compound	Glide score	Glide evdw	Glide ecoul	Glide energy	Interacting residues
1b	-7.33	-71.83	14.81	-51.39	O-bond interaction with SER-94, VAL-65 and PHE-41
1c	-7.15	-53.35	14.01	-46.01	O-bond interaction with SER-20



Scheme 1. Depiction of the synthesis of 4-fluoro-N'-(3-methyl-2r, 6c-diphenylpiperdin-4-ylidene) benzohydrazides 1(a-e).

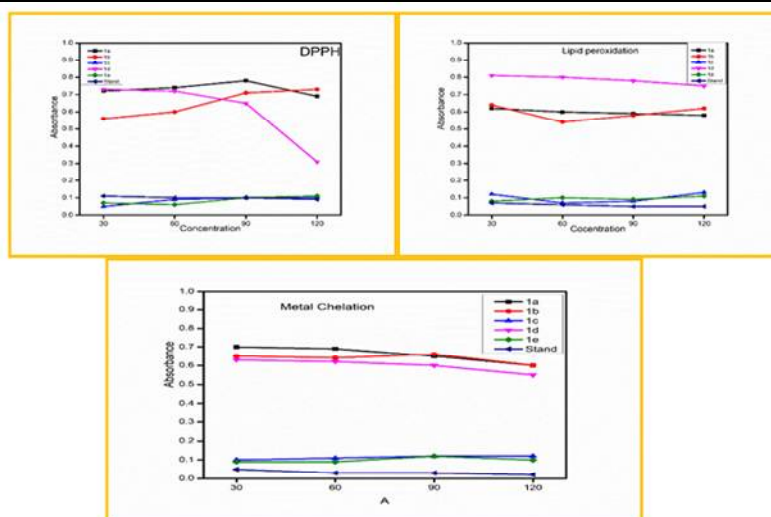


Fig 1. The anti-oxidant potential of synthesized compounds 1(a-e).





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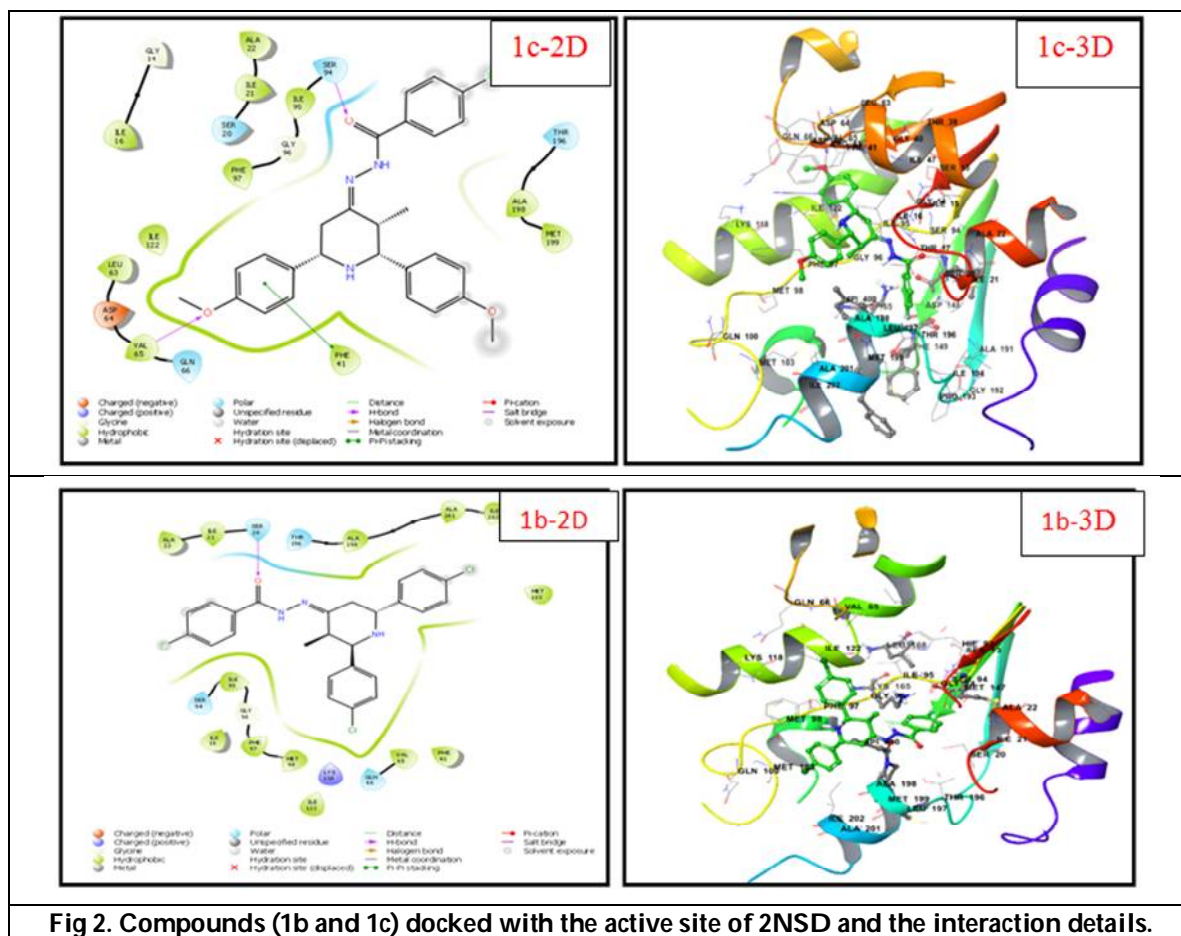


Fig 2. Compounds (1b and 1c) docked with the active site of 2NSD and the interaction details.





The Measure of Health Infrastructure of Alternative System of Medicine in Different States of India

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ABSTRACT

The very ancient Indian System of Medicine (ISM) is based on holistic treatment of mind and body in an integrated manner. This ISM is endowed with variety and diversity of health traditions i.e. AYUSH (Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homeopathy). The health infrastructure of ISM is an essential factor to determine the quality of health services which plays major role in both the economic and social progress of the country. The infrastructure Index is used to measure the health infrastructure. This research work reflects the empirical approach by considering the health indicators to measure the health infrastructure of ISM in different states of India. Based on the distribution of composite index, the infrastructure development is classified as low, moderate and high infrastructure development. This study also provides the quantification of state level scenario on health infrastructure of ISM before the government to promote occupational health related schemes at workplace with facility for household.

Keywords: Health Infrastructure, Indian System of Medicine, AYUSH, Empirical Approach, Probability Distribution, Infrastructure Index.

INTRODUCTION

The holistic living relies on the Alternative System of Medicine. In India, the healthcare service is gradually transforming from a predominantly public-funded system to a public-private participative initiative. The Alternative



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System of Medicine and National Health Mission (NHM) are the very vital components of strategic healthcare management in India. The NHM is one of the very key initiatives of the Government of India. The main aims of NHM are to provide timely access of quality healthcare to poor by ensuring availability of improved clinical technology in hospitals, low cost drugs for common ailments, timely immunization of new born babies, adequate health infrastructure, health insurance schemes for all economic strata, awareness campaigns for preventive healthcare and nutritional security, etc. The Union Ministry of Health and Family Welfare, has the prime responsibility for the healthcare of all the citizens of India. Additionally, the healthcare in India is being controlled by several ministries viz., Ministry of Labour for occupational healthcare, Ministry of Communication and Information Technology for health management information system, health awareness campaigns, telemedicine, emergency medicine services etc., The Ministry of Environment and Forests is aims reduce pollution levels and deforestation [1].

Alternative system of Medicine and Health Scenario of India

Indian health care system is predominantly based on three main streams namely Allopathy, Homeopathy, and Indian System of Medicine (ISM) which in turn comprises Ayurveda, Siddha and Unani. Homeopathy system of medicine is introduced by Dr. Samuel Hahneman, A German Physician, 200 years ago. Homeopathy means similar suffering, the system of homeopathy is based on 'let likes be treated by likes'. Homeopathy uses highly diluted doses from the plant, mineral and animal kingdoms to stimulate natural defenses in the body. Though Homeopathy is not of Indian origin, it is very popular in India. The Ayurveda, Siddha and Unani are based on humoral pathology (i.e., air, bile and phlegm are three supports of the body). It is believed that without these three humours, the individual cannot exist and that if those humours are not in proper balance, diseases or death will be the inevitable outcome.

Ayurveda is more flourished in Northern part of India. The unique remedial techniques of Ayurveda are healing with herbs, changing diet and lifestyle which helps to maintain the body and mind balance. The book *Charak Samhita* written by the Father of Indian Medicine Acharya Charack (600 BC), is considered as encyclopedia of medicinal characteristics of 1 lakh herbal plants. The principle of Ayurvedic system is that the three entities; body, mind and spirit are in constant interaction with the environment, governs the individual all the time and when there is any imbalance one falls sick. The Daivvyapashraya, Yukti-Vyapashray and Satvavajaya Chikitsa's are the three pillars of this ayurvedic treatment. The Daivvyapashraya Chikitsa (based on Divine blessing) is based on hymns and worshiping of different deities and zodiac signs, etc. Yukti-Vyapashray Chikitsa (logically based treatment) is based on herbs, metals, mineral or animal products and Panchkarma. Satvavajaya Chikitsa (affected by changing life-style) is based on livelihood pattern through hygienic living, adhering social and personal ethical norms (Achar Rasayan) [2].

Siddha, like Ayurveda is one of the two ancient systems of medicine in India, which is largely flourished in South. The word Siddha comes from Siddhi, which means an object to be attained or perfection of heavenly bliss. Siddhi generally refers to the Ashtama Siddh i.e. the eight supernatural powers. Those who attained or achieved these powers are known as siddhars. The siddhars were men of high cultural, intellectual and spiritual faculties combined with supernatural powers. Some of the siddhars like Bogars visited Arabia, Persia, Turkey, China and other places where they propagated the Siddha system of medicine [3]. The Siddha system of medicine in India has its roots in the Dravidian culture and it was developed by 18 siddhars, who were blessed by Lord Shiva and Goddess Parvati as mentioned in the Indian mythology [4]. The siddhars call the two essential entities of the universe i.e. matter and energy as Siva and Sakthi respectively. They also believe that the five primordial elements (Pancha Bhootas), namely Munn (solid), Neer (fluid), Thee (radiance), Vayu (gas), and Aakasam (ether) created the every matter in the world including animals, vegetation and minerals. The anatomy and physiology of the human, food for sustenance, causative factor of the disease, materials for the treatment and cure of the diseases, all fall within these five elemental categories. Three external elements (air, heat and water) respectively give rise to three humours (wind, bile and phlegm) as they enter the body. These three humours are called tirdosha, which maintains the human body through their combined function. When all these factors work in balance, the body will be healthy; any imbalance due to astral inuences, harmful substances, psychological and spiritual factors may lead to ill health. The siddhars look at





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body and the disease together to arrive at a conclusion regarding the condition or diagnosis of the case. According to the siddhars, the pulse is the manifestation of prana in living beings. A number of pharmaceutical preparations are common to both siddha and Ayurveda. The common preparations include: Bhasma (calcined metals and minerals), Churna (powders), Kashya (decoctions), Lehya (confections), Ghrita (ghee preparations) and Taila (oil preparations). Preparations specific to siddha are: Chunmna (metallic preparations), Mezhucu (waxy preparations) and Kattu (preparations impervious to water and flame), etc.

Unani system of medicine originated in Greece, which was promoted as a science by Bukrath, the Hippocrates (460-377 BC) by delinking the Unani medicine from superstition and magic. Unani became very popular in India during Mughal period. Unani system of medicine is based on the humoral theory of the four humors in the human body – Dam (blood), Balgham (phlegm), Safra (yellow bile) and Sauda (black bile). Each humor has its own temperament- blood is hot and moist, phlegm cold and moist, yellow bile hot and dry and black bile cold and dry. Every person attains a temperament according to the preponderance in them of the humors [5]. In Unani system there is a power of automatic preservation Quwwat-e-Mudabbira (medicatrix naturae) in the body. When this power weakens, imbalance in humoral compositions occurs resulting in disease. The medicines used helps to restore the humoral balance, thereby cures the disease. Unani system recognizes the influence of surroundings and ecological conditions on the state of health. It has laid down six essential pre-requisites (Asbab-e-Sitta Zarooriya) i.e. air, food and drinks, body movement and repose, psychic movement and repose, sleep and wakefulness, excretion and retention [5]. As most of the Unani books are available only in Arabic, Persian or Urdu with very limited and concise translations available in English and Hindi languages; many associate it as Islamic science of healthcare. Unani is regarded as very effective in treating chronic ailments like arthritis, asthma, urinary infections, cardiovascular ailments, and diabetes in early stages. At present Unani is claimed to be effective in enhancing immunity levels of AIDS patients [4]. Strategic healthcare management within the Indian perspectives particularly, the Indian System of Medicine, nature cure and fast expanding role of health insurance have a very positive impact on India's wellness security. Healthcare management in India is based on keeping oneself fit without giving hospital a chance to treat. When everyone takes care of one's health, barring cases of emergency and old-age, load on hospitals is automatically less.

Objective of the Study

The main objective of the study is to

- Quantify the level of AYUSH infrastructure in the different states of India.
- Develop a weighted index of AYUSH infrastructure to categorize the states as per their infrastructure.

Data and Methodology

Health Infrastructure Indicators: Hospitals, Beds, Dispensaries, Registered practitioners are the indicators used per 10,000 population; whereas the percentage of undergraduate, postgraduate colleges and licensed pharmacies were used as the remaining health infrastructure indicators in the present study

Data: The relevant information for the present study is collected from the Ministry of Health and Family welfare, Government of India official website –www.mohfw.nic.in. Efforts have been made to present the wide range of up-to-date factual data on diverse aspects of infrastructure of alternative system of medicine trend of India up to 2019.

METHODOLOGY

The Health composite infrastructure index is defined as,

$$HII_i = \sum w_i x_{ij} \quad (1)$$

where HII_i is the Health composite infrastructure index of alternative system of medicine for the i^{th} observation, x_{ij} is the value of the i^{th} aspect of infrastructure for the j^{th} state and it is defined by





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$$X_{ij} = \frac{y_{ij}}{y_i} * 100 \tag{2}$$

Where, y_{ij} = value of the i^{th} indicator for the j^{th} state of India

y_i = value of the i^{th} indicator for India.

W_i represents the weight associated with the i^{th} basic facility and is given by the following

$$W_i = \frac{\sigma_i^{-2}}{1 + \sum \sigma_i^{-2}} \tag{3}$$

The choice of the weights in this manner would ensure that large variation in any one of the indicators would not unduly dominate the contribution of the rest of the indicators and distort the inter district comparisons.

Distribution of the Weighted Index of Health Infrastructure of Alternative system of medicine

Iyengar and Sudarshan assumed that the development index followed the Beta distribution[6]. A better classification under a normal distribution. Hence, the assumed distribution played a crucial role in obtaining the empirical outcomes [7]. For testing the hypothetical distribution of the weighted index of infrastructure of alternative system of medicine ($HIII_i$), one may use the chi-square test of goodness of fit. As $HIII_i \in [0, 1]$, the values of the indices are essentially continuous in nature. To model the empirical frequency, the range [0, 1] can be divided into non-overlapping class intervals, and the chi-square test of goodness of fit can be conducted after obtaining the frequency within each class interval. The observed frequency can be compared with the theoretical frequencies expected under the hypothetical distribution. Although the interval setting could be arbitrary and converting the scale from continuous to discrete might have reduced the precision, the approach outlined above has been commonly used in practice [8]. The Kolmogorov Smirnov (K-S) test statistic could also be applied in this case as the indices are continuous in nature. Different authors have proved that the K-S statistic is more appropriate for continuous data compared to the chi-square test of goodness of fit [9,10]. The test statistic is given by,

$$D_n = \max | S_n(x) - F(x) | \tag{4}$$

where $S_n(x)$ and $F(x)$ are empirical and theoretical distribution functions respectively. However, for performing the K-S statistic the theoretical distribution needs to be completely specified i.e. the value of the parameters needs to be known. In this exercise, the parameters are estimated from data. The critical value of D_n for α level of significance depends on the number of observations and may be denoted by $D_{\alpha,n}$. If the number of observations are over 35, as the case here, the critical value at 5 percent level of significance ($D_{0.05,n}$) is $1.63/\sqrt{n}$. Thus, D_n value greater than $1.63/\sqrt{n}$, will indicate that the fitted distribution is significantly different from the theoretical distribution. Thus, both the tests viz. the K-S test and chi-square test can be used to verify the appropriate distribution to which the $HIII_i$ values, fit. The interval $[F(x) - D_{\alpha,n}, F(x) + D_{\alpha,n}]$ provides the $100(1-\alpha)\%$ confidence band for $F(x)$ which can be used as a visual tool for goodness of fit. After deciding about the probability distribution of $HIII_i$ it is important to find two real numbers $c, d \in [0, 1]$ to divide three linear intervals namely $[0, c]$, $[c, d]$ and $[d, 1]$ with the same probability weight of 33.33%, i.e.,

$$P[0 \leq HIII_i \leq c] = 0.3333 \tag{5}$$

$$\text{and, } P[0 \leq HIII_i \leq d] = 0.6666 \tag{6}$$

Thus, $P[c \leq HIII_i \leq d] = 0.3333$ using (5) and (6)

These intervals have been used in this study to characterize the various stages of deprivation as follows:

Low Deprivation if $0 \leq HIII_i \leq c$

Moderate Deprivation if $c \leq HIII_i \leq d$

High Deprivation if $d \leq HIII_i \leq 1$

Analysis and Result: Since the values of $HIII_i$ lies between 0 and 1, one may select the two parameter beta distribution of type I as a probable distribution. The beta distribution is generally a skewed distribution and its probability density function is given by,





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$$f(x) = \frac{1}{\beta(a,b)} x^{a-1} (1-x)^{b-1}, 0 < x < 1 \text{ and } a, b > 0 \quad (7)$$

$$= 0, \text{ otherwise}$$

$$\text{Here, } \beta(a,b) = \int_0^1 x^{a-1} (1-x)^{b-1} dx \quad (8)$$

Based on the values of *HII* for all states, the estimated values of *a* and *b* are obtained using the method of maximum likelihood (Johnson and Kotz, 1970). The estimated values are given by,

$$\hat{a} = m_1 \left[\frac{m_1(1-m_1)}{m_2} - 1 \right] \quad (9)$$

and

$$\hat{b} = (1 - m_1) \left[\frac{m_1(1 - m_1)}{m_2} - 1 \right] \quad (10)$$

Here,

m_1 = mean of all *HII*s and

m_2 = variance of all *HII*s

Based on the empirical data for this investigation, the estimated model parameters are $\hat{a} = 1.071396$ and $\hat{b} = 429.5436384$. The goodness of fit test has generated a result of $\chi^2(34 \text{ df}) = 17.33847$, $p = 0.992701$ for this model, which supports the use of $\beta(1.071396, 429.543638)$ to describe the values of *HII* in this investigation. The K-S test is also used to test if the *HII* values fit to the beta distribution specified by the parameters already estimated from the data. The value of the statistic,

$$D_n = \max | S_n(x) - F(x) | = 0.064182$$

which is insignificant at 5 percent level, confirms the findings of the chi-square test.

To reduce potential subjectivity in the model selection, the empirical distribution function plot is employed to triangulate the findings from the chi-square test and to visualize the results of the K-S test. The closeness of the step function (EDF) to the CDF curve and the step function lying within the bounds reconfirmed the model fitness to the empirical database. Based on the above categorization, the health infrastructure category of different states of India can be presented as in Table 2.

Probable Reasons for Low Infrastructure

In Table 2, it has been highlighted that nine states viz., Assam, Chhattisgarh, Jharkhand, Mizoram, Orissa, Tripura, Dadra & Nagar Haveli, Daman & Diu and Lakshadweep are plummeting into the low infrastructure category in terms of health infrastructure indicators. The following reasons may be responsible for the lower infrastructure of AYUSH:

- Awareness of the people at rural level is not taken under consideration in these states.
- Lack of quality control and good manufacturing practices.
- Due to rapid advances in western system of medicine, the traditional health practices are on decline. There is need for revitalization of the local health traditions by reviewing workable practices, completing what is incomplete, and dropping hardly effective practices vis-à-vis allopathic treatment.
- Healthcare authorities need to understand the principles underlying traditional practices, which may need modification and adaptation to suit the current lifestyle and situation.





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CONCLUSION

The outcome of the study reflects that the low infrastructure of different facilities mentioned above in some of the states of India crop up mainly because of the unequal distribution of facilities. The health infrastructure index is considered necessary to help the Ministry of Health & Family welfare (MOHFW) in the formulation and implementation of various development policies by the Government of India.

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Table 1: State Classification Range

Category of Infrastructure	Range of Infrastructure Index
Low Infrastructure	< 0.001063
Moderate Infrastructure	0.001063 - 0.002757
High Infrastructure	> 0.002757

Table 2: State classification

Type of Category	States of India
Low Infrastructure	Assam, Chhattisgarh, Dadra & Nagar Haveli, Daman & Diu, Jharkhand, Lakshadweep, Mizoram, Orissa, Tripura,
Moderate Infrastructure	Andhra Pradesh, Bihar, Chandigarh, Delhi, Goa, Gujarat, Haryana, Jammu & Kashmir, Madhya Pradesh, Nagaland, Punjab, Pondicherry, Rajasthan, Sikkim, Uttarakhand, West Bengal
High Infrastructure	Andaman & Nicobar Island, Arunachal Pradesh, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Manipur, Meghalaya, Tamilnadu, Uttar Pradesh

Appendix

States	Index values
Andhra Pradesh	0.001957
Arunachal Pradesh	0.003645





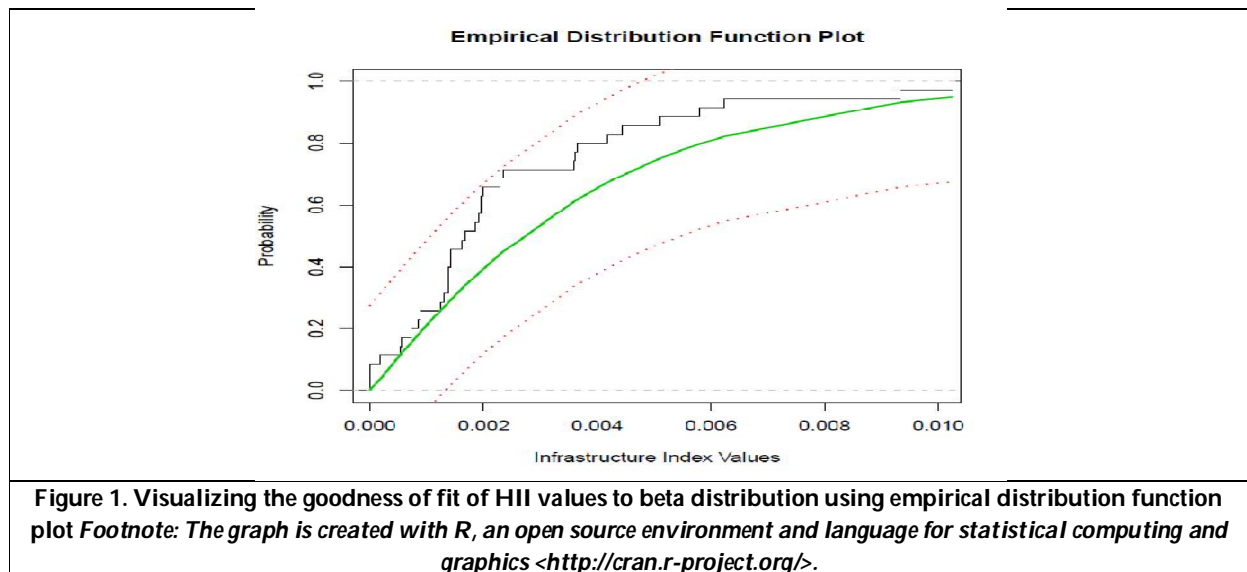
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Assam	0.000547
Bihar	0.001611
Chhattisgarh	0.000854
Delhi	0.002293
Goa	0.002351
Gujarat	0.001856
Haryana	0.001378
Himachal Pradesh	0.004443
Jammu & Kashmir	0.001384
Jharkhand	0.000174
Karnataka	0.005088
Kerela	0.00623
Madhya Pradesh	0.001917
Maharashtra	0.003603
Manipur	0.004174
Meghalaya	0.0036
Mizoram	0.000885
Nagaland	0.001386
Orissa	0.000733
Punjab	0.001682
Rajasthan	0.002003
Sikkim	0.001312
Tamil nadu	0.005805
Tripura	0.000526
Uttar Pradesh	0.01026
Uttarakhand	0.001413
West Bengal	0.001432
Andaman & Nicobar Islands	0.009338
Chandigarh	0.001948
D & N Haveli	0.000003
Daman & Diu	0.000003
Lakshadweep	0.000006
Puducherry	0.001245





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Antimicrobial Activity of Some Important Endophytes Isolated from *Tinospora cordifolia*

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ABSTRACT

Endophytes have been found in majority of plants. Endophytes inhabit plant tissues without infecting plants, promote plant growth, and act as a defense mechanism against stressed environmental conditions. *Tinospora cordifolia* generally regarded as "Gudhuchi" in India is a medicinal plant that's used to deal with numerous diseases. medicinal plants are herbal drug molecules in view that they include energetic compounds, residences of which might be useful to humans. In our study, we acquire a few endophytes from many studies papers which can be remoted from *Tinospora cordifolia*. In this review, we located 15 endophytes in the table wherein a few are fungal endophytes, and others are bacterial endophytes which are isolates from medicinal plant. This assessment article indicates the standard properties of endophytes and it's medicinal significance as well and discuss the many other antimicrobial activities of endophytes in plants and animals. This review article also describes the beneficial role of endophytes such as antibiotics production, phytohormones production, biocontrol, plant growth promotion and physiology.

Keywords: Endophytes, Antimicrobial activities, *Tinospora cordifolia*, Plant growth promotion, Biocontrol agent.



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INTRODUCTION

Endophytes are hidden and basically uninvestigated entities in the bacterial world. They colonize the inter or extracellular spaces of most of the medicinal plants studied to date [1]. De Bary introduces the term "endophytes" for organisms that live in healthy tissue [2]. Bacon *et al.* easily expanded De Bary's in 1866 definition by describing endophytes as microorganisms that found the active internal tissues of plants without responsible disease [3]. Endophytes play an essential role in plant life; they can benefit host plants by preventing other pathogens or parasites from colonizing them [4]. Endophytes can colonize plant tissue extensively and competitively exclude other potential pathogens [5]. Most endophytes come out of the soil around the plant's root or from the cuticle surface that covers the epidermal layer of the leaf although some can be obtained from the seed [6]. Endophytes are known to increase the stress tolerance of plants to heavy metals by increasing the plant's nitrogen-binding capacity, indole acetic acid (IAA) production, phosphate solubilization [7], and rhizosphere-siderophore production. Bacterial endophytes can play a major role in the development of the plant growth promotion, phytoremediation, diazotroph, photosynthesis and transmission of phytochrome signals, which leads to an adaptation of the biotic environment or to biotic stress [8]. There is major attentiveness in the use of endosymbionts for their agricultural application and they encourage plant growth production in cool, dearth conditions as a contaminate land structure or catalyze disease protection in plants [9]. The analysis of endophytic fungi has a long history. It has been found that the difference between plants is great, and each plant appreciates one or more endophytes [10]. Recent exploration showed that endophytic microbes appear via an excellent source of secondary metabolites that can have potent antimicrobial, antioxidant, and cancer-fighting effects [11], endophytes have received large amount of observation over the past twenty years and have ability to be safe against bacteria and pathogenic insects and fungi to stay [12]. Non-pathogenic endophytes, which are present in plant tissue and spend at least part of their life cycle, live or colonize in the good tissue of the host plant without causing any apparent disease characteristics [13]. In the last century and spread across India though most endophytes are not effectively understood like plant proximity [14]. Endophytic bacteria and fungi are present in the vascular plants of the world around the world, which has resulted in this plant helping some of the endophytes that can synthesize the phytochemical activity of medicinal plants [15]. Endophytes, recognized throughout the Asian nation for the last century, are bioactive metabolites that are helpful for the spread of necessary medical applications, for instance, metabolites with distinctive structures as well as alkaloids, coumarins, benzopyrones, phenolic resin acids, xanthenes, steroids, flavonoids, peptides, and others [16].

Antimicrobial activity is a secondary process exhibited by endophytes in promoting plant growth. The results show that all isolated endophytes produce cellulase, pectinase, xylanase, and protease enzymes [17]. These enzymes are solely involved in the hydraulic effects that allow endophytes to plant tissues and create conformal bonds between endophytes and host plants [18]. Antibacterial activity can be described as a general term for activities and drugs that send out or suppress the microorganisms that cause diseases and suppress the growth of bacteria [19]. Antibacterial activity suppresses the development of microbial communities and can destroy microbial communities without harming the host, and antibacterial agents provide this solution [20].

Tinospora cordifolia is a medicinal plant which has the top ranking in natural medicine and Ayurveda [21]. Natively speaking, it is known as "Guduchi." This specific word is implanted from SANSKRIT and called as "Amruthaballi" in Kannada. It is a remedy in the Indian science of medicine (ISM) [22]. *Tinospora cordifolia* is an excellent medicinal plant whose usage and employment with testimonial of human welfare have been glorify unspeakable heights in numerous Ayurveda and Vedic scriptures and procedures [23].

Habitat and description of *Tinospora cordifolia*

India has a huge habitat of medicinal plants. *Tinospora cordifolia* is also known as 'Giloy' is an herbaceous vine belongs to the family Menispermaceae [24] and easily found in deciduous, tropical and drought region [25]. Leaves of *Tinospora* plant are long, thin, heart-shaped, cordate with a broad sinus. These have long petiole and seven



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reticulate veins. it is an extensive climber with corky grooved bark with adventitious roots [26] India has a huge habitat of medicinal plants. *Tinospora cordifolia* has a broad spectrum of bioactive compounds and has proven to be an important plant from a medicinal point of view that has not received significant scientific attention [27].

Isolated Microbial Endophytes

Based on the antimicrobial activity of different endophytes, endophytes are isolated from different parts of plants. Endophytes are classified into bacterial, fungi and actinomycetes or algae [28]. The first fungal endophytes (*axomyces andreae*) were isolated by a research study in 1993 using a medicinal plant *Taxus brevifolia* [29]. A list of the endophytes that have been isolated from different plants and used in different studies highlighted in Table 1.

DISCUSSION

Endophytic microbes are those microbes who used to live by making colonies in plant tissues at period inside the plant without harming their host [30]. In the study so far, these different endophytes have been isolated from most of roots of medicinal plant *Tinospora cordifolia* and we will discuss them one by one. First, we talk about *Cladosporium velox* is a common mold which affect to humans. In very rare cases, it can cause allergies and infection in some people [31] and likely to use as a source of phenolic compounds accompanied by antioxidant and Geno protective potential [32]. *Nigrospora oryzae* have been remoted as an endophytic fungus from famous medicinal plant that's used to manipulate diabetic stage in human our bodies and assists as a potentialsupply for bioactive compound quercetin and performs a primary position with inside the steerage of Alzheimer's disease [33]. Phenotypic based on 16s rRNA sequence one of bacterial detach was recognized as *Pseudomonas* spp kind along with growth enhancing activities have been found to enhance development in many plants [34] and has beneficial uses in various commercial sectors [35]. *Phoma* can be classified by the evolution of single cell called hyaline pycnidiospores originated from fruiting body considered as pycnidium, that differentiate from globose, sub globose to coils forms [36] and these are rich source of secondary metabolites and used as bio-fertilizer [37]. It is founded were only appraise to (enhance) their plant growth promoting activity (PGPA) [38]. *Actinomycetes* are isolate from medicinal plant has strong potential to inhibit the alpha-glucose activity and formation of alpha-glucosidase inhibitor [39] compound in the plant majorly due to the donation of its endophytes. Actinomycetes are economically and biotechnologically most worthwhile microorganism and are well known to produce secondary metabolites of various medical values like antibiotic, antifungal, antiviral, anticancer, anticholesterol and immunosuppressant [40]. *Pseudofusicoccum adansoniae* is an endophytic fungus that might be canker pathogen [41], it is one endophytic fungus with 100% 18s-rRNA partial gene sequencing resemblance [42] and it is an isolate from photosynthetic roots of *Tinospora* [43]. The antimicrobial activity of the various endophytes was tested against the bacterial pathogens *Staphylococcus aureus*, *Klebsiella pneumonia* and *E. coli* [44]. Isolates from 101 endophytic fungi inhibited the antagonistic activity against at least two of the three pathogens tested and endophytic fungi from 10 plants were positive against *S. aureus* [45]. The endophytic fungal isolate from plant roots showed unique properties [46]. *Salmonella typhimurium* microorganism have been cultured in nutrient broth at 37°C for twenty-four h [47]. The air-dried discs with numerous attentions of the crude extract and purified compounds have been positioned on a garden of bacterial unfold on Muller Hinton agar [48]. These were actively studied as stay companies of heterologous antigens foe a probable vaccine application [49]. *S. typhimurium*, a facultative anaerobe, has been tailored as an antitumor agent able to preferentially proliferate inside tumors and inhibiting their growth [50]. *Colletotrichum* Corda is among the most necessary associate degreed widespread genera of plant-associated fungi, inflicting illness and occurring as well endophytes on aerial organs of a broad vary of host plants [51]. *Colletotrichum gloeosporioides* sensu lato represents a combination of species of rumored as a dominant endophyte of tropical non woody plants and is understood as a field and post-harvest fruit infectious agent of the many economically important crops [52]. *Bacillus subtilis* is a perfect multifunctional probiotic, with exceptional capacity for stopping the boom of pathogenic microorganism and improving nutrient assimilation [53]. In the prevailing studies, *Pseudomonas* species confirmed the manufacturing of siderophores, HCN and ammonia which can be motive for the sturdy adversarial interest of the bacterium [54]. *Cladosporium* species, endophytic fungi global broadly distributed, are regarded to be energetic in defensive



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vegetation in opposition to one-of-a-kind biotic and abiotic stresses [55]. The colonization of inner plant tissues, Cladosporium species aren't generating damages, and they're of extremely good hobby for particular scientific outcomes, along with useful human fitness outcomes [56] and agro-business applications, as with inside the bioremediation and detergent enterprise or in discoloration of fabric dyes and with inside the degradation of keratin containing wastes from herbal environment [57]. *Chaetomium globosum* is a saprophytic fungus that mainly lives on plants, soil, straw and manure [58]. The endophytic *C. globosum* helps break down cellulose in plant cells and may adversely have an effect on human fitness via allergic and poisonous reactions [59].

Advantages of endophytes

Endophytes play major role in plant's life cycle and animals. There are many beneficial roles of endophytes some of these are as follows:

Plant growth promotion and physiology: Endophytes sometimes assist the host plant's defenses against plant pathogens by supporting plant physiology [60]. As plant growth increases, it develops vigor and resistance to various abiotic and biotic stresses, which is considered one of the strategies used by plants to defend themselves against pathogens [61]. Plant growth can be enhanced by several compounds. One endophyte, *Colletotrichum* sp., isolated from *A. annua* produces a substance called indole acid (IAA) that helps to regulate plant physiology [62].

Antibiotics produced by endophytes: Most endophytes are reported to produce some secondary metabolites, some of which exhibit antibacterial and antifungal properties that help inhibit the growth of phytopathogenic microorganisms [63]. Many types of studies are still underway to identify commercially available endogenous metabolites [64]. Various biologically active compounds have been studied for their ability to inhibit many plant pathogens [65].

Biocontrol agents: Microorganisms are appeared as a powerful biological control, opportunity to chemically manage [66]. endophytic fungi had been defined to play a vital function in controlling insect herbivory now no longer handiest in grasses however additionally in conifers [67]. Now no longer handiest evidently going on microorganisms are used as biocontrol retailers although, additionally they were genetically modified to specific antipest proteins [68]. preliminary tries are created to introduce heterologous factor into an endophytic microbes for insect manage [69]. use of endophytes as biocontrol retailers expressing extraordinary proteins turns into favorable method to manage plant pests [70] as those endophytes can without difficulty colonize inside extraordinary crop vegetation successfully [71].

Phytohormone production: Endophytes produce plant hormones that promote plant growth and alter the morphology and structure of plants [72]. Due to this property, endophytes are attracting attention in the field of agricultural sustainability [73]. Plant hormones support the production of PGP and illegal plants through the secretion of gibberellic acid, auxin, indoleacetic acid, and ethylene [74].

CONCLUSION

Endophytes play an important role in regulating plant growth. this study suggests that these compounds exhibit nice potential in plant growth promotion for antimicrobial activity. They will be useful for its medical function. Modern studies have shown that endophytes appear to be an excellent source of secondary metabolites that can have potent antimicrobial, antioxidant, and cancer-fighting effects. Higher info of the native plant endophytes will assist explicate their capability and capacity to vary plant increase and fixing a sustainable appliance for plant production. The antimicrobial activity of these endophytic beings can be used in biotechnology, medicine and agriculture. Antimicrobial drugs are classified according to the microorganism against which they are primarily effective. It has also been shown that some endophytic plants can produce numerous bioactive chemicals and have potential uses in biological control and resistance. *Tinospora cordifolia* is an excellent source of endophytes.



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Table 1: List of different endophytes isolated from *T. cordifolia*

S. No.	Endophytes	Plants	properties	Plant tissues	Reference	Medicinal importance
1	<i>Cladosporium velox</i>	<i>T. cordifolia</i>	<i>C. velox</i> is a fungus found in high salt environments with spherical conidia.	stem	A Andolfi, MM Salvatore et al., 2021	It causes allergies and asthma and can cause infections.
2	<i>Nigrospora oryzae</i>	<i>T. cordifolia</i>	It is a saprotroph colonizing debris of different plant species and a weak parasite producing grain spot of rice, sorghum, and corn.	roots, leaves, stem	R Vig, SK Gupta et al., 2022	<i>N. oryzae</i> is an endophyte used to control diabetes.
3	<i>Pseudomonas spp</i>	<i>T. cordifolia</i>	<i>Pseudomonas</i> species are aerobic Gram-negative bacilli. Several <i>Pseudomonas</i> are pathogenic to different host organisms.	stem	C. Srinivas et al.,	These are commonly used as antibiotics, and <i>Pseudomonas</i> is resistant to high salt concentrations and dyes. Weak disinfectant.
4.	<i>Phoma spp</i>	<i>T. cordifolia</i>	It is a fungal pathogen and black yeast filamentous fungus that inhibits soil and plants material.	Stem	A. Kedar et al., 2014	<i>Phoma spp</i> are natural bioactive and phytopathogens.
5	<i>Actinomycetes</i>	<i>T. cordifolia</i>	<i>Actinomycetes</i> are a group of unicellular	roots	Gopal Jadhav et al., 2021	These bacteria have a variety of





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			Gram-positive bacteria, most of which are aerobic, but some are anaerobic to facultative anaerobic.			medicinal properties, including antivirals, antifungals, and anticholesterols
6	<i>Cladosporium uredinicola</i>	<i>T. cordifolia</i>	<i>C. uredinicola</i> was first identified and registered in Iraq as a potential new causative agent of leaf spot disease.	NA	Abhinay thakur et al., 2013	Most species of <i>Cladosporium</i> no longer cause disease in humans. Various factors that can be caused by <i>Cladosporium</i> can cause side effects such as allergic reactions and eye infections.
8	<i>Staphylococcus aureus</i>	<i>T. cordifolia</i>	<i>Staphylococcus aureus</i> is a gram-positive round bacterium and is a member of Firmicutes.	roots	A. Nigam et al., 2017	A group of bacteria that cause a multitude of disease. It is a major cause of skin and soft tissue infections, and cellulitis.
9	<i>Escherichia coli</i>	<i>T. cordifolia</i>	It is also known as coliforms are Gram-negative, facultative anaerobic, rod-shaped, and coliforms	roots	A. Nigam et al., 2017	<i>E. coli</i> associated with human infections such as diarrhea and urinary tract infections and is usually found in the intestines.
10	<i>Salmonellatyphimurium</i>	<i>T. cordifolia</i>	It is a gram-negative anaerobic bacterium that causes systemic infections in mice resembling typhoid fever caused by <i>S. enterica</i> serovar Typhi in humans.	roots	J. Nutr et al., 2019	<i>S. typhimurium</i> is necessary for the development of an improved attenuated typhoid vaccine and can also cause inflammatory diarrhea.
11	<i>Colletotrichum spp</i>	<i>T. cordifolia</i>	It is a genus of fungi parasitic with plants as endophytes or	Stem/ Leaf	Varinder singh et al., 2016	<i>Colletotrichum sp.</i> It is used in various test





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			phytopathogens.			systems to assess the infectivity of microbial pest control agents to non-target species
12	<i>Bacillus subtilis</i>	<i>T. cordifolia</i>	It is commonly found in soil and aids in plant growth. It is a gram-positive rod-shaped bacterium.	Stem	Duraipandiyan et al., 2012	<i>Bacillus subtilis</i> is commonly used as a probiotic supplement to treat or prevent intestinal disorders. Also used in the antibiotics manufacturing.
13	<i>Pseudomonas aeruginosa</i>	<i>T. cordifolia</i>	<i>P. aeruginosa</i> is a widely encapsulated gram-negative bacterium, a strictly aerobic bacterium that can cause disease in plants, animals, and humans also.	Stem	Khusboo, et al. 2014	Antifungal in the fight against rice blast.
14	<i>Cladosporium cladosporides</i>	<i>T. cordifolia</i>	This species produces asexual spores in branched, slender chains that easily split and float through the air. It can grow in low water and very low temperatures.	Stem/ Leaf	Varinder singh et al., 2016	This species rarely causes serious illness in animals and is an important causative agent of plant diseases
15	<i>Chaetomium globosum</i>	<i>T. cordifolia</i>	<i>C. globosum</i> has properties that may help in biological control, plant growth promotion, and enzyme production.	Leaf	A. Mishra et al., 2014	Antitumor, cytotoxic, antifungal and antibiotic activity.





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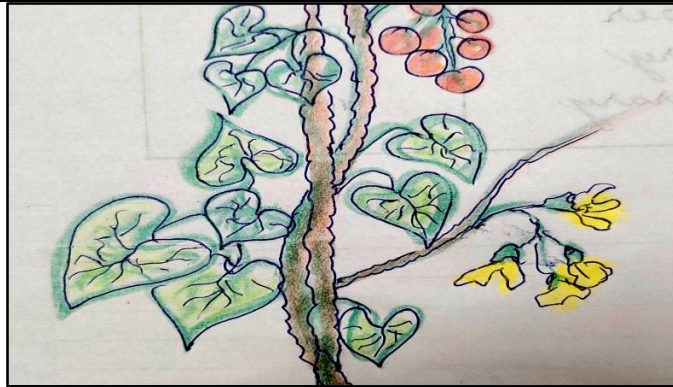
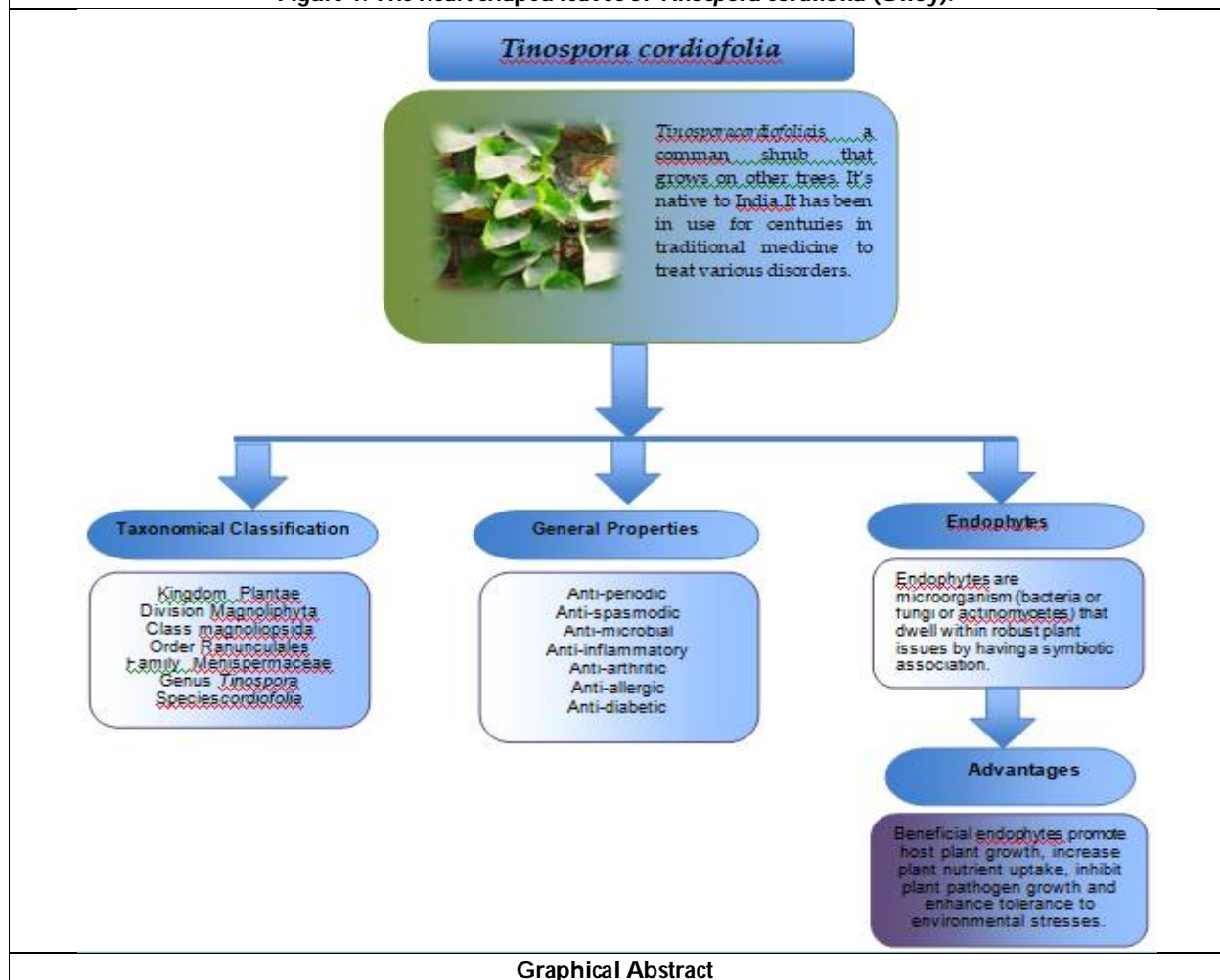


Figure 1: The heart shaped leaves of *Tinospora cordifolia* (Giloy).



Graphical Abstract

