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**RESERCH ARTICLE** 

## Seasonalwise Distribution of Phytoplanktonic Population in Mambazhathuraiyar Reservoir Water

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#### ABSTRACT

Reservoir waters fulfil the demand of India's drinking water. Planktonic density can greatly influence the water quality of these reservoirs. Therefore, understanding the dynamics of zooplankton as well as phytoplankton is necessary. Unlike reservoirs in the south India, plankton population in reservoirs in the south remains Largely characterized. In the present study samples were collected from the reservoir and analyses plankton population of different stations. Population density has demonstrated that the planktonic population in southern reservoirs varies from the density typically seen in northern reservoirs. While physicochemical factors noticeably shaped seasonal densities in some species, other species had variable dynamics and seemed to not be affected by this environmental factor, suggesting water quality parameters may regulate population composition and abundance. In the present study analyze seasonality and distribution of total plankton and phytoplankton.

Keywords: Marine, Seaweed, Phytochemical, Crude extract, Antibacterial activity, Pathogenic microbes.

#### INTRODUCTION

Aquaculture organisms have to obtain all their nutritional requirements, except for part of the mineral requirements, through the food they consume. In nature, most of the organisms subsist on live food consisting of plants and animals obtained from die environment, but some do ingest and possible utilize detritus along with associated organisms. The initial source of food for many larval organisms is phytoplankton. This is probably associated with the size of the larvae at hatching. After a certain period of time the larvae of most species can be fed exclusively on zooplankton or a combination of plant and animal matter i.e. plankton. The term 'plankton' can be defined chiefly as microscopic drifting or floating organisms in the sea and fresh waters and may be having feasible floating devices.





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Wan Maznah and Makhlough, [1] reported the water quality of tropical reservoir based on spatio-temporal variation in phytoplankton composition and physico-chemical analysis. Agostinho et al., [2] studied the Fish assemblages in Neotropical reservoirs. Adloff et al., [3] analyzed the phytoplankton community. The ecology of plankton in fresh water impoundments, mostly of ponds, tanks and reservoirs, has been studied for many years in different parts of the world. Several researchers reported the several studies on the phytoplankton distribution with availability of light, physical, chemical and biological qualities [4] in freshwater resources. Sugunan and Yadava [5] reported the phytoplankton distribution in Nongmahir lake, Meghalaya state. The average count of phytoplankton was 5440 units/L and dominated the chlorophyceae group. Authors concluded that the shallow depth of the lake created conditions. Today, Indian freshwater resources are facing tremendous ecological stress due to raising of pollution from rapid industrialization. However, mainly seasonal changes regulated pattern of phytoplankton growth. Studies reported that the summer is the most suitable season for the growth of phytoplankton in freshwater lakes because of long duration of sunshine period, increased salinity, pH and trophotropic activities. Jain et al., [6] observed that the phytoplankton productivity, hydrology and nutrient dynamics of a Khecheopalri lake in the western part of the Sikkim Himalaya. Steinhart et al. [7] studied phytoplankton as indicators of nutrient deficiency in the southern Chilean lakes and found that phosphorus should not be discounted as a limiting nutrient in aquatic system. They identified Desmids as indicators of good quality of water. Chattopadhyay and Banerjee [8] described the temporal changes in species composition, seasonal variation and diversity of phytoplankton community, related to some factors of water and sediment of Krishnasayer lake, Burdwan. Phytoplankton community progresses a serial successions to culminate in a peak sequences with low turbidity and low wind velocity in the lakes [9].Composition of phytoplankton varied seasonally in relation to salinity fluctuations. Singh and Balasingh [10] presented data on the phytoplankton population of the Kodaikanal Lake for a period of one year. During summer, phytoplankton dominated and declined in monsoon. Count of flora in turn increased during winter. Water quality Index (WQI) for protection of aquatic life in lakes [11] indicated that the water quality was almost always endangered and the conditions in it often deviated from natural waters. Zahraddeen Hassan Yusuf, [12] reported the phytoplankton as bioindicators of water quality in Nasarawa reservoir, Nigeria. The present study is aimed at analyzing the phytoplankton population to draw conclusion about the distribution, nature and ecology of the water.

#### MATERIALS AND METHODS

#### Description of study area

Mambazhathuraiyar dam is situated near Anaikidangu in Villukuri village which contemplate the formation of reservation with an effective capacity of 44.54M.ft. It is 35 meaters long and 80ft.high. From the dam 25 tanks receive water for irrigation. The river Mambazhathathurayar originates from Marcthathoor Malai. The free catchment area up to the reservoir site works out 2.80 sq mile. Necessary canal system is also proposed for giving assured supply to the ayacut of 455.76 Ac under the river and 6 rain fed tanks and also to divert the excess yield in to Erattakarai branch of Padmanabhapuram Puthanar channel under Kodayar system. This diverted quantity can be conserved in Kodayar to utilize in some other areas to bring dry lands of 459Ac under plough. The hilly catchment area spread over to an extent of 2,80 sq. miles at an attitude ranging from 76m to 833m mean sea level. The catchment areas are influenced by southwest and north east monsoon

#### Sampling stations

The site selection is very important for analysis is the water sample. Particular distant can be maintained for sample collection. For the analysis five station can be selected. Stations for sampling, dissolved material in surface water are usually operated by the Geological survey to determine the discharge of dissolved constituent pester point. Adequate sample must need for analysis water quality purpose. To formulise an effective field work, a survey was done initially to understand and also to evaluate the ecological status of mampazathuraiar reservoir. The field studies involved collection of the surface and bottom water samples from 5 stations at an interval of 0.5 Km between each station. The stations 1 to 5 falls around forest of ampazathuraiar reservoir. The stations were selected based on



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various environmental factors as follows: Station-I is located near the mouth or inlet of reservoir. Station-II is located about 500 m away from the S-I. Station-III: It is located about 700 m away from the S-II. Station-IV: It is located about 800 m away from the S-III. Station-V: is located near the outlet of reservoir.

#### **Collection of water samples**

The present study was carried out over a period of one year (January 2018 – December 2018). Water (1000 ml) and sediment (mg) samples were collected once a month from the reservoir at five different stations in the early morning and they were transported to the laboratory in plastic containers maintained at about  $5^{\circ}$  C.

#### **Planktonic study**

The samples were collected from the surface water by filtering 100 liters of water through plankton net having a mesh size of 30 pm. The water samples were allowed to settle by adding Lugol's iodine, centrifuged and the concentrate was made up to 20 ml with 4% formalin Plankton net is widely used for sampling phytoplankton. The advantage of using nets is that large volume of water can be filtered to the organisms. Different types of plankton net have been designed for collecting phytoplankton of which the most commonly used one is the standard net. It consists of a cone shaped gauze bag equipped with a plastic ring at the wider end and closed at the narrow raid by attachable plankton collecting vessel. The net mouth is attached to the towing line by usually three rope bridles from the mouth ring. A weight is attached to the end of the towing cable. The front and tail parts of the net am reinforced with non porous textile1 cuffs. The gauzes used in net are made of different materials such as bolting silk, polyester, nylon etc. Sampling with small mesh monofilament nylon net has been proved to be very successful in retaining high quality of plankton. Plankton net hauls may be made at the surface or at any desired depth. As the plankton net is in operation, the collecting vessel will receive most of the plankton. Some plankton that remain on the gauze must be washed into the bucket after the net operations is over. Water samples were collected at 60 cm depth, using plastic bottle. The samples were preserved properly and returned immediately to the laboratory. The one year study data (January 2018 – December 2018) were pooled for four months and three seasons and analyzed for seasonal changes, with respect to summer (February, March, April and May), Monsoon (June, July, August and September), Winter (October, November, December and January).

#### Identification of phytoplankton

It is very important to fix to planktons as soon as collection is over to prevent the adverse effects of light and temperature which might causes rapid decay of organisms. This can be done by preserving the collected samples in Lugols solution. The 20% formaldehyde solutions 11 (HCHO) mixed with hexamethylene tetra mine 100 gm It is a general preservative for all phytoplankton. Add 100 ml of water sample to 2ml of the fixing/ preserving agent For plankton samples, add the fixing/ preserving agent to make up about one third of the volume if the sample is dense. The desired amount of 20% formaldehyde solution mixed with 50ml glacial acetic acid in 1:1. It is a good preservative for all plankton. The 100 gm KI dissolved in 1 liter of distilled water mixed with 50 gm Iodine crystalline) and added 100 ml of glacial acetic acid. This preservative is good for all phytoplankton, for preservation purpose 0.4 to 0.8 ml of fixative was added to 200 ml of sample. The identification of plankton was carried out standard research microscope with high magnification and it can be used to measure density.

#### RESULTS

#### **Total plankton**

The total plankton collected and percentage composition recorded during 2018 are given in Plate 1 and fig 1. The percentage distribution of Total plankton during 2018 at the different seasons were southwest monsoon < northeast monsoon < pre-monsoon. During Pre-monsoon season, Maximum count of Total plankton was observed and was varied between  $13.91 \pm 3.99$  percentage/l at S-I station to  $14.61 \pm 5.14$  percentage/l at S-IV station. minimum count of





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Total plankton was observed during southwest monsoon season and was varied from  $4.04 \pm 3.03$  percentage/l at S-IV station to  $5.25 \pm 4.47$  percentage/l at S-III station. Moderate count of Total plankton was observed during northeast monsoon season and was varied from  $10.86 \pm 1.62$  percentage/l at S-I station to 11.66 .51 percentage/l at S-IV station (Table 1). The two-way analysis of difference in the data of Total plankton count of the sampling stations and seasons showed that there were statistically significant changes observed between stations and seasons as F= 0.045380448 and 562.0688; P>0.05 and P= <0.001 during 2018 respectively.

#### Phytoplankton

The phytoplankton recorded during 2018 are given in table 2. The percentage composition of phytoplankton during the study period is shown in fig.2. During the different seasons in 2017 distribution of Phytoplankton was southwest monsoon< northeast monsoon < pre-monsoon. The percentage distribution of Phytoplankton during 2018 at the different seasons were southwest monsoon< pre-monsoon < northeast monsoon. During Pre-monsoon season, Moderate count of Phytoplankton was observed and was varied between  $13.93\pm5.70$  percentage/l at S-V station to  $14.46\pm4.80$  percentage/l at S-IV station. Minimum count of Phytoplankton was observed during southwest monsoon season and was varied from  $4.48\pm2.93$  percentage/l at S-IV station to  $5.33\pm2.63$  percentage/l at S-I station. Maximum count of Phytoplankton was observed during northeast monsoon season and was varied from  $10.66\pm1.07$  percentage/l at S-I station to  $14.76\pm8.14$  percentage/l at S-V station. The two-way analysis of difference in the data of Phytoplankton count of the sampling stations and seasons showed that there were statistically significant changes observed between stations and seasons as F= 0.7356118 and 102.2785983; P>0.05 and P= <0.001 during 2018 respectively.

#### DISCUSSION

Dater is the single most vital component of the earth that made possible for life to originate, evolve, flourish and reach the present form today. Reservoirs are storage structures for surface water sources and exhibit wide variations in their morphometric, limno-chemical and biological characteristics. Planktons are important component of aquatic flora and play a key role in maintaining proper equilibrium between abiotic and biotic components of aquatic ecosystem. Phytoplankton constitutes the first stage in tropic level by virtue of their capacity to transducer environmental radiant energy into biological energy through photosynthesis. In the present study phytoplankton (microalgae) of Mambazhathuraiar reservoir are mainly composed of four families which include Myxophyceae, Chrysophyceae *Bacillariophyceae* (Diatoms), and Chlorophyceae respectively. The phytoplankton of Mambazhathuraiar reservoir had reached its peak value Pre-monsoon season, maximum count of Phytoplankton was observed at S-V station to S-IV station and the Minimum count of Phytoplankton population was dependent on quality of water, climate, temperature and nutrient content. Phytoplankton diversity and productivity are strongly related to water quality as well as to biotic factors [13].

Maximum count of Phytoplankton was observed during northeast monsoon season at S-I station to S-V station 2018 and this may be due to more nutrients, aquatic birds' excreta, more bottom sediments and brought from hills enhanced the increased phytoplankton growth. Moreover, small streams will bring the organic and inorganic nutrients to the S-II sampling station. Aquatic birds' inhabitation and their water quality impacts. Among the seasons, northeast pre-monsoon and monsoon seasons showed comparatively low total phytoplankton and this may be due to the nutrients in the reservoir water was low and exhausted by the planktons. Gopinathan and Rodrigo [14] also confirmed and supported clearly the findings of the present study. However the total phytoplankton level was very low. The Maximum count of Phytoplankton was observed during 2018 northeast monsoon season at S-I station to S-V station. The present study has indicated that the reservoir water experiences growth of diverse organisms. This statement is agreed with Sudeep *et al.*,[15]. On the other hand the Mukkadal reservoir water which is protected from major disturbances is always moderately polluted [16]. It indicates the Mukkadal reservoir water is not





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polluted by phytoplanktons and has a well balanced phytoplankton community that enjoys an even representation of several species indicating the dynamic nature of this aquatic ecosystem [17]. The minimum count of Phytoplankton was observed during 2018 southwest monsoon season at S-IV to S-I station. The maximum plankton growth was observed during summer months, since a number of factors favour algal growth. The present study agrees with the above statement that maximum planktons were observed during April 2018. It was due to light and temperature as an important factor for phytoplankton growth through photosynthesis, through which light energy is used to transform inorganic molecules into organic matter [18]. Minimum count of Phytoplankton was observed during southwest monsoon season 2018. The fall down of the phytoplankton community can be attributed to dilution of the phytoplankton biomass caused by runoff during rain.

#### CONCLUSION

The diversity of biota was a component studied with perception of its possible role in ecosystem management as well as fishery potential. The phytoplankton species in the present study belong to the three groups viz. Chlorophyceae, *Bacillariophyceae*, and *Cyanophyceae*. *Chlorophyceae* contributed to the maximum percentage of total phytoplankton followed by *Bacillariophyceae* and *Cyanophyceae*. The analysis of mambazhathathurayar reservoir water with reference to planktonic study is widely useful in many ways for the peoples and it is important to observe the usefulness and the effects of these micro and macro elements on the aquatic flora and fauna in the water body itself. Population density has demonstrated that the plankton in southern reservoirs vary from the density typically seen in northern reservoirs. In the present study samples were collected from the reservoir and analysed on planktonic populations in water of five stations and observed that the station – V was more well than the other four stations.

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### Table 1. Shows Seasonal Variation and average (Mean $\pm SD$ ) in total plankton during the study period-2018

Cassans	Stations							
Seasons	Ι	II	III	IV	V			
Pre-Monsoon	$13.91 \pm 3.99$	$14.06\pm3.98$	$14.06 \pm 3.71$	$14.61\pm5.14$	14.23 ±4.10			
Southwest	5 17 + 2 54	$5.05 \pm 2.01$	$5.25 \pm 4.47$	$4.04 \pm 2.02$	1 85 ± 2 72			
Monsoon	$5.17 \pm 5.54$	$5.05 \pm 5.91$	5.25 ± 4.47	4.04 ± 5.05	$4.05 \pm 5.75$			
Northeast	$10.86 \pm 1.62$	11 11 +11 11	10.06 ±1.88	11 66 ±0 51	$11.28 \pm 1.26$			
Monsoon	$10.00 \pm 1.02$	11.11 ±11.11	10.90 ±1.00	11.00 ±0.51	$11.20 \pm 1.30$			

Table 2. Shows Seasonal Variation and average (Mean  $\pm SD$ ) in phytoplankton during the study period – 2018

Cassana	Stations							
Seasons	Ι	II	III	IV	V			
Pre-Monsoon	14.25±4.16	14.26±3.85	14.04±4.33	$14.46 \pm 4.80$	13.93±5.70			
Southwest	5 22+2 62	4 00+2 65	5 27+2 22	1 18+2 02	5 07+1 06			
Monsoon	5.33±2.63	4.90±3.63	5.27±5.52	4.40±2.95	5.07±1.96			
Northeast	10 66+1 07	11 10+1 24	10.07+1.78	11 22+1 21	1176+911			
Monsoon	10.00±1.07	11.10±1.24	10.97±1.78	11.35±1.21	14.70±0.14			



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**RESEARCH ARTICLE** 

# Characterization and Phylogenetic Reconstruction of *MecA* and *Pvl* Genes of Methicillin Resistant *Staphylococcus aureus* from Retail Meats in North East India

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#### ABSTRACT

Methicillin-resistant *Staphylococcus aureus* (MRSA) associated with foods of animal origin is an emerging issue and excess antibiotic usage has made the livestock a reservoir of it; thus the objective of the study being to resolve the existence of *mecA*(resistant gene) and *pvl* (exotoxin) genes and to establish a genetic relationship through phylogram analysis. Four hundred and fourteen samples were procured from retail meat shops and screened for MRSA against cefoxitin and oxacillin followed by disk diffusion method. A PCR assay determined the presence of *mecA* and *pvl* genes and the alignment of these genes was performed using ClustalW. The phylogenetic tree using Mega 7.0.18 was generated and data were analysed using chi-square test ( $\chi$ 2). One hundred and thirty six (32.85%) isolates of MRSA were isolated and the rate of prevalence was observed to be 26% in mutton and pork followed by 35.13% in beef, 36.53% in fish and 38.37% in chicken. 29 isolates harboured the *mecA* gene while 15 isolates harboured the *pvl* gene. The phylogenetic analysis of the amplified *mecA* genes marked the closest match of sequences of *S. aureus* with humans suggesting the possibilities of horizontal transfer of genes accompanying antibiotic resistance while evolutionary distances of the amplified *pvl* gene expressed its closest relation which were community associated. All the isolates of MRSA were resistant towards cefoxitin, oxacillin ciprofloxacin and clindamycin. This study is the first in Silchar and Manipur to determine the MRSA surveillance data from retail meat shops along with molecular characterization and their phylogram analysis.

Keywords: MRSA, retail meats, phylogram, animal food origin

#### INTRODUCTION

Methicillin-resistant *Staphylococcus aureus* are considered as utmost important bacterial pathogens because of their higher rate of prevalence and the severeness of the infections cause by them [1,2]. Their isolation has been well expanded in various retail meat producing animals that include cattle, pigs, poultry, sheep, goats and even fish [3,4]. The potential route of contamination is thought to occur during the slaughtering as well as butchering process [5,6].





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The environmental surroundings of the farm vicinity and the slaughter houses often poise as a frequent source and reservoirs of contaminating points. Frequent close contacts between farms-animals-humans increase the risk of MRSA transfer to humans but some reports have shown that cases of MRSA have also been found to be transmitted where no direct contacts with animals occurred and due to this reason it has been strongly suggested that other than livestocks, MRSA may also exist in retail meats [7,8]. The introduction of LA-MRSA (livestock associated MRSA) was to initially differentiate itself with the previously known hospital acquired and community acquired MRSA [9] and hence the LA-MRSA has become an important matter, as human MRSA infections are found to be caused by direct contact of the animals with humans [10,11] and through consumption of MRSA positive animal foods such as cow milk, cheese, processed and ready-to-eat meat products [12,13] and meats of raw chicken, pork, beef, mutton and fish [14,15,16]. Identified MRSA isolates from animal foods that contain Panton-Valentine leukocidin (pvl) and mecA genes and certain other factors which are virulence based such as genes associated with biofilm formation, hemolysin, capsule, etc., pose as potential threat to public health [17], thus suggesting the potentiality of animals to act as primary source of infections and contaminants [18]. MRSA infected fish has raised various concerns since fish is not the normal host of staphylococci. Many reports have identified that contaminated fish or diseased fish harbour the enterotoxins and other resistance genes that act as powerful tools in disseminating the infections to the healthy communities and serve as the reservoir for such strains that take on major role in zoonotic transfers. Since precise reports on animal MRSA based foods are not available here in North East region of India, therefore to provide basis for further investigations, we examined the prevalence of MRSA by phenotypic and genotypic methods, antimicrobial susceptibility patterns and to establish genetic relationships through phylogenetic analysis.

#### MATERIALS AND METHODS

#### Sample and bacterial isolates

A total of 414 both retailed as well as butchered meat samples consisting of chicken 86 (20.77%), beef 74 (17.87%), mutton 100 (24.15), fish 104 (25.12%) and pork 50 (12.07%) were randomly collected from various supermarket areas throughout Silchar and Imphal, North East India between January 2017 to April 2017. After procurement of the samples they were immediately stored in a mini cooling container (4°C) and transported to the Department of Microbiology, Assam University for microbiological analyses within four hours of collection period. Peptone water was used as enrichment medium where a loopful of the sample was inoculated onto Manitol Salt agar (MSA) and Baird parker (BP) medium (Hi- media, India). The samples were incubated for 24 hours at 35°C aerobically. Isolates were tentatively identified as *Staphylococcus aureus* based on their morphological characters (round colonies with golden yellow-colour on MSA and convex, black shiny colonies on BP medium). Further biochemical characterization of the isolates was performed by a series of tests that included Gram's staining, oxidase, catalase and coagulase, The isolates were then stored at -80°C by subculturing in nutrient agar slant.

#### Antimicrobial susceptibility testing

Besides oxacillin and cefoxitin, other antibiotics-ampicillin ( $10\mu g$ ), Cefoxitin ( $30\mu g$ ), Gentamicin ( $10\mu g$ ), Erythromycin ( $15\mu g$ ), Clindamycin ( $2\mu g$ ), Oxacillin ( $1\mu g$ ), Levofloxacin ( $5\mu g$ ), Nitrofurantoin ( $300\mu g$ ), Ciprofloxacin ( $5\mu g$ ) and Tetracycline ( $30\mu g$ ) listed for routine antimicrobial susceptibility test against *S. aureus* were screened as per the guidelines of Clinical and Laboratory Standard Institute (CLSI 2013). Disk diffusion method was followed using Muller Hinton agar. The MRSA cultures grown overnight were compared with 0.5 McFarland standards. Swabbing of culture containing *S. aureus* isolates was done on Muller Hinton agar plates with the help of cotton swab. The antibiotic discs were then placed and slightly pressed. The plates were then incubated at  $37^{\circ}$ C for 24 hours. Further, cefoxitin- $30\mu g$  and oxacillin- $1\mu g$  antibiotic discs were used to determine the presence of MRSA isolates [19,20]. Isolates exhibiting inhibition zone which is less than 17mm were confirmed as oxacillin resistant and those isolates exhibiting more than 22mm zone of inhibition as cefoxitin resistance.





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Detection of the *mecA and pvl* genesA PCR amplification of *pvl* and *mecA* genes was performed with the primers as listed in table 1. The reaction conditions of the thermal cycle (table 1) as previously described by Duran et al. (2012) and Shresthaet al. (2014) [21,22] were followed. The final PCR products were electrophoresed on 1% agarose gel and visualized under UV trans-illuminator once the staining procedure with ethidium bromide was completed. Phylogenetic analysis of *mecA* gene and *pvl* genes The alignment of *mecA* and *pvl* genes of *Staphylococcus aureus* was performed using ClustalW which was carried out in Mega 7.0.18 consensus Neighbour Joining Tree. Phylogenetic tree was generated by Mega 7.0.18 with the option which was mean for protein alignment and tree construction [23].

#### Data analysis

The chi-square test ( $\chi$ 2) was performed to resolve the prevalence of *pvl* and *mecA* genes in different types of meat samples from animal food origin where 95% confidence intervals for prevalence were obtained.

#### RESULTS

#### Prevalence of MRSAin animal based foods

Of 414 samples collected, 136 (32.85%) isolates of MRSA were isolated and the rate of prevalence of MRSA was detected to be 38/104 (36.53%) in fish followed by 13/50 (26%) in pork, 26/100 (26%) in mutton, 26/74 (35.13%) in beef, and 33/86 (38.37%) in chicken. The *mecA* and *pvl* genes did not harbour in all the MRSA isolates and the prevalence rate of MRSA was recorded to be highest in chicken followed by fish, beef, mutton and pork.

#### Detection of *mecA* and *pvl* gene

The PCR assay revealed the presence of *pvl* and *mecA* genes from 136 MRSA isolates. A total of twenty-nine (21.32%) isolates from five different types of animal foods that are chicken, mutton, pork, beef and fish harboured the *mecA* gene. The prevalence rate of this gene was confirmed to be highest in beef (31.03%), followed by chicken and pork (24.13%) while mutton and fish recorded the lowest prevalence rate (10.34%). The *pvl* gene harboured in fifteen (11.02%) isolates from four out of five animal origin foods that are chicken, beef, fish and pork and the prevalence rate was observed to be highest in pork at 46.66%, followed by chicken and fish at 20% and beef at 13.33%. The amplification of both *mecA* and *pvl* genes was observed at 331bp and 433bp (Fig: 1 and 2

#### Sequencing of *mecA* and *pvl* genes

Using specific primers of the *mecA* and *pvl* genes of *Staphylococcus aureus* as describes by Duran et al., 2012 and Shrestha et al., 2014, Sanger sequencing (Geneombio technologies PVT LTD, Pune) was performed and the sequenced data were then analyzed using NCBI (National Centre for Biotechnology Information) and BLAST (Basic local alignment search tool) for highly significant matches.

#### Phylogenetic analysis of *mecA* and *pvl* genes

Phylogenetic analysis of the amplified *mecA* genes from our isolates marked the closest match of sequences of *S. aureus* with humans thus, suggesting the possibilities of horizontal transfer of genes accompanying antibiotic resistance or some staphylococcal enterotoxin strains. Neighbour-Joining method [24] was used to study the evolutionary history and the optimal tree with the sum of branch length= 0.83287357 as presented in Fig. 1 was computed using the Maximum Composite Likelihood method [25] based on the units of the number of base substitutions per site. The analysis involved 13 nucleotide sequences and all positions containing gaps and missing data were eliminated. Thus, a total of 225 positions in the final dataset and the evolutionary analyses were conducted in MEGA7 [26] that described the MA2 and MA4 *S. aureus* strains from beef and chicken isolates. The MA4 *S. aureus* strain was observed to be firmly associated with *S. aureus* from human source isolated in USA and the cluster was observed to be far away from those which are isolated from human sources in Pakistan.Similarly the evolutionary



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distances of the amplified *pvl* gene expressed its closest relation to those sequences of *S. aureus* which are community associated. The neighbour joining tree was generated along with the optimal tree with sum of branch length= 0.00492490. Eight nucleotide sequences were involved in the analysis with 408 positions in the final dataset (Kumar S et al. (2016)). Presence of PV1 and PV5 strains from pork isolates exhibited their close association with *S. aureus* from community associated sources isolated in China followed by USA, thus increasing the probability of acquiring methicillin resistant strains to accumulate in animal foods which upon consumption will be then transferred to consumers is a matter of potential health risk concern.

#### Antimicrobial susceptibility testing

The antimicrobial susceptibility patterns for MRSA isolates were determined and differences in resistance patterns among each meat samples were observed. As expected, all the isolates of MRSA were found resistant towards cefoxitin, oxacillin ciprofloxacin and clindamycin. However, isolates belonging to mutton, chicken and fish expressed their sensitivity towards gentamicin at 71.32% and isolates belonging to pork and beef were observed to be resistant at 28.67% towards gentamicin. Resistance towards erythromycin was recorded on pork, mutton and chicken isolates at 52.94% while isolates belonging to beef and fish samples were sensitive towards erythromycin at 47.05%. Nitrofurantoin expressed its sensitivity for all the isolates except for pork isolates at 90.44% and resistance at 9.55%. Ampicillin resistance was observed at 56.61% in fish, pork and beef isolates while chicken and mutton isolates were sensitive towards ampicillin at 43.38%. Tetracycline revealed 52.94% resistance towards chicken, mutton and pork isolates but was sensitive at 47.05% towards beef and fish isolates. The isolates of fish, mutton and chicken were sensitive towards levofloxacin at 71.32% while pork and beef isolates showed intermediate resistance (28.67%). The highest resistance was observed in pork isolates at 80% where 8 out of 10 antibiotics were observed to be resistant while very low resistance was observed in fish isolates (4 out of 10 antibiotics).

#### Data analysis

The prevalence of *mecA* and *pvl* genes was found to be significantly different. After analysis, the P-value was found to be  $\leq 0.05$  which was contemplated to be significant statistically at the confidence interval of 95%.

#### DISCUSSION

The present study recorded a high recovery of 136 (32.85%) isolates of MRSA from different animal origin foods (pork, mutton, chicken, beef and fish). Such high recovery of MRSA isolates maybe due to cross contamination of meat products by S. aureus from environmental sources such as water, abattoir conditions and transportation. Other causes like random collection of samples from various supermarket areas throughout Silchar and Manipur may also contribute to the differences and the rate of contamination. Besides, reports have shown that 1.2% of total randomly collected samples were found to be MRSA positive [27]. Which is less when compared to our study which depicts 32.85% MRSA positive isolates. In North East India, pork and beef are the most relished and popular meats. The prevalence rate of MRSA in pork from this region was observed at 26% and in beef at 35.13%. Results from the present study are in accordance with the previously published reports thus suggesting that presence of MRSA in pigs and cattle are dependent on pig and cattle production types and its herd size. Transportation from farm to slaughter houses or lairage or pig trade along with the employees has reported to enhance MRSA contamination and contribute their important roles in transmitting the bacteria. Presence of MRSA in pig or cattle farms that are closely associated with humans may also act as a risk factor thus suggesting that a prolonged association with farm animals is an important factor for higher rates of colonization and pose a potential hazard to public health. Although fish is not usually the normal host for staphylococci but association of staphylococci on fish usually refers to either diseased condition or their contamination and hygienic status of the fisheries or ponds in which they are reared [4]. The present study recorded the rate of MRSA prevalence in fish at 36.53% which is quite higher than the reports from other parts of Indian states as well as other countries where only 3.3% of MRSA was harboured by the fishes [28] . It is suggested that fish trade increases the possibilities of such transmission and its influence on the consumer's health





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should be monitored. The study also unmasks the occurrence of 38.37% of MRSA in poultry. These findings underscore the importance of extensive usage of antibiotics commonly practiced by the farmers here at north eastern region though not in prescribed form in animals raise for food to boost their growth. Besides these, factors such as sampling and post handling of samples and geographical differences may also constitute and form a baseline for serious threat to public health. MRSA in mutton observed at 26% too suggests that such MRSA contaminated meat requires public attention and food safety regulators should be strictly implemented to improve the supervision hygienic status of the animals, farms, lairage and slaughter houses. The *mecA* gene was detected in 29 out of 136 (21.32%) isolates and prevalence rate of this gene was confirmed to be highest in beef (31.03%) while mutton and fish recorded the lowest prevalence rate (10.34%). However, a total of 107 isolates were found negative for the presence of *mecA* gene in them. Such types of discrepancies in correlation between the *mecA* gene and MRSA isolates has also been reported by earlier workers [29,30] thus suggesting over production of phenotypic growth conditions that are involved in interpretation of methicillin resistance [31,32,33].

The pvl gene encodes the Panton-Valentine leukocidin toxin which was detected in 11.02% (n=15) of methicillin resistant S. aureus in this study along with absence of pvl gene detection from maximum of the MRSA positive samples. Presently, MRSA positive strains expressing pvl gene are usually responsible for causing infections in various countries through infiltrating the veterinary as well as human hospital settings and alternative close associations with the livestock thus making community acquired infections a great significance due to their similarities with the isolates as well as their inability to be differentiated from healthcare associated MRSA [17]. Reports with high *pvl* gene prevalence rate at 38% and 56.5% have also been reported by previous workers [34,35,36] along with a much lower frequency of *pvl* gene where prevalence rate of *pvl* gene in MRSA strain is almost negative or zero percent [37,38] thus suggesting that low and moderate prevalence rate prevails in north eastern states, and periodic surveillance is much needed to keep a check to it with regard to public health [39]. Increasing reports on MRSA based infections and colonization in animals has raised various issues and concerns [40] today. The present study revealed that the MRSA isolates were closely related and belonged to human source and were community associated thereby suggesting that the probability of acquiring methicillin resistant strains was due to its accumulation in animal foods and its environment which upon consumption is then transferred to consumers. Various reports have also well documented those humans living in close association with infected animal farming environment or post slaughter houses contamination or lairages may have been infected by consumption of foods from such infected animals. Heterogeneous resistance is usually observed by many of the MRSA isolates thus making antibiotic susceptibility test more challenging. The study observed that all the isolates were resistance towards cefoxitin, oxacillin ciprofloxacin and clindamycin [41].

Various studies have also declared resistant to antibiotics for strains of *S. aureus* in certain animal food products [12, 42, 43] and our data shows similarity with their results. In our study highest resistance was observed in pork isolates at 80% where 8 out of 10 antibiotics were found to be resistant while very low resistance was recorded in fish isolates (4 out of 10 antibiotics). Similar results observed by Wang et al. (2014) [44]. were reported expressing 97.6% of *S. aureus* isolates resistance from animal retail meats in one or more than one antimicrobial agents. The prevalence of resistance to clindamycin, ampicillin, erythromycin, tetracycline, and ciprofloxacin is in agreement with our data. Antibiotics serve as essential additive for animal feeds and growth enhancer and also for the medication of human diseases [45,46], thus they are the major reason for more and more resistant strains that have been commonly observed. Though the prevalence of MRSA varies greatly by geographical location in retail meats but apart from this, sample size, geographic settings and collection period may also be responsible for the differences observed [47].

#### CONCLUSIONS

Since the present study recorded a high recovery of MRSA isolates from different animal origin foods (pork, mutton, chicken, beef and fish) we therefore recommend a proper risk assessment and surveillance to be conducted for



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further prevention of the possible health hazards to both animals and the consumers. Rapid molecular biological techniques like genome sequencing have the potentiality and expertise to differentiate the MRSA isolates that can be used for determining the actual cause of infections and their possible sources in the prevailing environments of the farms as well as in the marketed animal foods. It is, therefore, highly important to differentiate the animal and human MRSA isolates as such techniques will additionally aid in monitoring their associated virulence factors and antibiotic resistance.

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#### **Conflict of interest**

None to declare

#### **Authors Contribution**

Sagolsem Yaiphathoi Performed all the experiments. Dr. Indu Sharma Supervising, Manuscript writing and data compilation.

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#### Table 1: Sequence of primers and PCR conditions for mecA and pvl genes of MRSA.

			Denaturation		Annealing		Elongation		No. of
PCR	Genes	Primer sequence (5'–3')	Temp	Time	Temp	Time	Temp	Time	NO. 01
			(°C)	(sec)	(°C)	(sec)	(°C)	(min)	cycles
	mecA -F	CCTAGTAAAGCTCCGGAA							
	mecA -R	CTAGTCCATTCGGTCCA	94	45	54	40	72	2	
		ATCATTAGGTAAAATGTCTG							30
	ры-ғ	GACATGATCCA	0.4	20	(0	20	70	2	cycles
	uml D	GCATCAACTGTATTGGATAG	94	94 30	60	30	72	2	
	ры-к	CAAAAGC							



500 — 433 300 — 10

Fig 1:- Gel image showing amplification of mecAFiggene. Ladder used is 100 bp (Lane 1). Lane 2, 3, 5,gen6 and 7 shows amplified mecA gene (331bp).andLane 8 is negative control.is 10

Fig 2:- Gel image showing amplification of *pvl* gene. Ladder used is 100 bp (Lane 1). Lane 2, 4, 5 and 6 shows amplified *pvl* gene (433bp). Lane 8 is negative control



Figure 3: Phylogenetic relation of *S. aureus* (*mecA*) from different regions of the world along with the country of origin of the isolates.



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**RESEARCH ARTICLE** 

#### **Applications of Smart Agriculture**

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#### ABSTRACT

The style consists of the recognition of quality of fruits and vegetables. This is the new approach to Predict pesticide levels in fruits and vegetables by using agricultural robots are increasing production yields for farmers in various ways. From drones to autonomous tractors to robotic arms, the technology is being deployed in creative and innovative applications. Harvesting and picking is one amongst the foremost popular robotic applications in agriculture because of the accuracy and speed that robots are able to do to enhance the dimensions of yields and reduce waste from crops being left within the field. Harvesting and picking robots have become very hip among farmers, but there are dozens of other innovative ways the agricultural industry is deploying robotic automation to enhance their production yields and Smart agriculture is a developing idea on the concepts because IOT sensors with irrigation techniques are fit for providing information about agriculture fields.

**Keywords:** Artificial Intelligence, Fruits, Irrigation techniques, Harvesting Robots Agriculture, Spraying, Temperature, Soil, Vegetables.

#### INTRODUCTION

Using AI for intelligent spraying of chemicals and Brings in cost savings.AI systems are helping to boost the harvest quality and accuracy – called precision agriculture. AI technology helps in detecting disease in plants, pests and poor nutrition of farms. AI sensors can detect and target weeds then decide which herbicide to use within the region. This helps in reduced usage of herbicides and value savings. Many technological companies developed robots, which use computer vision and computer science to watch and precisely spray on weeds. These robots are able to eliminate





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86% of the degree of the chemicals normally sprayed on the crops and produce down the expenditure of herbicide by 93%. These intelligent AI sprayers can drastically reduce the quantity of chemicals employed in the fields and thus improve the standard of agricultural produce, and produce in cost efficiency. Have you ever wondered who actually picks the produce from the agricultural land? Well, in most cases, it's not the standard hand but robotic machines that are capable of doing bulk harvesting with more accuracy and speed that are chargeable for getting the produce on your table. These machines help improve the dimensions of the yield and reduce waste from crops being left within the field. Many companies are engaged on improving agricultural efficiencies. There are products like autonomous strawberry-picking machine and a vacuum apparatus that may harvest mature apples from trees[1]. These machines use sensor fusion, machine vision and computer science models to spot the placement of the harvestable produce and help pick the correct fruits.

#### Literature Survey

#### Crop yield predictions and price forecasts

For many farmers, the most important worry is that the price fluctuation of the crop. because of unstable prices, farmers are never able to plan a precise production pattern. This problem is extremely prevalent in crops like tomatoes that have very limited shelf time. Companies are using satellite imagery and weather data to assess the acreage and monitor crop health on a real-time basis. With the assistance of technologies like big data, AI and machine learning, companies can detect pest and disease infestations, estimate the tomato output and yield[2-3], and forecast prices. they'll guide the farmers and governments on the longer term price patterns, demand level, variety of crop to sow for max benefit, pesticide usage etc [4-5]. During this way, the applying uses AI and ML to unravel plant diseases. Over seven million farmers have downloaded this app and it's helped identify over 100 crop diseases among field crops, fruits, and vegetables.

#### **Proposed methodology**

#### Smart farming

Every day, farms produce thousands of information points on temperature, soil, usage of water, atmospheric phenomenon, etc. With the assistance of computer science and machine learning models, this data is leveraged in real-time for obtaining useful insights like choosing the correct time to plant seeds, determining the crop choices, hybrid seed choices to get more yields and therefore the like. Smart farming and precision agriculture involve the mixing of advanced technologies into existing farming practices so as to extend production efficiency and also the quality of agricultural products. Fig 1As an extra benefit, they also improve the standard of life for farm workers by reducing heavy labor and tedious tasks. Replacing human labour with automation could be a growing trend across multiple industries, and agriculture isn't any exception. Most aspects of farming are exceptionally labor intensive, with much of that labour comprised of repetitive and standardized tasks an ideal niche for robotics and automation. We're already seeing agricultural robots beginning to look on farms and performing tasks starting from planting and watering, to harvesting and sorting. Eventually, this new wave of smart equipment will make it possible to supply more and better quality food with less manpower.

#### Irrigation Techniques: Intercropping crop yields

Intercropping mixed crop species cultivation on a field can potentially reduce pressure on land and water resources by generating higher contribute use efficiencies and crop yields through exploitation of complementarities between species (fig.2,3) [6].

#### Automatic Watering and Irrigation

Subsurface Drip Irrigation (SDI) is already a prevalent irrigation method that permits farmers to manage when and the way much water their crops receive. By pairing these SDI systems with increasingly sophisticated IoT enabled sensors to continuously monitor moisture levels and plant health, farmers are able to intervene only necessary, otherwise allowing the system to control autonomously.





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#### **Crop Spraying**

There are drones currently available and in development for crop spraying applications, offering the possibility to automate one more labor-intensive task. Employing a combination of GPS, laser measurement and ultrasonic positioning, crop-spraying drones can adapt to altitude and placement easily, adjusting for variables like wind speed, topography and geography. this permits the drones to perform crop spraying tasks more efficiently, and with greater accuracy and fewer waste. In IoT-based smart farming, a system is made for monitoring the crop field with the assistance of sensors (light, humidity, temperature, soil moisture, etc.) and automating the irrigation system. The farmers can monitor the sector conditions from anywhere. IoT-based smart farming is extremely efficient in comparison with the traditional approach.

#### **Artificial Intelligence in Agriculture**

#### Crop yield prediction and price forecasts

Identify the output yield of crops and forecast prices for the subsequent few weeks will help the farmer to get maximum profit

#### **Intelligent Spraying**

AI Sensors can detect weed affected areas and might precisely spray herbicides within the right region reducing the usage of herbicides

#### **Predictive Insights**

Insights on right time to sow the seeds for max productivity .insghts on the impacts created by the climatic conditions

#### **Agriculture Robots**

Using Autonomous robots for harvesting huge volumes of crop at a better volume and faster pace

#### **Crop and Soil Monitoring**

Using ML /AI we will monitor the crop health for diagnosing pests /soil defects ,nutrient deficiencies in soil etc

#### Disease diagnosis

Prior information and classification and plant diseases help farmers control the disease through proper strategy

#### **RESULTS AND DISCUSSION**

#### Future scope

AI solves the scarcity of resources and labor to an oversized extent and it'll be a strong tool that may help organizations deal with the increasing amount of complexity in modern agriculture. it's time that big companies invest during this space.

#### CONCLUSIONS

The response is perhaps no for now- but definitely within the near future, AI will complement and challenge the way decisions are made and improve farming practices. Such technological interventions are likely to guide to raised agricultural practices, yields, and qualitatively improve the lives of farmers.





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**RESEARCH ARTICLE** 

## The State of the Cytokine Profile and Immune Disorders in Patients with Chronic Pancreatitis

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#### ABSTRACT

The role of inflammation in the pathogenesis of pancreatic lesions in pancreatitis and tumors is widely discussed. The study examined the relationship between the production of cytokines IL1, IL4, IL6, IL8, IL10, TNF $\alpha$ , and clinical variations in pancreatitis. Patients with chronic pancreatitis and pancreatic carcinoma were examined. The level of cytokine production in blood serum was determined by enzyme immunoassay. Studies show convincing evidence of the participation of cytokines in the mechanisms of immune inflammation in both pathologies, especially expressed in pancreatic carcinoma. The high level of pancreatic enzymes, accompanied by the overproduction of pro-inflammatory cytokines to reduce the progressive inflammatory process and prevent the transition to a severe complicated form.

Keywords: Pancreatitis, pancreas carcinoma, proinflammatory, cytokines, anti-inflammatory cytokines, CD

#### INTRODUCTION

All over the world, there is a steady tendency to increase the number of diseases of the pancreas. Currently, certain results have been obtained that can reduce the incidence rate, in particular, acute and chronic pancreatitis. The last decade was marked by an increase in research on disorders of the immune and cytokine status in diseases of the





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digestive system and, in particular, the pancreas. However, today there are not enough studies devoted to a detailed analysis of the immune mechanisms of cytokine interactions in the development of inflammatory changes, the relationship between the level of different groups of interleukins, the nature and degree of the assessment of the clinical, cytokine and immunogenetic status of patients. (Belotsky S.M., Avtalion R.R., 2008; Rudiger L., Wolfgang ED, Torsten K., 2010). Currently, various research methods are used to diagnose chronic pancreatitis (CP), however, most of them do not allow to establish a diagnosis of CP at an early stage of the disease. In the pathogenesis of pancreatitis is crucial genes dysfunction of cytokine cascade, causing yuschaya- an expression of various key mediators of inflammation and promotes destructive-inflammatory changes pancreas ( Sun HC, Qiu ZJ, et al, 2007;. Alvarez C., Buss BI, 2010; Fogar P. et al., 2009; Kazbay K., Tarnasky PP, Hawes R. H., 2011). Errors in the diagnosis of exacerbations of CP can be up to 90% at the prehospital stage and up to 17% in a hospital. As a result of the measures taken, a reduction in the incidence rate to a level of less than 5% and mortality to 1.3 times was achieved. The average age of patients with CP decreased from 50 to 38 years. People with a chronic form of pancreatitis who become disabled make up 11%. A large number of drugs used in the treatment of CP often confers the practical physician with the difficult task of choosing the most effective combinations for a particular patient. Therefore, the problem of developing clearer criteria for choosing CP treatment tactics, taking into account the individual characteristics of the patient, remains open (Gubergrits N. B., Kazyulin A. N., 2011). Within the framework of this problem, it seems reasonable and timely tactics of complex immune correction to increase the effectiveness of CP therapy. Given the above, further study and improvement of early diagnosis methods with the expansion of its therapeutic capabilities in therapy and prognosis are relevant and practically important.

#### MATERIALS AND METHODS

Collection of clinical material was carried out on the bases of the Tashkent Medical Academy, in Uzbekistan, as well asin the Department of Gastroenterology of the University Hospital and the center of then pan create carcinoma, Freiburg in Germany, by support of grant of the German fund DAAD. The object of study - 245 patients with chronic pancreatitis (CP), of whom 125 were hospitalized in the clinic of TMA, the remaining 120 patients, of whom 105 HP, 15 pan creati carcinoma(PC) in the Division of Gastroenterology at the University Hospital and the center of the Pancreatic carcinoma in Freiburg, Germany. Clinical research methods were based on the history, general clinical, biochemical studies in the formulation of non-invasive tests of early diagnosis - determination of trypsinogen-2 in the urine (Actim Pancreatitis, Medix Bio chemica Finland) and fecal elastase-1 (BIOSERV Diagnostics BS-86-01 Elastase ELISA ) Immunological examination in the dynamics of observation included the determination by means of immune phenol typing of membrane antigens of peripheral blood lymphocytes (CD3, CD4, CD8, CD16, CD95, CDHLA-DR) using monoclonal antibodies (Sorbent JSC). The determination of serum immune globulins of classes A, M, G was carried out by the method of radial immuno diffusion according to G. Manchiniusing monospecific serums against human immune globulins. The concentration of cytokines - IL-1 $\beta$ , IL-2R, IL-4, IL-6, IL-8, IL-10, TNF- $\alpha$ , TGF- $\beta$ 1, and INF- $\gamma$  - was determined by enzyme-linked immunosorbent assay (Russia), DRG- Diagnostica (Germany).

#### Statistical data processing

For the analysis of the obtained data, the BioStat 5.8.4.3 software was used. The data were presented in the form of an average value and a standard error (M  $\pm$  m). Correlation analysis of quantitative values was carried out using the Pearson correlation coefficient. The level of reliability P <0.05 was taken as statistically significant changes.

#### RESULTS

We have investigated that the level of IL -1  $\beta$  with CAP with complications rises by 31.2 times, and without complications - by 17 times, IL -4 with a complicated course - by 6, 3 times, and with an uncomplicated course - by





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3.7 times, IL- 6 levels increase 7.1 and 3.2 times, IL -8 13 and 7.7 times, TNF -  $\alpha$  6.1 and 3.1 times and IFN -  $\gamma$  24.3 and 15.1 times, respectively, compared with healthy individuals. From the data obtained, it is also seen that in the complicated course of CP, the level of cytokines increases in comparison with the uncomplicated course by 1.6-2.1 times. The content of T GF-  $\beta$ 1, which stimulates the formation of fibrosis, in patients with CAP was 627.8 ± 92.2 pg/ml, in patients with CAP with the complicated course - 812, 3 ± 98.5, in the control - 40.2 ± 4.6 pg/ml ( P <0.05) (Tab.1). The values obtained by us indicate that there are multiple increases in the level of cytokines in the complicated course of CP than in the absence of complications. At HP, as well as at acute course, marked correlation between the severity of disease and the level of pro-inflammatory cytokines and their involvement in the development of relapse. Recurrent damage to acinar cells is caused by the synthesis of activated T-lymphocytes, macrophages, in particular, T GF-  $\beta$ 1, which enhances the infiltration. An analysis of the cytokine profile in patients with CP in Germany who were hospitalized in the gastroenterological department of the University Hospital in Freiburg, Germany revealed a significant increase in the content of TNF- $\alpha$ , INF- $\gamma$  in 26 (65%) and 33 (82%) patients respectively, compared with the control group ( P <0.001). In 17 (42%) patients, the concentration of IL-2R and IL-6 was sharply increased (P <0.001), in 23 (58%) - a moderate increase (P <0.01) (Tab. 2).

When comparing with biochemical data, a significant direct correlation was established (r = 0.7): the levels of TNF -  $\alpha$ and IFN -  $\gamma$ , on the one hand, and the concentration of pancreatic cytolytic enzymes on the other (P <0.01), the amount of TNF-  $\alpha$  and lipase level, (P <0.01), IFN -  $\gamma$  concentration and gamma-GT and alkaline phosphatase levels (P <0.01). Based on the results of CT studies, a statistically significant direct correlation was found: the levels of TNF - $\alpha$  and IFN -  $\gamma$  with the severity of inflammation of the pancreatic tissue, as well as a significant relationship between the level of cytokines IL- 2 R, IL- 6 of blood serum and the stage of tumor lesion of the pancreas. When studying cytokines in patients with CP, we found an increase in serum concentrations of IL-2.6, as well as TNF- $\alpha$  and IF N-  $\gamma$ from the corresponding parameters of the control group. The high content of TNF- $\alpha$  and IF N-  $\gamma$  in the blood of patients with CP indicates a shift in the pro-inflammatory side of cytokine production. The death of pancreatocytes in pathology can occur by necrosis and apoptosis. Installed in our study the relationship between the levels of  $\alpha$ -TNF, IF N - $\gamma$ , IL-2, IL-6, and containing cytolytic enzymes, indicates the effect of both mechanisms is damaged pancreas. TNF- $\alpha$  with the participation of INF- $\gamma$  can exert a direct cytotoxic effect on pancreatocytes.

#### DISCUSSION

Thus, we believe that the cytokine system is activated in patients with CP. Its dysfunction is accompanied by increased production of pro-inflammatory cytokines IL-2, IL-6, TNF- $\alpha$ , IF N- $\gamma$ , the level of which in the blood serum has a reliable relationship with the main clinical and laboratory parameters recorded in such patients. The results obtained may indicate that the cytokine system is involved in the pathogenesis of CP. An analysis of the cellular immunity indices of patients with chronic pancreatitis in the acute stage showed that the total number of lymphocytes was increased (P <0.01), a decrease in the content of T-lymphocytes-C D Z (P <0.001), T-helper cells CD 4 (P <0.001), a marker of apoptosis CD 95 (P <0.01), a marker of natural killer CD 16 (P <0.05). Elevated levels of cytotoxic cells CD 8 (P<0.001), B-lymphocytes CD 22 (P<0.01) and antigen-presenting HLA - DR cells (P<0.05) were noted . Thus, in patients with chronic pancreatitis, there was a pronounced imbalance in the T- and B- lymphocytic cellular immunity link, indicating the depletion of T-cell lymphocytic immunity, impaired recognition of antigens. The high content of HLA - DR - cells, combined with inhibition of the natural killer population (CD 16), is an unfavorable situation with the possibility of developing autoimmune aggression in patients with CP. A marked decrease in the CD 95 subpopulation may indicate a decreased readiness for apoptosis. In studies of humoral immunity in patients with CP in the exacerbation of the inflammatory process observed increase in the concentration of the CEC to  $82,4 \pm 0.5$  (in the control group  $14.5 \pm 0.8$ , P <0.05), IgG - up to  $16.51 \pm 0.50$  g / l (respectively  $9.39 \pm 0.65$  g /l, P <0.001), IgA - up to 3.42 + 0.14 g /l (2.2 ± 0.18 g /l, P <0.001), IgM - up to 1.8 ± 0.22 g /l (1.13 ± 0.05 g /l, P <0.001). The increase in concentrations of immune globulins is probably due to chronic inflammation of the pancreatic tissue leading to antigenic stimulation, with irritation of the B-cell immunity, and an increase in antibody formation, which





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is a natural response to a persistent pathological process and indicates the preservation of an adequate response to the antigen. The increase in the concentration of CEC, in our opinion, occurs as a result of functional T-link deficiency, deficiency of T-helpers, and humoral immune response to prolonged antigenic stimulation and the presence of an autoimmune component of the disease. Identified violations in various parts of the immune system indicate the development in patients with CP of immune dysfunction, leading to the failure of the immune response. An increase in the concentration of immune globulins determines chronic inflammation in the pancreatic tissue, which supports antigenic stimulation, irritating the B-cell immunity with an increase in antibody formation, with a more pronounced increase in the concentration of CIC, IgA, and IgG in the blood serum found in patients with a frequently recurring form and severe course diseases.

The immunological profile was studied depending on the main etiological factors of CP in the acute stage. The analysis of indicators of the immune status of patients with AHP and BHP revealed a significant decrease (P < 0.001) of complementary activity in both groups compared with the control group, most pronounced with AHP (P <0.05). The state of the cellular immunity in patients with AHP was characterized by a significant decrease in the level of CD3 (P <0.001), with BHP (P <0.01) compared with the control group and more pronounced (P <0.05) with AHP, the level of T-helpers (CD4) with AHP (P < 0.001) and BHP (P < 0.01) compared with the control group, CD16 level with AHP (P <0.01) and BHP (P <0.05) compared with the control group, CD95 level in both groups of patients with CP (P <0.001) compared with the control group with a significant difference between the groups (P < 0.05). There was an increase in the level of T-cytotoxic cells (CD8) with AHP and BHP (P < 0.001) compared with the data in the control group, CD22 with AHP (P <0.01) and BHP (P <0.001) but compared with the control group, the level of HLA- DR with ACP and BHP (P <0.05) compared with the control group. The research results indicate that the dysfunction of cellular immunity is more pronounced in the alcoholic version of CP. The study of the humoral immunity revealed a significant increase (P < 0.001) in the level of CEC in ACP and this indicator was higher than in BHP (P < 0.05). A significant (p <0.001) increase in immunoglobulins of all three classes - IgA, IgM, IgG with ACP and BCP, was noted compared with the control group. At the same time, differences in levels of immunoglobulins between groups were not significant (P>0.05).

#### CONCLUSIONS

Thus, when comparing the indicators of immunological status in patients with AHP and BCP, data were obtained that indicate violations in the immune system in patients in both groups. Significantly more pronounced violations of cellular immunity and a more pronounced suppression of nonspecific resistance were detected in ACP. The revealed changes in the immune system indicate the development of chronic immune deficiency in CP with a decrease in the possibility of an adequate response, which leads to a violation of the apoptotic reaction and probably supports the chronic course of the pathological process with an increase in exocrine insufficiency. The results of our study indicate that cytokines are involved in the pathogenesis of CP. This study has demonstrated that PSCs have the capacity to respond to cytokines known to be upregulated during pancreatitis. Persistent activation of PSCs by cytokines during acute pancreatitis may be a factor involved in the progression from acute pancreatitis to chronic pancreatic injury and fibrosis (8). The inflammatory IL-6 is often expressed by multiple cell types within the tumor microenvironment. IL-6 produced in the bone marrow microenvironment to bone metastasis and this cytokine has a strong pro-tumorigenic activity due to its multiple effects on bone metabolism, tumor cell proliferation and survival, angiogenesis, and inflammation .Supporting the role of IL-6 in human cancer is the observation of elevated serum levels of IL-6 and sIL-6R in patients with bone metastasis and their association with a poor clinical outcome. Thus, IL-6 emerges as a key player at all stages of the pathogenesis of pancreatic diseases, including carcinogenesis, and a potential molecular therapeutic target(2,3,6).





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#### CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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#### Table 1. The content of cytokines (PG / ml) in the blood serum of patients with CP with complications

Cytokines	CP with complications (pancreatic cysts ), $n = 27$	CP without complications n = 45	Control, n = 20
IL-1β	1201, 3 ± 1 0 2, 3 ***	6 31 , 2 ± 9 0 , 8 *** ^^^	37.1 ± 5.3
IL-4	2 35 , 1 ± 3 0 , 7 ***	131, 0 ± 1 4 , 5 *** ^^	$40.3 \pm 5.7$
IL-6	1 81 , 1 ± 2 5 , 1 ***	85,1±13,4*** ^^	$28.0 \pm 1.1$
IL-8	5 23 , 5 ± 71 , 1 ***	3 13 , 1 ± 4 3 , 2 *** ^	$41.1 \pm 4.6$
TNF-α	2 29 , 3 ± 3 3 , 7 ***	1 25 , 8 ± 19 , 4 *** ^^	$43.5 \pm 6.1$
IFN-γ	9 08 , 7 ± 1 10 , 7 ***	5 52 , 0 ± 7 7 , 2 *** ^^	38.9 ± 5.5

Note:

\* - differences relative to the data of the control group are significant (\*\*\* -P<0.001), ^ - differences relative to the data of the CP group with complications are significant (^ -P<0.05, ^ - P < 0.01, ^^ -P<0.001)

### Table 2. The content of cytokines (PG / ml) in the blood serum of patients with CP and pancreatic carcinoma of pancreas

Group of surveyed	TNF-α	INF-γ	IL-2R	IL-6
Patients with CP	159 + 19 6 ***	873 + 97 5 ***	1623 + 55 4 ***	139 + 22 3 ***
(n = 40)	109 ± 19.0	020 ± 97.5	1020 ± 00.4	107 ± 22.0
Patients with PC	201 ⊥ 21 / *** ^^^	952 + 85 2 ***	<b>22</b> 12 ± 26 5 *** ^^^	216 + 6 6 *** ^^^
(n = 15)	$291 \pm 21.4$	902 ± 00.5	$2213 \pm 30.3$	$240 \pm 0.0$
Control (n = 25)	$43.5 \pm 6.1$	$38.9 \pm 5.5$	$390 \pm 15.5$	$28.5 \pm 1.1$

Note : \*differences relative to the control group data are significant (\*\*\* - P < 0.001), ^ - differences relative to the CP group data are significant (^^^ - P < 0.001)



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**RESEARCH ARTICLE** 

## **Corporate Social Responsibility in Indian Banking Sector: Study on Selected Banks**

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#### ABSTRACT

Corporate Social Responsibility (CSR) is one of the most important issues in the era of globalization. Considering the importance of CSR the Indian banks are investing money in environmental and social programs which will be beneficial for the society and the banks itself. In the present time CSR is the most interesting topic for the research. CSR was considered as what the companies do for the society apart from the statutory obligation. But now CSR is also coming under statutory requirements of the company. CSR is basically required for the sustainable development. Corporate should not think only about their profit. They have to spend money for the society. The present study is done for the period of 7 years from 2012-13 to 2018-19. To analyse the objectives of the study a sample of 2 Public Sector Banks (PSBs) i.e. State Bank of India (SBI) and Canara Bank and 2 Private Sector Banks (PVBs) i.e. ICICI Bank & HDFC Bank has been taken. The main focus is to understand the trend of CSR expenditure in selected Indian banks.

**Keywords:** Corporate Social Responsibility (CSR), CSR expenditure, Public Sector Banks, Private Sector Banks, Companies Amendment Act, 2013.

#### INTRODUCTION

Traditionally, companies have ultimate responsibility and objective of making profit. But now a days the companies have to satisfy the stakeholders also. So one of the most important factors to satisfy the stakeholder is CSR. They have to work for sustainable development. Due to this the new concept is getting more importance as "corporate social responsibility (CSR)" (İlker Yılmaz, 2013). CSR is a concept where the company works for the benefit of society and other stake holders without profit motive. Now CSR is not a charitable act. According to companies Act 2013 , the companies have to spend 2% of its average net profit for the previous 3 years on CSR if it had in any of those years net worth of Rs 500 crore or more, or turnover of Rs 1000 crore or more, or net profit of Rs 5 crore or more. CSR



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plays a major role for the development of our society as well as economy. Now all the banks are doing CSR activities for the sustainable development. No doubt banking sector is following more statutory obligations in today's world. Indian banks shown significant changes in following CSR activities Indian banks are doing lot of charities since long. But now as it is statutory obligation, the banks have to be more systematic while spending in CSR activities. Social responsibility is not new for Indian banks. The study is mainly focusing on how and how much the Indian banks are spending on CSR activities and what are the CSR initiatives taken by the banks.

#### Literature Review

Eliza Sharma et al. (2013) have done their research on Indian banks for the period from 2009 to 2012. They found that the public sector banks are doing more CSR activities than the private sector banks for the study period. The study was before 2013. So it shows the voluntary CSR activities by the banks. Similarly Namrata Singh et al. (2015)done their analysis for the year 2013-14. They found that CSR activities of Indian Banks are not so good. They basically found the Private sector banks are spending more than the public sector banks for the study period. Rajnish Yadav & Dr. F. B. Singh (2016)have analysed the impact of CSR on the financial performance of the banks. They have taken a period of 2008 to 2016 for the analysis. They have used regression model for the study. They found an overall positive impact of CSR on the financial performance of the banks. But individually it is different. For public sector bank it is insignificant while for private sector it is positively significant on net profit. Also the trends of all the selected banks increasing for the study period. Prabhavathi, K & Dinesh, Dr. G P (2017) analysed the change in the CSR activities by the banks for before and after 2013 CSR Amendment Act. They have taken 41 Indian banks for the period 2012 to 2016 for the study. They used descriptive analysis for the research. They found that the spending on CSR by the banks has been increased after 2013. Also there is an increase in the number of banks spending 2% of the average net profit for the study period. Dutt, Rajul (2018), has done his analysis in SBI for the period of 2014 to 2018. He found an increasing trend in the spending of CSR in SBI for the study period. SBI is spending more in education, healthcare and for skill development in its CSR activities. Kewlani & Bhatt (2019) tried to find the impact of CSR activities of Private and public sector banks on the market price of the bank. They have taken a period of 2014 to 2018 for the study. They found that the trend of CSR in public sector bank is fluctuating but in case of private sector bank it is increasing. There is a negative impact of CSR on market price in case of public sector bank while the impact is positive in case of private sector banks.

#### **Objectives of the Study**

To study the CSR initiatives taken by the selected banks To understand the concept of CSR To study the trend of CSR expenditure in selected Indian banks

#### **CSR** Initiatives and Activities

Now a day CSR is playing a major role in the corporate and financial world. Banks are investing huge amount of money in CSR activities. Before 2013 act banks were voluntarily spending money in CSR. But after 2013 they have to spend as statutory obligation. Most of the banks are preparing their CSR report.

#### State Bank of India (SBI)

SBI does lot of work for the poorer section of the society. SBI is doing the CSR activities from many years. SBI has adopted the Business Responsibility Policy in 2012-13. Sustainability Report published in the year 2015-16 was a comprehensive review of CSR activities for all the stakeholders over the last four years of BR Reporting. Bank has worked in different areas of CSR. During the seven years, i.e. 2012-19, the bank has included various activities under Education, Healthcare, Sanitation, Skill Development and Livelihood Creation ,Environment Protection, Culture, Sports and others under their CSR practices. Apart from that, activities under National donation (Assistance during natural calamities), activities for Person with a disability, Supporting for Women's Health and Welfare, Children's Welfare fund, Support to Rural Self Development Training, Swachh Bharat Mission, SBI Youth for India Fellowship



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program and Supporting India's Defenses Services were taken place. The initiatives under CSR practices of the bank are Green Initiative, Energy Saving Initiative, SBI Gram Seva, Centre of excellence for a person with a disability, etc. SBI had launched a number of projects under different areas such as Umeed, Shishu Raksha, SBI Eye care, Anugraha, Lifeline Express in Healthcare; Bodhsalas, Gyanshala, SBI Udaan, Beti Padhao Kendras in Education; Shravanshakti, Swabhimaan, Samridhi in Empowerment of People with disabilities and Women; SBI Welfare, SBI Corbett in Environment and Sustainability areas for community development during 2012-19.

#### Canara Bank

The Canara bank has multiple CSR activities during the years 2012-19 under Education, Healthcare, Poverty & Nutrition, Skill development, Environment protection, Women empowerment, Swachh Bharat, Financial Literacy, activities for the person with disability & old age and rural development. The various initiatives taken under CSR practices by Canara bank along with some NGOs and different Government institutions are Automatic Roti Making Machine under "Rajasthan Kitchen for School Children", Mid-day meal Programme, 'Retail Mobile Marketing Van' to assist women entrepreneurs, SHGs and artisans to market their products etc. They have started. CanaraVidyaJyothi Scholarship schemes for the meritorious SC/ST Girl Students. This is one of their initiatives in education. They have also started many programmes for disable people. The bank also started Self Employment Training Institutes (RUDSETIs) in 17 states in India in the year 2017-18.

#### ICICI Bank

ICICI Bank have also done lot of CSR activities. It started ICICI foundation for inclusive growth and to expand their CSR activities in 2008. During the study period 2012-19, the bank has implemented various CSR activities in Education, Healthcare, Financial Inclusion, Environment Protection, Skill development and sustainable livelihoods and many more. ICICI Bank had implemented School and Teacher Education Reform Programme (STERP) in collaboration with Chhattisgarh Government on promoting Education in the year 2012-13. ICICI bank spent huge amount for women, education, Swachh Bharat and in Pan-India Programme in the year 2017-18.

#### HDFC Bank

HDFC Bank's social philosophy is "Businesses cannot succeed if the communities they operate in don't". The bank is doing a lot of work in CSR activities. During the financial years 2012-19 the bank had engaged in different CSR activities and made huge amount of expenditure in Environmental Sustainability, rural and social development programmes. It started "Parivartan" in 2017-18 for their major CSR activities. Parivartan focuses on major initiatives such as Rural Development, Healthcare & Hygiene, Promotion of Education, Financial Literacy & Inclusion and Skill Training & Livelihood Enhancement. Under Parivartan Initiatives different developmental programmes like Zero Investment Innovations for Education Initiatives (ZIIEI), Teaching The Teacher' programme (3T), Holistic Rural Development Programme (HRDP), Sustainable Livelihood Initiative (SLI) under Skills Training and Livelihood Enhancement programme and Digidhan under Financial Literacy programme have launched.

#### **Research methodology**

Secondary data has been used for the study. All the secondary data are collected from the annual reports published by the banks, organizational reports, weekly and monthly journals, articles, newspapers, books and different websites. The present study is done for the period of 7 years from 2012-13 to 2018-19 in selected banks. To analyse the objectives of the study a sample of 2 Public Sector Banks (PSBs) i.e. State Bank of India (SBI) and Canara Bank and 2 Private Sector Banks (PVBs) i.e. ICICI Bank & HDFC Bank has been taken. Percentage increase and decrease in CSR expenditure, charts and graphs are used for the analysis.



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#### Data analysis and Interpretation CSR Spending in Public Sector Banks

Table 1 represents the net profit after tax, CSR spending and trend of increase/decrease in CSR spending over the previous financial year by two Public Sector Banks for seven financial years covering from 2012-13 to 2018-19. The table discloses that State Bank of India shows the highest profit and CSR expenditure as compared to Canara Bank during the study period whereas there is a fluctuation in the trend of CSR spending in last 6 years because of rise and fall in net profit and loss in both the banks. The amount of net profit and CSR expenditure of SBI has substantially more than Canara Bank.

Figure 1 shows that SBI has the highest amount of net profit among the two banks during the study period. There is no fixed trend for rise or fall in net profit for public sector banks. However, both the PSBs suffered loss in the year 2017-18. Figure 2 shows that CSR spending of SBI is much more than the Canara Bank during the period 2012-19though in the year 2018-19 Canara bank has spent more than SBI towards CSR. There is no stable trend for increase or decrease in CSR expenditure for PSBs. CSR expenditure of SBI is increasing in the year 2013-14, 2015-16 and 2017-18; however, it decreases in the year 2014-15, 2016-17 and 2018-19. This indicates in every other year CSR expenditure of SBI gone up and down respectively. CSR expenditure of Canara bank has also not steady; it also shows a fluctuating trend like SBI. The figure (3 and 4) shows the graphical representation of increase/decrease in CSR spending of the PSBs over the previous FYs during the period 2013-14 to 2018-19. It can observe that from both the figures (3& 4) that both the PSBs have not static increase or decrease rate in CSR spending of each year in comparison to its preceding year. Both the banks have not doing impressive contribution towards CSR activities.

#### CSR Spending in Private Sector Banks

Table 2 represents the net profit after tax, CSR spending and trend of increase/decrease in CSR spending over the previous financial year by two Private Sector Banks for seven financial years covering from 2012-13 to 2018-19. The table discloses that HDFC bank shows the highest profit and CSR expenditure as compared to ICICI Bank during the study period. HDFC bank is showing an upward trend in net profit and CSR spending whereas ICICI Bank shows an upward and downward trend in both net profits as well as CSR spending. Figure 5 show that HDFC Bank has rising trend of net profit among the two banks during the study period but there is no fixed trend for rises or falls in net profit for ICICI bank. The amount of net profit is also more in HDFC bank than the ICICI bank Figure 6 shows that CSR spending of HDFC Bank is much higher than the ICICI Bank during the period 2012-19. There is no stable trend for CSR expenditure in ICICI Bank where as HDFC Bank has fixed increasing trend of it. The amount of CSR expenditure of HDFC Bank is appreciable in comparison to ICICI Bank.

Figure 7 and 8 shows the graphical representation of increase/decrease rate of CSR spending of the Private Sector Banks in comparison to preceding FY during the period 2013-14 to 2018-19. It can observe from the figure 7 that ICICI bank has mostly decreasing rate in CSR spending (sometimes in negative rate) of each year in comparison to its preceding year but in FYs 2015-16 and 2016-17 it has increasing rate in comparison to preceding year. From figure 8 it can be observed that HDFC bank has positive increasing rate in CSR spending in each FY in comparison to preceding FY. But the trend of increasing rate is not fixed throughout the study period. From both Private Sector Banks HDFC Bank has consistently an increase in CSR spending in comparison to preceding year whereas the CSR spending is not consistently increasing in ICICI bank, in maximum FYs the CSR spending are less than preceding year. Table 3 depicts the comparison of CSR expenditures as a Percentage of the average profit of preceding 3 years of four sample banks for the financial years from 2012-13 to 2018-19. The above table reveals that there has been a significant increase in CSR spending by the four selected banks in year 2013-14 comparison to the previous year from 2012-13. In the year 2014-15 all banks clocked lower CSR expenditure than the previous year. Most of the banks except ICICI Bank expanded their CSR expenditure in 2015-16.In 2016-17, Canara Bank and ICICI Bank has increased their % of CSR expenditure in comparison to Previous year. It shows increased % of CSR expenditure in all banks except ICICI



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Bank in the FY 2017-18 whereas Canara bank spent an appreciable per cent i.e. 8.46% of average net profits of three preceding FYs. During 2018-19 all banks have significant downfall in CSR expenditure.

#### CONCLUSION

This paper analysed that SBI is contributing more in comparison to Canara bank but it is observed that in percentage on preceding 3 years average profit basis Canara bank doing well in selected sample Public sector banks. Out of the two sample Private sector banks HDFC Bank has done commendable work and appreciable expenditure in CSR activities in all aspects as compared to ICICI Bank. Both Public and Private sector banks have voluntarily contributed on various CSR activities under Education, Health, Environment protection and Rural Development programmes prior to the mandatory CSR contribution prescribed in Companies Act, 2013. Private sector banks are more concerned than PSBs in CSR expenditure. After ensuring the prescribed amount i.e. at least two per cent of average net profit after tax during the three immediately preceding FYs of the company, by Regulatory body of CSR Committee (after Companies Act, 2013) has to be investing on CSR activities of the corporate houses, it can be observed (Table 3) that most of the commercial banks have spent a very small proportion of their previous year's average net profit after tax spent on current year CSR activities. However, among Public sector banks Canara bank spent more than 2 per cent of average net profits in CSR activities in the FYs 2016-17 and 2017-18. HDFC Bank consistently spent more than 2 per cent in CSR from the year 2015-16. But SBI and ICICI Bank have not spent the required amount on corporate social responsibility. Banking sector in India is showing interest in integrating sustainability into their business models but its CSR reporting practices are far from satisfaction. The study concluded that the Indian Banks are making serious efforts in CSR activities and initiatives but more initiatives have to be taken by the Indian commercial banks. Despite of regulatory requirements, most of the banks are failing to meet the minimal legal CSR requirements.

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Table 1- Net Profit & CSR Spending of Public Sector Banks during 2012-13 to 2018-2019 Amount (Rs.)in crore

BANKS	S	TATE BANK	OF INDIA		CANARA B	ANK
Financial Years	Net Profit	CSR Spending	Increase/ Decrease in CSR Spending (%)	Net Profit	CSR Spending	Increase/ Decrease in CSR Spending (%)
2012-13	14105	123	NA	2872	11.30	NA
2013-14	10891	148.93	21.08	2438	41.98	271.50
2014-15	13102	115.8	-22.25	2703	30.39	-27.61
2015-16	9951	143.92	24.28	(2813) Loss	32.78	7.86
2016-17	10484	109.82	-23.69	1122	32.68	-0.31
2017-18	(6547) (Loss)	112.96	2.86	(4222.24) Loss	28.53	-12.70
2018-19	862	16.46	-43.20	347.02	23.62	-17.21

(Source: Annual Reports & Business Responsibility Reports of SBI and Canara Bank)

Table 2- Net Profit & CSR Spending of Private Sector Banks during 2012-13 to 2018-19 Amount (Rs.)	in
crore	

BANKS	IKS ICICI BANK			HDFC BANK		
Financial	Net	CSR	Increase/ Decrease	Net	CSR	Increase/ Decrease
Years	Profit	Spending	in CSR Spending (%)	Profit	Spending	in CSR Spending (%)
2012-13	8325	96.57	NA	6726	39.01	NA
2013-14	9810	192	98.82	8478	70.37	80.39
2014-15	11175	174.33	-9.20	10216	81.48	15.79
2015-16	9726	172	-1.34	12296	297.75	265.43
2016-17	9801	182	5.81	14550	305.42	2.58
2017-18	6777	170	-6.59	17486.8	374	22.45
2018-19	3363	92	-45.88	21078	444	18.72

(Source: Annual Reports & Business Responsibility Reports of ICICI and HDFC Bank)





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#### Table 3- Actual CSR Spending as % of the Average Profit of Preceding 3 years

Financial Year	SBI	Canara Bank	ICICI Bank	HDFC Bank
2012-13	1.27	0.33	1.85	0.97
2013-14	1.31	1.24	2.89	1.33
2014-15	0.95	1.06	2.13	1.20
2015-16	1.13	1.23	1.76	3.51
2016-17	0.97	4.21	1.78	2.96
2017-18	1.01	8.46	1.66	3.03
2018-19	0.36	NA	1.05	3.00

(Source: Calculated)



the Year 2012-13 to 2018-19

## during 2012-13to 2018-19



Figure 3 & 4: Increase/ Decrease (%) in CSR Expenditure of SBI and Canara Bank over the Previous **Financial Year** 





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**RESEARCH ARTICLE** 

# Modeling of Adsorbent (ZnO-NPs-AS-Os) with Artificial Neural Network

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#### ABSTRACT

An Artificial Neural Network (ANN) representation was developed to anticipate the bio sorption proficiency of Zinc oxide nano particle deep-seated on activated silica using *Oscimum sanctum*(ZNO-NPs-AS-*Os*) for the confiscation of total As(III) from aqueous solution based on 95 data sets obtained in a laboratory batch study. Experimental parameters affecting the bio sorption succession such as initial concentration, dosage, pH, contact time and agitation were intended. The three layered ANN modeling technique was applied to optimize this process. The Leven berg–Marquardt algorithm (LMA) was found best of BP algorithms with a minimum mean squared error (MSE) for training and cross validation as 0.0012 and 0.0017 respectively. The maximum removal As(III) ions of 98% is obtained at concentration of 0.07N.

Keywords: Artificial Neural Network, Modeling, Ocimum sanctum, Leven berg-Marquardt algorithm, Adsorption





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## **INTRODUCTION**

In waste water treatment various technologies are available such as chemical precipitation, ion exchange, electrochemical precipitation, solvent extraction, membrane separation, concentration, evaporation, reverse osmosis, emulsion per traction and adsorption [1]. Among these technologies adsorption is a user friendly technique for the removal of heavy metals. This process includes the selective transfer of solute components in the liquid phase onto the surface or onto the bulk of solid adsorbent materials. In last two decades artificial neural network (ANN) models have been extensively studied in different fields of engineering, finance with a basic objective of achieving human like performance. The neural networks are powerful tools to identify underlying highly complex relationships from input– output data [2]. ANN derived from the biological counterparts and based on the concept that a highly interconnected system of simple processing elements known as nodes or neurons, enables to learn highly complex nonlinear interrelationships existing between input and output variables of the data-set. In ANN model of system feed-forward architecture namely multilayer perception (MLP) is most commonly used. This network consists of at least three layers namely input layer, one or several hidden layers and output layer.

Each layer consists of a number of elementary processing units known as neurons. Each neuron in the input is connected to its hidden layer through weights. Also there is connection between hidden and output layers. When an input is introduced to the neural network the synaptic weights between the neurons are simulated and these signals propagate through layers and the output result is formed. The main objective is to form the output by the network in such a way that it should be close to the expected output. The weights between the layers and the neurons are modified in such a way that next time the same input will provide an output that are closer to the expected output. Various algorithms are available for the training of the neural networks. Feed-forward back propagation (BP) algorithm is the most versatile and robust technique which provides the most efficient learning procedure for MLP networks. This algorithm is especially capable of solving predictive problems [3-4]. Researchers pointed out that increasing the number of hidden layers enables a trade-off between smoothness and closeness-of-fit.

The greater number of hidden layers improves the closeness- of-fit while a smaller number of hidden layers improve the smoothness or extrapolation capability of the ANN. Single hidden layer with arbitrarily large quantity of neurons is capable of modeling accurately. It is also observed that two hidden layer networks are better than the single hidden layer network for specific problem. Single hidden layer can solve most of the problems for more input variables and outputs. Recently researchers have successfully modeled a three layer feed forward BP network to predict the removal of Cu(II) from industrial lea chate by pumice and Zn(II) from hazelnut shell [5-7]. The present paper deals with a development of a more general and system-independent neural network based on MLP having a single hidden layer trained with BP and Leven berg-Marquardt (LM) algorithms for the prediction of the percentage removal of As (III) from aqueous solution using five different variables under different operating conditions using two different transfer functions in a single hidden layer. Recently, the use of neural networks has gained popularity for modeling biological wastewater treatment processes. The details of the adsorption study of these adsorbents are reported in our earlier publications and the relevant experimental data are taken for this ANN analysis [8-9].

## MATERIALS AND METHODS

#### **Feed-Forward Networks**

The initial ANN model used in this study was feed-forward networks with one hidden layer of neurons. The simplest way to define feed-forward network, all connections point in one direction from the input towards the output layer. Multi-layered perceptrons are feed-forward structures with one or more layers between the input and output nodes. The advantage of multilayer perceptrons (with one or more hidden layer) is that the number of nodes in the hidden layer can be varied to adapt to the complexity of the relationships between input and output variables. One of the experimental objectives of this research was to determine the size of the hidden layer that produces the





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best predictive performance. Feed-forward neural networks (FFN) are found to perform the best for one time-step forecasting. Feed Forward Back Propagation (FFBP) and Leven berg-Marquardt (LM) Algorithm with Input Parameters Para meters such as concentration, dosage, contact time, pH and agitation speed have been evaluated by means of portable instruments and analyzed in the laboratory. In line with the studies carried out, Multi Layer Perceptron (MLP) with Back Propagation (BP) algorithm has been adopted in designing different structures of the neural network. In the multilayer neural network, depending on the pattern of relation between the materials, input is put in first layer (Xi) and the output in the last layer (y) by means of neurons weights (W), bias (b) and the activity algorithm (f(x)) in the middle layer(s).

The network design has been grounded on a combination of information on the parameters effective on the adsorption. In each structure the input information after processing is put through to the next layer(s) through the output of the first layer neurons and finally provided that it is acceptable to the network output. This process goes on as long as a suitable result comes out. In this study several training algorithms and functions embedded in the neural networks toolbox software 2011a were adapted. In this research the data has been divided into two groups randomly and based on the experiences on the part of other researches and trial and error has been taken to all stages training data, accounting for 70% training and testing data making up 30 percent of the total data. The sigmoid simulating tangent and linear purelin algorithms were applied in operating the neural network. Moreover for each simulating algorithm training rules such a Leven berg Marquate is subjugated. It is worth mentioning that the input, middle and output neuron simulating algorithms were considered identical.

In this regard, studies also implied that the simulating algorithms being the same, more satisfactory results come out, as opposed to the simulating algorithms corresponding to different layers. The adequacy of the ANN is evaluated by considering the coefficient of determination (R<sup>2</sup>) and also the values of root mean square error (RMSE) represented in equation 1 and 2. The acceptance criterion rests on the quantitative error passing into the calculations and observations including maximum R<sup>2</sup> and minimum RMSE. The present work deals with a development of a more general and system-independent neural network based on Multi Layer Preceptron (MLP) having a single hidden layer trained with Feed Forward Back Propagation (FFBP) and Leven berg-Marquardt (LM) algorithm for the prediction of the percentage removal of As(III) from aqueous solution using five different variables under different operating conditions using two different transfer functions in a single hidden layer[10-13].

$$RMSE = \sqrt{\frac{\sum_{i=0}^{n} (actual - pridicted)^{2}}{n}}$$
(1)  
$$R^{2} = 1 - \frac{\sum_{i=0}^{n} (actual - pridicted)^{2}}{\sum_{i=0}^{n} (actual - average)^{2}}$$
(2)

## **RESULTS AND DISCUSSION**

A three-layered Artificial Neural Network (ANN) model was more advanced to foretell the removal efficiency of As (III) ions from aqueous solution with *Ocimum sanctum* (Zn O-NPs-AS-*Os*).For the present study a total of 95 points have been used to train the neural network, of which 67 points are chosen for training and 14 points are chosen for validation and 14 points for testing. Total iteration number was set as 1500 at 7 epochs for the learning algorithms and the performance goal is set at 10<sup>4</sup> (Figure 1). A Feed-Forward BP was used for modeling the experimental design for predicting the removal capacity of As (III). The experimental design used in this research work was based on one factor experiment at a time. The data and their related statistics are given in table 1.The network is tested with different number of neurons to find the optimal number of neurons at the hidden layer by observing the least mean squared error. Thirty two neurons are selected in the hidden layer when mean square error starts decreasing. Learning and momentum parameters are set at 0.20 and 0.10 respectively during the training phase. Then network is





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trained till minimum mean square error is observed (Table 1). A mean square error of 0.0012 is observed at epoch number 7 (Figure 1). Training was stopped at this point and weights have been frozen for network to undergo testing phase with neuron number 32 (Figure 2). A high degree of correlation between target and output efficiency of 100% observed. Coefficient of determination with R<sup>2</sup>=0.9846 for training data set (Figure 3). When the network is well trained testing of the network with testing data set and validation is carried out. A high degree of correlation R=0.9752 and R=0.983 are obtained with least MSE of 0.0012 In the field of machine learning a confusion matrix also known as a contingency table or an error matrix is a specific table layout (Figure 4) that allows visualization of the performance of an algorithm. Each column of the matrix represents the instances in a predicted class, while each row represents the instances in an actual class. This demonstrates how a confusion matrix can be used to assess the performance. All dominant diagonal elements represented in the green and blue cells (67, 14, 14) on the confusion matrix represents the classified data with 100 percentage performance while the off-diagonal (red cells) represents the misclassified data. This error histogram graphically represents (Figure 5) the distribution of data and a plot of the number of data points in each 20 bins. Experimental histogram depicts zero error after repeated trials of 20 instances. The correlation coefficient (Figure 3). confirms the degree of linear dependence of two random variables.

An added variable plot illustrates the incremental effect on the response of percentage removal by removing the effects of all other terms. The slope of the fitted line is the coefficient of the linear combination of the specified terms projected onto the best-fitting direction (R=0.9846).Introduction of this knowledge-based systems is efficient and this green approach confirmed the prediction of percentage adsorption efficiency for the removal of As(III) ions. The present piece of work demonstrates the successful removal of As(III) ions from the aqueous solutions using *Ocimum sanctum* (Zn O-NPs-As-*Os*) with maximum removal efficiency (98.08%). The three layered ANN modeling technique was applied to optimize this process. The Leven berg–Marquardt algorithm (LMA) was found best of BP algorithms with a minimum mean squared error (MSE) for training and cross validation as0.0012 and 0.0017 respectively. The maximum removal As(III) ions of 98% is obtained at concentration of 0.07ppm, absorbent dosage to 3g, contact time 30 min and agitation speed of 250 rpm at pH 6. The correlation coefficient (R=0.9846) confirms the degree of strong dependence of two random variables. The present outcome recommends that Zn O-NPs-AS-*Os* synthesized in a inventive green method may be used as an economical and effectual adsorbent for the confiscation of As(III) ions from aqueous solutions. The power of the proposed neural isotherm models lies in the universality of its application. The ability of a single unifying model capable of representing data for all recognized types of adsorption isotherm models is an achievement that classic adsorption isotherm models cannot attain individually [14-16].

## CONCLUSION

The (ZNO-NPs-AS-Os) used as a low-cost adsorbent showed good adsorption performance for removal of As(III) ions from aqueous solutions. Batch adsorption experiments showed that optimal operating initial concentration of 0.07ppm, pH of 6, an adsorbent dosage of 3 g and agitation speed of 250 rpm and contact time of 30 min was found to be sufficient to achieve equilibrium. The correlation coefficient (R=0.9846) confirms the degree of strong dependence of two random variables. The optimal neuron number for the LMA was determined to be 32hidden neurons with MSE of 0.0012 with a tangent sigmoid transfer function (tansig) at hidden layer and a linear transfer function (purelin) at output layer.

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Training Algorithm	Max (MSE)	Min (MSE)	Max (R2)	Min(R2)
Levenberg-Marquardt	0.0507	0.0012	1	0.9846

#### Table 1 The Performance of LMFFBP Network For 5-32-1 Type of ANN







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**RESEARCH ARTICLE** 

# A Retrospective Study of Psoriasis Severity and Prevalence of Comorbid Conditions in a Tertiary Care Hospital of Salem District, Tamilnadu

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## ABSTRACT

To study the prevalence of comorbid conditions in a tertiary care hospitals of Salem district, Tamil Nadu India. This retrospective study was conducted for a period of 6 months from November 2018 to April 2019, in which all kinds of information of psoriasis patients were collected from a total of 300 cases in different hospitals on the basis of inclusion and exclusion criteria. Majority of psoriasis patients were found to be males 51% and females 49%. Patients mostly affected were in age ranges of (41-60) and majority of them were illiterate. Out of 300 patients 207 patients had psoriasis vulgaris, and 48% patients were affected for a period of 1-5 years and the most areas affected were knees. The most common factor that triggers the worsening of Psoriasis is stress, our study shows that 54% patients were with comorbidities and 46% patients were without comorbidities. We have analyzed that out of 161 patients with comorbidities,75% had Diabetes mellitus,32% had Hypertension,10% Psoriasis Arthritis,2% Airborne contact dermatitis,3% coronary artery disease,17% had one or more other comorbidities. Majority of 67% prescriptions were prescribed with oral and topical therapy and rest were prescribed with oral, topical and phototherapy. In this study,42% cases were prescribed with Chlorpheniramine maleate, Methotrexate and Folic acid,20% with prednisolone, Chlorpheniramine maleate and Multivitamin,19% with Methotrexate, Folic acid, Cyclosporine and Multivitamin,14% with Methotrexate, Folic acid and Multivitamin and 4% with Apremilast and Rantidine. The most commonly prescribed Topical drugs were Liquid paraffin 35%, followed by Diprovate 9%, Ionex T shampoo 18% Candid dusting powder 7% and 17% patients were prescribed with both Liquid paraffin and Beta gel, followed by 14% patients were prescribed with Tenovate ointment and Liquid paraffin. In the Retrospective study among 300 patients 76% of patients were found to have higher incidence of anemia, followed by 6% patients with Hypertension while administering Cyclosporine and 2% of patients were found to have skin itching with Beta gel.

Keywords: Retrospective, Psoriasis, Prevalence, Comorbidities





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## INTRODUCTION

Psoriasis is a T cell mediated chronic inflammatory disorder of the skin which is painful and disabling disease seen in 3.5% of the population .This condition negatively impacts on patients quality of life. Psoriasis is an immune mediated inflammatory disease characterized by the common features of erythema, skin thickening, scaling, and lesions in hands, fee, scalp and genital areas. Multiple observational studies have demonstrated that psoriasis is a systemic disease [1]. The most common systemic disease which is affected in psoriasis patients are hypertension, diabetes mellitus and cardiovascular disease. Recent studies found that psoriasis associated hypertension is the most common comorbidities in psoriasis patients. Inflammatory cells and pro-inflammatory cytokines contribute both to the development of psoriatic lesions and to the breakdown of atherosclerotic plaques. Patients with mild and severe psoriasis have higher level of C -reactive protein. Based on the symptoms of psoriasis they are divided into five types such as Plaque, Guttae, Inverse, Pustules, Erythrodermic and Psoriatic arthritis [2]. The key factors which because psoriasis is immune system and genetics. In case of psoriasis white blood cells known as T cells are mistakenly attack the skin cells and speed up the skin cell production. Goal of therapy of psoriasis is to reduce or clear the lesions, erythema, papules and plaques as well as scales. The (PASI) psoriasis area and severity index) is a reliable method to identify the clinical severity of psoriasis. Topical treatment for mild to moderate psoriasis include cortecosteroids, vitamin D analouges, tezarotine, Methotrexate remains as an effective therapeutic approach for psoriasis [3].

## METHODOLOGY

The Retrospective study was conducted to assess the psoriasis severity and prevalence of comorbid conditions among all types of psoriasis patients in a Tertiary care hospital of Salem district for a period of six months from (November 2018 – April 2019) the case sheets were collected from dermatology department of VMKV Medical college and hospital Salem district Tamil Nadu. The 300 cases were analyzed to examine the prevalence of comorbid conditions of psoriasis which includes both male and female. Data collections were done by random method on the basis of inclusion and exclusion criteria (pregnant women and lactating mothers)

## **RESULTS AND DISCUSSION**

The 300 consecutive patients of psoriasis were included in this study. All types of psoriasis patients were included and cases were collected from dermatology department of VMKV Medical college hospital Salem district Tamil Nadu. The purpose of this study is to conduct a detailed analysis on psoriasis patients and clinical severity of the disease. The study mainly focuses on the comorbidities of psoriasis. Out of 300 cases 151 (51%) were males and 149 (49%) were females. The data shows that more male patients are more affected with psoriasis when compared with females. In this study, majority of patients were affected with psoriasis vulgaris 207 (69%) followed by 35 (12%) which involves scalp and area behind the ears, especially elbows and knees, and the least percentage was found in patients with nail psoriasis 8 (3%). The data's were shown in Table 1. On the contrary Sunil Dogra *et al* concluded the study and found out 69% were affected with Psoriasis Vulgaris [4]

#### Distribution Based on Severity of Psoriasis

The 300 patients were diagnosed with mild, moderate, severe symmetrical lesions of psoriasis on various parts of body by the dermatologist, while assessing the severity 29% were mild followed by 39% were found to be moderate and 31% cases were severe. Howa Yeung *et al* performed a population based study in the prevalence of major medical co-morbidity and proved that majority of patients had mild psoriasis [5]. Out of 300 patients, most affected areas are knees 77 (26%) and elbows 63 (21%) followed by leg 51 (17%), hand 42 (14%), foot 34 (11%), scalp 18 (6%), nail 9 (3%), genitals 6 (2%).The data's were shown in the Table: 8and corresponds to the findings by various







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literatures such as Golnaz Sarafian *et al* who conducted a study on clinical management of psoriasis and reported that most of the affected areas are knees and elbows.

#### **Distribution Based on Trigger Factors of Psoriasis**

In this study trigger factors were evaluated such as stress 39%, temperature 32% and sunburn 28% and temperature changes were reported to be the most common trigger factors for the exacerbation or worsening of psoriasis. Golanz Sarafian *et al* performed the same study and reported that stress is the most common trigger factor [6].

#### **Distribution Based on Rates of Comorbidities**

Among 300 patients, 161 patients were found with comorbidities (54%) and 139 patients without comorbidities (46%). It has been found that psoriasis patients are reported with maximum number of comorbidities. The Distribution of various co-morbid conditions in our Study was shown that among 300 patients, 40 patients was found to have DM (75%), 51 patients had SHTN (32%), followed by 20 patients SHTN With DM (12%), 16 patients PA (10%), 8 patients had PA+HTN (5%), 6 patients had PA +DM(4%), 5 patients had CAD (3%), 4 patients had ACD (2%), 1 patient had CAD+SHTN (1%). The data's were shown in Table 3.

#### Gender Wise Distribution Based on Comorbidities

Out of 300 cases 161 patients were analysed with cormorbid conditions and among that 76patients were male and 85 patients were female; the prevalence of comorbid condition is more in females than males. In an Indian study conducted by Thomas *et al* reported that females have higher prevalence of co-morbid conditions when compared to males [7].

#### **Distribution Based on Treatment of Psoriasis**

Out of 300 patients, maximum number of 200 patients (67%) was combined with Oral and Topical Therapy, only 33% patients were treated with Oral, Topical and Phototherapy. Out of 300 cases, 126 cases were prescribed with combination of Chlorpheniramine maleate + Methotrexate + Folic acid (42%) followed by 61 were prescribed with combination of Prednisolone + Chlorpheniramine maleate + Multivitamin(20%), 58 were prescribed with combination of Methotrexate Folic acid + Cyclosporine + Multivitamin(19%), 43 were prescribed with combination of Methotrexate Folic acid + Cyclosporine + Multivitamin(19%), 43 were prescribed with combination of Methotrexate + Folic acid + Cyclosporine + Multivitamin(19%), 43 were prescribed with combination of Methotrexate + Folic acid + Cyclosporine + Multivitamin(19%), 43 were prescribed with combination of Methotrexate + Folic acid + Cyclosporine + Multivitamin(19%), 43 were prescribed with combination of Methotrexate + Folic acid + Cyclosporine + Multivitamin(19%), 43 were prescribed with combination of Methotrexate + Folic acid + Out of 300 cases, the most common Topical drugs prescribed for the patients were Liquid paraffin for 104 patients (35%),followed by Diprovate for 28 patients (9%), Ionex T Shampoo for 54 patients (18%),Candid dusting powder for 21 patients (7%),51 patients were prescribed with combination of Liquid Paraffin +Beta gel (17%) and 42 patients were prescribed with combination of Tenovate ointment +Liquid Paraffin (14%).The data's were shown in the Table:5

Out of 300, prescriptions higher incidence of anemia was found with Methotrexate 227 (76%) as an adverse effect followed by 18(6%) patients have Hypertension as the side effect of Cyclosporine and the least incidence of skin itch was found with Beta gel 6(2%) as an adverse effect. The data's were shown in Table: 6

## CONCLUSION

Psoriasis is an immune mediated noncommunicable common skin disease which rapidly develops the life cycle of skin cells were there is no cure for psoriasis but we can reduce the symptoms. Psoriasis typically worsens because of trigger factors such as stress, temperature and sunburn. Psoriasis is now considered as the systemic disease associated with various comorbid conditions which include Diabetes, Hypertension, Cardiovascular diseases, Psoriasis Arthritis, such comorbid conditions linked with psoriasis are associated with increasing rate of morbidity and mortality. 300 consecutive patients of psoriasis were included in this study. This chronic disease not only reduce standard of living but also causes an exorbitant amount for the treatment. Treating psoriasis and their associated



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comorbid conditions from the beginning can manage the symptoms and improve the quality of life of the patient. Therefore physicians should aware of these comorbid diseases to provide more care to the medical patient mainly those facing severe diseases.

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S. No	Types	Number of Patients	Percentage (%)
1.	Psoriasis Vulgaris	207	69
2.	Palmoplantar Psoriasis	15	17
3.	Guttate psoriasis	35	12
4.	Nail Psoriasis	08	03
	Total	300	100

#### Table 1: Distribution Based on the Types of Psoriasis

#### Table 2: Distribution Based on Psoriasis Lesions

S. No	Affected parts	Number of Patients	Percentage (%)
1.	Knee	77	26
2.	Elbow	63	21
3.	Leg	51	17
4.	Hand	42	14
5.	Foot	34	11
6.	Scalp	18	06
7.	Nail	09	03
8.	Genitals	06	02
	Total	300	100



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Table 3	Table 3: Distribution Based on Comorbidities						
S.NO	Comorbidities	Number of Patients	Percentage (%)				
1	Diabetes Mellitus	40	75				
2	Systemic Hypertension	51	32				
3	Psoriatic Arthritis	16	10				
4.	Air borne Contact Dermatitis	4	2				
5	Coronary Artery Disease	5	3				
6	Systemic Hypertension + Diabetes Mellitus	20	12				
7	Psoriatic Arthritis + Diabetes Mellitus	6	4				
8	Psoriatic Arthritis + Systemic Hypertension	8	5				
9	Coronary Artery Disease with Systemic Hypertension	1	1				
10	Others	10	6				
	Total	161	100				

## Table 4: Distribution Based on Prescribed Systemic Drugs in Psoriasis

S.No	Drugs	Number of Prescriptions	Percentage (%)
1.	Chlorpheniramine maleate + Methotrexate + Folic acid	126	42
2.	Prednisolone + Chlorpheniramine maleate + Multivitamin	61	20
3.	Methotrexate Folic acid + Cyclosporine + Multivitamin	58	19
4.	Methotrexate + Folic acid+ Multivitamin	43	14
5.	Apremilast +Ranitidine	12	4
	Total	300	100

## Table 5: Distribution Based on Prescribed Topical Drugs in Psoriasis

S.No	Number of Drugs in each Prescription	Number of Prescription	Percentage (%)	
1.	Liquid Paraffin	104	35	
2.	Diprovate	28	9	
3.	Ionex T Shampoo	54	18	
4.	Candid dusting powder	21	7	
5.	Liquid Paraffin +Beta gel	51	17	
6.	Tenovate ointment +Liquid Paraffin	42	14	
	Total	300	100	

## Table 6: Distribution Based on Adverse Effect of Drugs in Psoriasis

S.No	Drugs	Effects	Number of patients	Percentage (%)
1.	Methotrexate	Anemia	227	76
2.	Chlorpheniramine maleate	Constipation	9	3
3.	Cyclosporine	Hypertension	18	6
4.	Apremilast	Abdominal pain	7	2
5.	Prednisolone	Weight gain	17	6
6.	Betagel	Skin itch	6	2
7	Cuclosporino+ Mathetrovate	Elevation of liver	16	5
1	Cyclosporner Methotrexate	enzymes	10	5
	Total		300	100







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**RESEARCH ARTICLE** 

# Fish Diversity and Physico-Chemical Studies on Pradhanpat Waterfall Reservoir, Deogarh, Odisha

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## ABSTRACT

On facing the problem of environmental pollution, global warming, globalization, anthropogenic activities to affect the diversity of fishes which is essential to balance ecosystem. The present research work reveals that DEOGARH is blessed with a very nice scenic beautiful waterfall PRADHANPAT and flow of water store in a reservoir which is built with abundant species richness of many fresh water fishes. A fish population is well developed depending on water quality parameters like temperature 28.7°, pH7.37, iron 0.050mg/L, fluoride 0.28Mg/L, chloride 26.00mg/L, nitrate 0.0222mg/L, hardenss 66.00, conductivity 145.5, turbidity 00, total dissolved solids 95.00, alkalinity 66.00, colour clear to evaluate reservoir having rich diversity of fishes. About 21fish species of order- *Cypriniformes, Siluriformes, Perciformes, Cyprinidontiformes*, are recorded in the reservoir helpful for consumers, researchers and fisher community. It needs proper management, utilization and sustainable steps to monitor and conserve the diversity of fishes on Pradhanpat waterfall. To create awareness among the locality to conserve the fish and its habitats.

Keywords: Pradhanpat waterfall reservoir, fish fauna, water quality parameter, conservation status.

## INTRODUCTION

The district DEOGARH, ODISHA is blessed with a very nice scenic beautiful waterfall Pradhanpat situated in the heart of the town. In Odisha both fresh and marine water fishes first studied by Day(1869). Basing on salt tolerance habit the fresh water fishes is divided into three types – (a) fresh water, (b) fresh and brackish waters, (c) fresh, brackish and marine water. Out of 1758 fish species only teleosts fish species is 478 species. Eschmeyer (2005) reported catalog of fishes. About 32,500 species of fishes are found globally (Nelson, 2006). The parameters water quality based on occurrence of species of fishes (Peter, 1987).The toxic chemicals present in water is monitored by





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aliveness of species of fishes (Seth et al., 1967). The presence of fish in India studied about three million B.C.ago (Hora,1956). The diversity of fishes is well developed in reservoir due to stable water condition having good socioeconomic value (Battul et al., 2007). The distribution of fish fauna in a reservoir is important for fishery development (Pawar et al., 2006). Due to urbanization, human activities towards environments, pollutants contaminate the 70% quality of water affect on diversity of fishes which is not utilize for consumption of water as per the report of WHO, CPCB, BIS, ICMR in India (Ramakrishnaiah et al., 2009, Jindal and Sharma, 2010). The mathematical equation of water quality index for measurement physico-chemical and biological parameters determine the water quality indices of the reservoir (Yogendra and Puttaiah, 2008). The water quality index first proposed (Horton, 1965 & Brown et al.,1970). The water quality index of water calculate by Weighted arithmetic water quality index (WAWQI), National sanitation foundation water quality index (NSFWQI), Canadian Council of Ministers of the Environment Water Quality Index (CCMEWQI). There is less research work on freshwater fish fauna in reservoir need more investigation work helpful for more productivity benefit for socio-economical fabric of Asian countries (Sharma and Navak,2001). About 20,000 species of freshwater fishes are found in dams, lakes, reservoirs in the world from which 2179 fishes in India studied by Day (1978), Khanna (1992), Suresh(2003), Jayaram (1994) and price(1978). India need a matter of more investigation on freshwater fish fauna. Depending on impmpact of environment the fish species vary in size, shape, life span, growth (Jhingran, 1977). The diversity of freshwater fishes is highest in North-Eastern India (Sarkar et al, 2008). The diversity of fishes and species richness is based on the physico-chemical characteristics of fishes. The fish present in fresh water reveals the occurrences of other aquatic bodies indicates the quality of water benefit for consumption. About 186 fresh water fish species having 11 orders,33 families,96 genera are reported in Odisha region (Sarkar et al., 2015). The predatory and weed fishes is dominant over all species in the fish diversity(Pati,2008).

Substantial studies on the diversity of fishes on the Pradhanpat waterfall reservoir about 20 species are noted which all are economically important helpful for socio-economic status of fisher community. The families of fisher community are under below poverty line. The present investigation of the reservoir report data on diversity of fishes are the main objectives and a key role to conserve the fish recorded present in that reservoir. The fish species collected are identified by diversity indices like Shannon-weiner index(H), Simpsons dominance index (D) simpsons index of diversity (1-D). To evaluate the conservation status by conservation assessment and management plan(CAMP,1998). The analysis of Physico-chemical parameter of water by standard methods of APHA (1989), Tridevi and Goel (1986). The reservoir contain many fishes like *Amblypharyngodon* sp.(pathari), *Barilius* sp.(bahari), *Chela* sp.(jaradi), *Cirrhinus* sp.(pohala), *Labeo* sp.(pohala), *Labeo* sp.(rohi), *Puntius* sp.(karandi), *Parluciosoma* sp.(jodda), *Puntius* sp.(kuji karandi), *Puntius* sp.(sarana), *Rasbora* sp.(singi), *Acanthocobitis* sp.(gentu), *Mystus* sp.(kantia), *Wallgo* sp.(balhia), *Clarias* sp.(magur), *Heteropneustes* sp.(singi), *Channa* sp.(chenga), *Channa* sp.(gadisha), *Mastacembelus*(todi), *Macrognathūs* sp.(balitodi) are present in reservoir of Pradhanpat waterfall, district DEOGARH, Odisha

## MATERIALS AND METHODS

The present research work is done during the month October 2018 to march 2020. The Pradhanpat waterfall is one of the part of western Odisha situated latitude 21.533 degree N 84. 733 degree E . The water flow from the top of the hill 26 ft. height and the running water store in a reservoir at samantarapalli which cover 33 acre area in which number of fresh water fishes are alive due to physico-chemical parameters of water is suitable for growth of fishes. .The water temperature, dissolved oxygen, pH are examined in the field and other parameters like inorganic nutrients, fluoride, chloride, hardness, alkalinity, nitrate are analysed in the District level water testing laboratory, Deogarh. A survey work is done on the study area from month October, 2018 to March, 2020 by physical verification interview with local fisher community. The water samples collect quarterly from different points of Pradhanpat waterfall and tested at District water testing laboratory, Deogarh. Fish samples are collected carefully with the help of local fisher community using cast nets, drag nets, gill nets, scoop net, basket trap with take immedieate photograph of fish





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species before preserve in formalin because formalin decolorizes the samples and carried in separate container .Specimens are take laboratory for further identification as per Talwar and Jhingran(1991):Jayaram(1999); Vishwanath (2002).To reduce stress condition of fish species acclimatize in a tank for 2 to 3 days. The blood is drawn below the head by using disposable syringe within 24 hours to evaluate the haematological parameters of fish species. Then the specimens are preserved 10% formalin in a container. Collections of water samples in a air tight polypropylene bottles quarterly from Pradhanpat waterfall reservoir. On the field by hydro thermometer measure the temperature of air. pH of water measured by pH meter, conductivity meter measure the conductivity of water. Other inorganic nutrients like dissolved oxygen, free carbondioxide, alkalinity, chlorinity, phosphors, nitrogen, calcium, magnesium and hardness are tested in the District water testing laboratory, Deogarh.

## **RESULTS AND DISCUSSION**

On present collection about 21 species fresh water fishes are repoted on Pradhanpat waterfall reservoir. Cypriniformes have highest diversity with 1 families, 10 genera, 21 species. Siluriformes (5-families, 8-genera, 5-species), Perciformes (3families,3 genera,5 species), Cyprinidontiformes (1 family,1genera,1species). The recorded fresh water fishes are Amblypharyngodon (pathari), Barilius sp.(bahari), Chela sp.(jaradi), Cirrhinus sp.(pohala), Labeo sp.(pohala), Labeo sp.(rohi), Puntius sp.(karandi), Parluciosoma sp.(jodda), Puntius sp.(kuji karandi), Puntius sp.(sarana), Rasbora sp.(karandi), Acanthocobitis sp.(gentu), Mystus sp.(kantia), Wallgo sp.(balhia), Clarias sp.(magur), Heteropneustes sp.(singi), Channa sp.(chenga), Channa sp.(gadisha), Mastacembelus (todi), Macrognathūs sp.(balitodi), Anabas sp. (Kau) are present in reservoir of Pradhanpat waterfall. Below the rocks and stones the small size fishes are hide where as large size fishes are found deeper region. The recorded water sample parameter of Pradhanpat waterfall reservoir having pH 7.37, Temperature 28.7°c., Iron 0. 054 mg /L, Fluoride o.28 mg/L , Chloride 26.00 mg/L ,Total hardness 66.00 mg/L, Alkalinity 66.00 mg/L, Total dissolved solids 95.00 mg/L, conductivity 145. 5, Turbidity 00, Nitrate 0.0222 mg/L. The productivity of water increases depends on the presence of basic nutrients Nitrogen and Phophorus. Seasonal variation of water takes place due to moderately rich of nutrients. A number of fresh water fishes are suitable grow in Pradhanpat waterfall reservoir having economically importance. The pH and dissolved oxygen are not contaminate the water quality of the reservoir. It needs a sustainable management to investigate more species of fishes and save the fish fauna of the reservoir. For the conservation of fishes an application of technique in situ cultivation of fishes for sustainable management of fish fauna of the Pradhanpat waterfall reservoir.

## CONCLUSION

The Pradhanpat waterfall reservoir having a huge amount of fishes which critically faced problem by activities of human. It needs a scientific training to fisher community, awareness among them, give information about Govt. plan and programme about culture of fishes, avoid fishing in immature condition of fish, give loan with subsidies to get high yield and conservation measures by Dept. of fishery or minimizing anthropogenic activities.

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S.N	Parameter	Desirable Limit	Premissible Limit	Pradhanpat	Pradhanpat
		(As per BIS)	(As per BIS)	waterfall	Waterfall reservoir
1	Colour		•••••	Clear	Clear
2	Ph	6.5	8.5	7.43	7.37
3	Temperature			28.0 C	28.7 C
4	Iron mg/L	0.30	1.00	0.113	0.054
5	Fluoride, mg/L	1.00	1.50	0.20	0.28
6	Chloride,mg/L	250.0	1000.0	16.00	26.00
7	Total Hardness, Mg/L asCaCO3	300.0	600.0	52.00	66.00
8	Alkalinity,m/L	200.00	600.00	46.00	66.00
9	TDS, mg/L	500	2000	69.00	95.00
10	Conductivity			106.10	145.5
11	Turbidity(NTU)	01	05	00	00
12	Nitrate,mg/L	45.00	45.00	0.1594	0.0222

#### Table 1 ANALYTICAL REPORT OF WATER SAMPLE OF PRADHANPAT





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## Table 2. LIST OF FISHES ON PRADHANPAT WATERFALL RESERVOIR

S.N	ORDER	FAMILY	NAME OF THE FISH	COMMON NAME OF FISH
1	Cypriniformes	Cyprinidae	Amblypharyngodon mola	Pathari
2			Barilius barna	Bahari
3			Chela fasciata	Jaradi
4			Cirrhinus reba	Pohola
5			Labeo rohita	Rohi
6			Puntius conchonius	Karandi
7			Parluciosoma daniconius	Jodda
8			Puntius punctatus	Kuji karandi
9			Puntius sarana	Sarana
10			Rasbora daniconius	Kerandi
11	Cyprinidontiformes	Aplocheilidae	Apolocheilus panchax	Dandikiri
12	Siluriformes	Balitoridae	Acanthocobitis botia	Gentu
13		Bagridae	Mystus gulio	Kantia
14		Siluridae	Wallago attu	Balia
15		Claridae	Clarias batrachus	Magura
16		Heteropneustidae	Heteropneustes fossilis	Singi
17	Perciformes	Mastacembelidae	Macrognathus pancalus	Todi
18		Channidae	Chnna punctata	Gadisa
19			Channa striata	Seola
20			Channa marulius	Chenga
21		Anabantidae	Anabas cobojius	Kau







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**RESEARCH ARTICLE** 

# A Systematic Analysis of Medicinal Plants and Its Associated Knowledge among the Indigenous Communities of Tamil Nadu

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#### ABSTRACT

Medicinal plants play a critical role in primary health care and treatment of ailments in various parts of the world. The indigenous tribal communities of Tamil Nadu exhibit extensive therapeutic knowledge of medicinal plants use in the treatment of various ailments. The present study aims at assimilating and summarizing medicinal plants usage by the indigenous tribal communities of Tamil Nadu. A total of 354 medicinal plants belonging to 98 families were identified which were used for the treatment of various ailments. The ailments were categorized into 23 categories depending on the type of body system treated. The highest number of medicinal plants (187) were used in the treatment of Gastro-intestinal ailments, followed by Dermatological infections (120) and the lowest number recorded as Abortifacient and in the treatment of Mental disorders (2). Herbs and leaves were among the most frequently used, life form and parts respectively for the treatment of ailments. The highest relative importance value was observed in Euphorbia tirucalli (97.06), Achyranthes aspera and Sida cordifolia (94.12) and Asparagus racemosus (91.67) etc. and the lowest value exhibited by several medicinal plants with a relative importance value of 7.11. The highest fidelity level was observed in Acalypha indica and Leucas aspera (55.2%) which were used in single ailment category with multiple informants. The systematic analysis revealed the dependence of indigenous tribal communities on plant-based knowledge system for treatment of particular ailment. The study infers the versatility of Euphorbia tirucalli and preference of Acalypha indica and Leucas aspera throughout the entire region for their therapeutic potential. Further, attempts should be made to study and harness the phytochemicals associated with these plants for the development of new drugs.

Keywords: Ailments, Assimilating, Indigenous, Medicinal plants, Systematic analysis, Tamil Nadu

## INTRODUCTION

Plant resources have been vital in the expansion of human civilization. Resources in the form of food, medicine, material for fire, shelter, cloths have been in the forefront of all cultures and civilizations. Among the various plant





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resources, medicinal plants are regarded crucial in health care, with about 80% of the world inhabitants relying on traditional medicines involving the use of plant extracts or their active principles for primary health care needs [1]. The earliest record of medicinal plants written on clay tablets in cuneiform date back from 2600 BC of Mesopotamia describing the use of oils from plants for the treatment of ailments such as coughs and colds, parasitic infections and inflammation <sup>[2]</sup>. In India the traditional medicinal systems *i.e.* Ayurveda have found mention in the ancient Vedas and other scriptures developed between 2500 and 500 BC with famous medicinal plants including Azadirachta indica (Neem), Centella asiatica (Gotu Kola), Cinnamomum camphora (Camphor), Elettaria cardamomum (ela or cardamomum), Rauwolfia serpentina (Indian snake root), Santalum album (Sandalwood) and Withania somnifera (Aswargandha) [3]. Fifty percent of all drugs in therapeutic use are represented by natural product and their derivatives with higher plants representing not less than 25% [2]. In the last few decades dozen potent drug have been derived from flowering plants viz., diosgenin a steroidal sapogenin from Dioscorea spp from which anovulatory contraceptive have been derived [4],[5], reserpine and other anti-hypertensive and tranquilizing alkaloids from Rauwolfia species [6],[7],[8],[9],[10],[11] Pilocarpine to treat glaucoma and dry mouth, derived from a group of South American trees (Pilocarpus spp.) in the Citrus family [12]; two powerful anti-cancer agents from the Rosy Periwinkle (Catharanthus roseus) [13]; laxative agents from Cassia sp. [14] and as a cardiotonic agent to treat heart failure from Digitalis species [15].

India with 4 biodiversity hotspots and 10 biogeographic regions provides immense plant wealth to the indigenous people. As per the release of Plant Discoveries 2018 by Botanical Survey of India, there is a total of 32,584 plant species in India (excluding Bacteria, Virus and Fungi) of which 18,532 species belongs to angiosperms, 81 species to gymnosperms, 1293 species to pteridophytes, 7396 species to algae, 2754 species to bryophytes and 2528 species to lichens, accounting for approximately 12.65 percent of total recorded plant species in world. According to Foundation for Revitalization of Local Health Traditions (FRLHT) and National Medicinal Plant Board (NMPB) there are 6560 plants species used as medicinal plants in the country. The annual demand of medicinal plants in India was estimated at 3,19,500 Metric Tons. In all 960 medicinal plants are traded, out of which 178 have annual consumption of more than 100 Metric Tons [16]. Tamil Nadu is endowed with rich biodiversity, right from marine coastal systems in the Gulf of Mannar to terrestrial evergreen forests in the Western Ghats. Tamil Nadu is located between 8° 05' and 13° 34' North latitudes and 76° 14' and 80° 21 East longitudes. Tamil Nadu has a geographical area of 1, 30,058 km<sup>2</sup>, which constitutes about 4 per cent of the country's total area. Tamil Nadu shares the Western Ghats (one of the 25 biodiversity hotspots) with the states of Kerala, Karnataka, Goa, Maharashtra and Gujarat. It shares the Eastern Ghats with the States of Andhra Pradesh and Orissa (ENVIS, Tamil Nadu). Both Eastern and Western Ghats experiences wide range of topography, varied climate favors luxuriant growth of vegetation and forest with number of invaluable medicinal plant species [17],[18]. The wealth of medicinal plants available in this region are exploited by the indigenous communities for therapeutic use despite the availability of modern medicine. However, information on use of medicinal plant in this region for treatment of diseases is fragmented with emphasis on a specific disease or area. Therefore, the current investigation aims at integrating and summarizing medicinal plants usage in Tamil Nadu and, further extending the knowledge of plant resource utility by the indigenous population of this area.

## MATERIALS AND METHODS

Research articles published on the uses of medicinal plants in Tamil Nadu, in scientific journals over the past 10 years were located. The articles were found by online database searches using the keyword phrases 'Medicinal Plants', 'Indigenous people' and 'Tamil Nadu', by examining the reference lists of relevant articles. A total of 35 study sites with their respective tribes were identified from the published articles (Table 1). Data collected was categorized into scientific name, family, common and local name, ailment or disease cured, parts used and habit, major chemical compounds for data analysis and interpretation.



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#### Data analysis

The data were assessed with the help of two indices viz., Relative importance and Fidelity level.

#### **Relative importance (RI)**

Relative importance (RI) is calculated based on the number of pharmacological properties (PH) attributed to each medicinal plant and the number of body systems (BS) it treated. Data on medicinal uses were organized according to the pharmacological properties attributed to each taxon (e.g. analgesic, anti-inflammatory etc.) and to the specific body systems treated (e.g. skin diseases, fever, asthma etc.). The RI was calculated using the following formula  $[19]:RI = \frac{\text{Rel PH} + \text{Rel BS}}{2} \times 100$  Where RI is the relative importance, PH is the number of reported pharmacological properties for the given plant, RelPH is the relative number of pharmacological properties (PH of a given plant/maximum PH of all reported species), BS is the number of body systems treated and RelBS is the relative number of body systems treated (BS of a given plant/maximum BS of all reported species).

#### Fidelity level (FL)

To determine the most frequently used plant species for treating a particular ailment category by the informants of the study area. In this case, each published article was considered as an informant with use reports of a given study area. The Fidelity level is calculated using the following formula [20]: FL (%) =  $\frac{Np}{N}$  X 100 Where Np is the number of use-reports cited for a given species for a particular ailment category and N is the total number of use reports cited for any given species.

## RESULT

The present systematic analysis revealed the use of 354 medicinal plants distributed in 275 genera belonging to 98 families, for the treatment of ailments/conditions by indigenous tribes, herbalists and traditional healers of Tamil Nadu (Commonly used medicinal plants with highest RI and FL levels are exhibited in Table 2). Medicinal plants belonging to the family Fabaceae (40) exhibited the highest number of species followed by Apocynaceae (22), canthaceae (20), Lamiaceae (17), Asteraceae (16), Rubiaceae (14), Euphorbiaceae (13), Amaranthaceae (11), Rutaceae (10), Solanaceae (8), Moraceae (7), Cucurbitaceae and Convolvulaceae (5), Vitaceae, Poaceae, Phyllanthaceae, Capparaceae, Boraginaceae, Bignoniacea, Asperagaceae (4), Ten families represented by 3 species, Twenty two families represented by 2 species and the lowest number exhibited by 46 families represented by 1 species each (Figure 1). These medicinal plants were used for the treatment of various ailments which are classified into 23 ailment categories (Figure 2). The highest number of medicinal plants (187) were used in the treatment of Gastro-intestinal ailments, followed by Dermatological infections (120) and the lowest number recorded as Abortifacient and in the treatment of Mental disorders (2). Some of the diseases or conditions responded to multiple plant species e.g. Skin ailments (treated by 63 species), Fever (treated by 52 species) etc. However, some ailments responded specifically to a particular plant species e.g. Anorexia cured by Cissampelos pareira, Bladder Calculus cured by Phyllanthus maderaspatensis etc. (Table 2). The treatments were used in the form of decoction, extract, juice, paste, powder etc. Among the various life forms, Herbs (150 species) were most frequently used in the treatments of ailments followed by shrubs (104 species), trees (88 species), climbers (75 species), grass (3 species), sub-shrubs (2 species) and aquatic herb (1 species) (Figure 3). Among the plant parts, leaves were found to be most frequently used (36%) followed by whole plant (15%), roots (13%), bark and Seed (7%), flowers (6%), fruits (5%), shoots and stem (4%), rhizome (2%) and essential oil and Gum (0.4%) (Figure 4).

The plants with the highest record of pharmacological properties were *Asparagus racemosus* and *Bacopa monnieri* (17 PH) with a relative pharmacological value of 1.00 (17/17). Further the highest number of body system treated was recorded by *Achyranthes aspera, Euphorbia tirucalli, Phyllanthus maderaspatensis* and *Sida cordifolia* (8BS) with relative body system treated value of 1.00 (8/8). The highest relative importance (RH) value was observed in *Euphorbia* 





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*tirucalli* (97.06) followed by *Achyranthes aspera* and *Sida cordifolia* (94.12) and *Asparagus racemosus* (91.67) etc. and the lowest value was exhibited my several medicinal plants with a RI value of 7.11 (Table 2). The most important plants for each ailment categories were analysed among the 354 reported medicinal plants. For this analysis the plants with less than six use-reports were not considered. A total of 71 medicinal plants were identified among the reported plants, of which 2 species recorded the highest fidelity level of 55.2% (*Acalypha indica* L. and *Leucas aspera* (Willd.) Link.) which were used in single ailment category with multiple *Acalypha indica* informants. The lowest FL of 20.7% was recorded in 17 species viz., *Andrographis echioides, Bacopa monnieri, Blepharis maderaspatensis, Calotropis gigantea, Clitoria ternatea, Delonix elata, Eclipta alba, Grewia tiliifolia, Heliotropium indicum, Ipomoea staphylina, Jatropha gossypifolia, Phyllanthus niruri, Plumbago zeylanica, Ricinus communis, Sida acuta, Wrightia tinctoria* (Table 2).

#### DISCUSSION

The present analysis revealed the use of 354 medicinal plants by the people of this region suggesting their dependency on plants for primary healthcare. The area under investigation falls under part of Eastern and Western Ghats which is recognized as biodiversity hotspots of India, advocating the abundance of medicinal plants available to the indigenous population of this region. Plant parts such as leaves, flower, bark, fruit, stems etc. are used in the form of juice, paste and powder for the treatment of various ailments/conditions. The indigenous people of this region predominantly used medicinal plant belonging to fabaceae, which is one of the most evaluated botanical group for its chemical as well as pharmacological properties [21],[22]. Fabaceae apart from its easy availability is an important repository of chemical components such as flavonoids, alkaloids, coumarins and other metabolites [21], which aids in the treatment of various ailments and body system [23], thus making this family a preferable choice for therapeutic properties over others by the indigenous population. The dependency of the tribal population on medicinal plants is reflected by the number of plants used for the treatment of various ailments (figure 2). Gastrointestinal disorders accounts for the highest therapeutic use of medicinal plants among the indigenous people of this region. Poor hygiene and use of contaminated water [24] are the main cause of gastro-intestinal diseases, however rich diversity and knowledge of medicinal properties of forest wealth among the indigenous people allows them to carry out primary treatment for these disorders. Among the life forms, herbs were most frequently used followed by shrubs and trees (Figure 3) due to its abundance and availability in their environment [25],[26]. Usually it is supported that herbaceous species richness is higher in comparison to other life forms in any natural community which may lead to easy accessibility and utilization of herbs for medicinal purpose then other habits [26], [27], [28]. Among the different plant parts used, the leaves were most frequently used for treatment of ailments (Figure 4). Indigenous communities are known to utilize leaves for the preparation of herbal medicine [26],[29] as they can be collected very easily than underground parts, flowers and fruits [30] also leaves are active in the production of metabolites [31] which are the key ingredient in preparation of medicines.

#### **Relative importance**

Analysis of relative importance revealed *Euphorbia tirucalli* as the most versatile medicinal plant of the study area. This plant is also revered for its medicinal properties in different parts of the world e.g. Brazil against cancroids, cancer, sarcomas, tumors, etc.[32], Java against skin ailment and bone fracture, Indian Malabar and Moluccas (Eastern Indonesia) as an emetic and an anti-syphilitic, Kokan, as a purge [33],[34] and in East Africa, latex is used against tooth-ache, sexual impotence, hemorrhoids, epilepsy, snake bites and cough [32],[35]. The medicinal properties of *Euphorbia tirucalli* is attributed to the presence of ingol ester, triterpenoids, euphorbinol, cycloeuphordenol, ingenol and phorbol esters (diterpenoids), and triterpenoids, hentriacontane, hentriacontanol, beta-sitosterol, Me-ellagic and ellagic acids and kaempferol glucoside [36]. *E. tirucalli* is also reported to act as analgesic [37], anthelmintic [38], tiarthritic [39], antibacterial/antifungal/antimicrobial [40],[41], anti-HIV [42], anti-inflammatory [43], antioxidant [44] and treats various ailments like human-lymphocytes [45], cancer [46], neuropathic pain [47], tumor [48].





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#### Fidelity level

The highest Fidelity Level (FL) for the above plants indicates 55.2% choice for the treatment of specific ailments. Generally, high FLs are obtained for plants for which almost all use-reports refer to the same way of using it, whereas low FLs are obtained for plants that are used for many different purposes [29]. Leaves of *Acalypha indica* L. is used for the treatment of skin disease which is in accordance with Ameenah Gurib-Fakim [49], Gurib-Fakim [50], Lingaraju *et al.* [51], Mutheeswaran *et al.* [52], Rampilla *et al.* [53], Rastogi [54], Seebaluck *et al.* [55] suggesting the use of leaves with oil and other herbs such as black cuminum and *Cardiospermum halicacabum* for external application to treat any disease related to skin ailment. Chinnasamy *et al.* [56] also reported higher FL value (88) for *Acalypha indica* in the treatment of dermatological ailments by the tribal communities in Sathyamangalam wildlife sanctuary. Similarly, *Leucas aspera* (Willd.) Link is also used for the treatment of skin diseases. Xavier *et al.* [57] reported fidelity level of 100% for *L. aspera* in the treatment of skin diseases. Khare [58] reported the use of leaf juice as an external application for psoriasis, chronic skin eruptions and painful swellings. Presence of nectandrin B, meso-dihydroguaiaretic acid, macelignan, acacetin, apigenin 7-O-[6'-O-(p-coumaroyl)-3-D-glucoside], chrysoeriol, apigenin, erythro-2-(4-allyl-2,6-imethoxyphenoxy)-1-(4-hydroxy-3-methoxyphenyl)propan-1-ol, myristargenol B and machilin C, (-)-chicanine, (7R,8R)- and (75,85)-licarin A [59] may be attributed to the cure of skin disease by Prostaglandin inhibitory and antioxidant activities [60].

## CONCLUSION

The present analysis identified a vast majority of medicinal plants used by tribal communities residing in different geographic locations of Tamil Nadu. The results concede the associated knowledge and applications of medicinal plants which is still prevalent among the indigenous communities of this region. However, with the advent of modern medicine, the knowledge based ethnobotanical practices are at risk and could vanish with time. Therefore, an attempt is made to provide cumulative information on the use of medicinal plants and its associated diseases by the indigenous communities. Analysis of data revealed *Acyranthes aspera, Asperagus racemosus, Euphorbia tirucalli* and *Sida cordifolia* as the most convenient plants for therapeutic purpose due to their ability to respond to multiple ailments and body systems. Similarly, preference of *Acalypha indica* and *Leucas aspera* throughout the entire region for treatment of skin related ailments is indicative of their therapeutic potential. Further attempts should be made to study and harness the phytochemical associated with these plants for development of new drugs.

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Table 1.	list of study sites.		
Sl. No	District	Area	Tribe/Traditional healer
1	Ariyalur	Ariyalur	Irular [61]
2	Coimbatore	Marudhamalai Hills	Irular [62]
3	Coimbatore	Karamadai Range	Irulas tribe [63]
4	Cuddalore	Cuddalore	Irular [64]
5	Dharmapuri	Kottur hills	Malayali [65]
6	Dindigul	Palani Hills	Paliyan, Aasariyars [66]
7	Dindigul	Vellimalai hills	Valaiyans [67]
8	Erode	Chennimalai Hills	Malayali & Narikuravar [68]
9	Erode	Hasanur Hills	Iralu tribe [69]
10	Kancheepuram	Kancheepuram	Irulan, Narikuraver, Vathiyas, Mudhalyar and Vaniyars [70]
11	Kanyakumari	Kanyakumari	Kanikkars [71]
12	Krishnagiri	Krishnagiri	Irulas [72]
13	Madurai	Alagar Hills	Valaiyans [73]
14	Madurai	Madurai	Paliyar tribes [74]
15	Madurai	Sadhuragiri hills	Paliyar tribe [75]
16	Madurai	Uthapuram	Traditional healers [76]
17	Nagapattinam	Nagapattinam	Seenthil Valayars [77]
18	Namakkal	Kolli Hills	Malayali tribe [78]
19	Nilgiri	Nilgiri hills	Kota [79]
20	Perambalur	Perambalur	Irulas [80]
21	Salem	Kumaragiri Hills	Palliyar tribes [81]
22	Salem	Servarayan Hills	Malayali tribe [82]
23	Salem	Yercaud Hills	Malayali Tribes [83]
24	Sivagangai	Sivagangai	Traditional medicine practitioners (Vaithiyar) [84]
25	Thanjavur	Thanjavur	Traditional medicine practitioners (Vaithiyar) [85]
26	Theni	Theni	Paliyar Tribals [86]
27	Thiruvannamalai	Jawadhu Hills	Malayali Tribals [87]
28	Tirunelveli	Tirunelveli Hills	Kanikkars [88]
29	Tiruppur	Thirumoorthy Hills	Pulaya Tribes [89]
30	Tiruvallur	Tiruvallur	Pahan and Teli Tribal [90]
31	Tiruvarur	Kudavasal taluk	Traditional healers of Kudavasal taluk [91]
32	Tuticorin	Srivaikundam village	Traditional healers [92]
33	Vellore	Yelagiri hills	Malayali tribals [93]
34	Villupuram	Kalrayan Hill	Malayali tribes [94]
35	Virudhunagar	Shenbagathope	Paliyar Tribes [95]





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## **BIBHUTI BHASHAN DAS**

# Table 2: List of common medicinal plants used by the indigenous people of Tamil Nadu based on Fidelity level (FL) and Relative importance (RI).

SI. No	Botanical Name	Family	Common Name/ Local Name	Uses	Parts Used/ Habit	Major chemical compounds	FL	RI
1	Abrus precatorius Linn.	Fabaceae	Jequirity (ratti)/ Kuntumani	Diuresis, Fever, Sore Throat, Bronchitis and Hepatitis [96]	Leaves/ Herb	Abrin, a toxalbumin, indole derivatives, anthocyanins, sterols, Terpenes, precol, abrol, glycyrrhizin and alkaloids— abrasine and precasine, triterpenoids—abruslactone A, methyl abrusgenate and abrusgenic acid.	41.4	31.37
2	Abutilon indicum (L.) Sweet	Malvaceae	India mallow/ Thuthi	Leg pain, Piles [76]	Leaves/ Herbs	Tannins, β-sitosterol, asparagines, flavonoids, alkaloids, hexoses, n-alkane mixtures (C22-34), alkanol, gallic acid and sesquiterpenes.	41.4	14.22
3	Acalypha indica L.	Euphorbia ceae	Indian acalypha/ Kuppaimeni	Skin allergy and itch [76]	Whole plant/ Herb	Kaempferol, acalyphine, quinine, tannin	55.2	10.05
4	<i>Achyranthes aspera</i> (L.) Blume.	Amarantha ceae	Prickly Chaff Flower / Naayuruvi	Anti-Inflammatory, Cough, Wounds, Otalgia, Haematometra, Haemostasis, Rabies, Poisonous bites [98]	Leaves, Stem, Roots / Herb	Achyranthine, saponins, ecdysterone.	51.7	94.12
5	Acorus calamus Linn.	Acoraceae	Sweetflag/ Vasambu	Analgesic, Diarrhoea, Dysentery, Eczema, Gastritis, Sedative, Stomach Ache, Vomiting, Worms [99]	Rhizom es/ Herb	β-asarone, sesquiterpenes and sesquiterpenes alcohols, choline, flavone, acoradin, 2,4,5-tri-MeO- benzaldehyde, 2,5-di-MeO- benzoquinone, galangin, calameone, acolamone, isoacolamone, epoxyisoacoragermacrone, lutcolin-6,8-c-diglucoside.	27.6	46.08
6	Adhatoda vasica (L.)	Acanthace ae	Malabar nut/ Adathodai	Asthma, Cold & Cough, Leprosy, Piles, Rheumatism, Sore Eyes, Stomach Problems [100]	Leaves, Roots, Flowers and Bark/ Shrub	Phenols, tannins, alkaloids, anthraquinone, saponins, flavonoids, reducing sugars, vasicine, 1, 2, 3, 9-tetrahydro- 5- methoxypyrrol [2, 1-b] quinazolin-3-ol, Vasicinone, Vasicinol, Adhatodine, Adhatonine, Adhvasinone, Anisotine and Hydroxypeganine, betaine, steroids and alkanes.	31.0	49.75





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7	Aegle marmelos (Linn.) Corr. ex. Roxb.	Rutaceae	Wood apple/ Vilvam	Scabies [101]	Fruits/ Tree	Umbelliferone, coumarins, $\beta$ - sitosterol, aurapten, marmin, lupeol, ferro-quinoline alkaloid, /dictamine, marmasin and $\beta$ - sitosterol, $\gamma$ -sitosterol, aegeline, aegelenine, lupeol; sitosterol, rutin, marmesinin, $\beta$ -sitosterol, glucoside, psoralen, aegelinol, furanocoumarin, marmelide, $\beta$ - sitosterol, xanthotoxol, scoparone,	44.8	7.11
8	Aerva lanata (L.) A.L. Juss.	Amarantha ceae	Mountain Knotgrass/ Siru peelai	Astringent, Cough, Demulcent, Diabetes, Diuretic, Emollient, Headache, Kidney Stones, Vermifuge, Wounds [102]	Flowers Roots and Leaves/ Herb	Methylervine, kaempferol, quercetin.	34.5	68.63
9	<i>Albizia amara</i> (Roxb.) Boiv.	Fabaceae	Wheel Tree/ Unja maram	Anti-inflammatory, Astringent, Diarrhea [103]	Leaves and Seeds/ Tree	Macrocyclicspermine alkaloids, echinocystic acids, Saponins, tannins, alkaloids, terpenoids, glycosides, flavanoids, phenols, cardiac glycosides, quinones, Melanoxetin, melacacidin,3'-0- methyl melanoxetin, 3'-0-methyl melacacidintrimethyl ether, Glycosides, tannins, Triterpenesaponins.	27.6	17.16
10	Alternanthera sessilis (L) R. Br. ex Dc.	Amarantha ceae	Alligator Weed/ Ponnakanni	Diabetes, Diarrhoea, Dysentery, Eye Disorders, Fever, Jaundice, Leprosy, Skin Diseases, Snakebite, Stomach Disorder [105]	Whole plant/ Herb	α-Spinasterol, β- spinasterol,stigmasterol.	24.1	65.69
11	Andrographis echioides (L.) Nees in Wall.	Acanthace ae	False Waterwillow / Goburamtha nki	Toothaches [107]	Leaves/ Herb	Echioidinin, pinostrobin, rographidine C, dihydroechioidinin, tectochrysin 5-glucoside, methyl salicylate glucoside, skullcapflavone I 2'- methyl ether, androechin, tectochrysin, β-sitosterol, β- sitosteryl-3-O-β- glucopyranoside, squalene	20.7	7.11
12	Andrographis paniculata (Burm.f.)	Acanthace ae	Green Chireta/ Periyanangai	Dysentery, Joint Pain, Scorpion and Snake bite, Skin Diseases, Viral Fever [108]	Whole plant/ Herb	Andrographolide, bicyclic diterpenoid lactone, kalmeghin.	51.7	48.53





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							T	1
13	Aristolochia indica L.	Aristolochi aceae	Indian Birthwort/ Urithookki	Snake Bite and Scorpion Sting [81]	Roots/ Herb	Aristolochic acid, Aristololactum, Aristololactum- $\beta$ -D-glcicoside, Aristolic acid, Aristoloamide, Methyl aristolochate, Sesquiterpenoids – Ishwarane, Ishwarene, Steroids – $\beta$ sitosterol, sterol glycoside, Napthoquinone- aristolindiquinone.	24.1	10.05
14	Asparagus racemosus Willd.	Asparagac eae	Climbing Asparagus/ Thanneervitt an kilangu	Fevers, Cough, Diabetes, Diarrhoea, Diuretic, Dysentery, Piles, Jaundice, Leucorrhea, Snakebite, Ulcer [96]	Leaves, Roots/ Shrub	Quercetin-3-glucoronide, sitosterol, stigmasterol, sarsasapogenin, sito-sterol D- glucoside, stigmasterol-B-D- glucoside, two sirostanolic and two furostandic saponins.	41.4	91.67
15	Azadirachta indica A. Juss.	Meliaceae	Neem tree/ Vepamaram	Skin Diseases, Eczema, Psoriasis, Healthy Hair, Liver Function, Detoxify Blood and Balance Blood Sugar, Antimicrobial [101]	Whole plant/ Tree	Nimbin, nimbinin, nimbidin.	41.4	53.19
16	Bacopa monnieri (L.) Pennell.	Scrophular iaceae	Brahmi/ Neerpirambi	Astringent, Bronchodilators, Carminative, Digestive, Diuretics, Epilepsy, Fever, Leucoderma, Nervine Tonic, Syphilis, Tumors, Ulcer [97]	Whole plant/ Aquatic Herb	Becoside A & B, betulic acid, betulinic acid, d-mannitol, stigmasterol, β-sitosterol, saponin, stigmastanol, hersaponin, monnierin, nicotine, luteoline and its glucosides.	20.7	87.5
17	Bambusa arundinacea (Retz.) Willd.	Poaceae	Bamboo/ Periya Mungil	Body Coolant, Intestinal Worms [111]	Leaf/ Tree	Taxiphyllin, silicious crystalline, Silicic acid, cholin, betain, nuclease, urease, cyanogenetic glucoside, benzoic acid and cyanogenetic glucoside	24.1	14.22
18	Blepharis maderaspatens is (L.) Heyne ex Rot h	Acanthace ae	Creeping Blepharis/ Nethirapoon du	Bone fracture, Deep cuts and Wounds [80]	Leaves/ Herb	Benzoxazine glucoside, blepharin,	20.7	17.16
19	Boerhavia diffusa Linn.	Nyctaginac eae	Common Hogweed/ Sattaranai	Jaundice, Liver complaints [97]	Leaves, Roots/ Herb	Punarnavine, β-sitosterol, β - Dglucoside, tetracosanoic, hexacosanoic, stearic, palmitic, arachidic acid, hentriacontane, urosolic acid, punarnavoside and liriodendrin	24.1	10.05
20	Borassus flabellifer L.	Arecaceae	Palmyra palm/ Panai	Cough, Diuretic and Stimulant [112]	Leaves, Roots/ Tree	Vitamins A and C, borassosides, dioscin, spirostane	24.1	17.16





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21	Calotropis gigantea L.	Apocynace ae	Crown Flower/ Erukku	Coughs, Leprosy, Leucoderma, Piles, Rheumatic pain, Scabies, Skin care, Stomachache, Toothache, Tumor, Ulcers, Wounds [114]	Whole plant/ Shrub	Akudarin, $\beta$ -amyrin, calotropin, uscharidin, uzarigenin, kundrol, mudarol, giganticine, $\beta$ - amyrinacetate, tetracyclic resinols, sterols, acetic, isovaleric acids, isogiganteol, taraxasterol, acetate, lupeol acetate, flavonol glycosides, hyperoside, rutin, amyrin, stigmasterol, anthocyanin,	20.7	88.73
22	<i>Calotropis</i> procera (Ait.) Ait.f.	Apocynace ae	Gigantic swallow wort/ Velerukku	Anthelmintic, Asthma, Bronchodilator, Dyspepsia, Emetics, Fever, Scorpion bite, Paralysis, Purgative, Stomachache, Stomachic Tumors, Swelling [115]	Leaves, Root, Bark, Flower/ Shrub	Evanidin, 3-rhamnoglucoside, cardenolide, proceragenin	27.6	74.51
23	Cardiospermu m halicacabum L.	Sapindacea e	Ballon vine/ Mudakathan	Knee Joint pain relief, remove gas trouble [76]	Leaves, roots, seeds/ Herb	Pentadecanoie acid, apigenin, protocatechuic acid, calycosin, rutin	44.8	14.22
24	Cassia auriculata L.	Fabaceae	Tanner's Cassia/ Aavaram poo	Reduce abdominal heat [76]	Flower/ Shrub	Nonacosane, nonacosan-6-one, chrysophanol, emodin and rubiadin	27.6	7.11
25	Cassia fistula L.	Fabaceae	Golden shower tree/ Sarakondrai	Anti-Inflammatory, Antipyretic, Biliousness, Laxative, Leucorrhea, Pyoderma, Rheumatism, Snakebite, Syphilis, Ulcers [104]	Whole plant/ Tree	Sennosides A, rhein, tannin, kaempferol, fistul.	34.5	71.57
26	Cassia tora L.	Fabaceae	Sickle Senna/ Tagarai	Skin Disease [116]	Whole plant/ Herb	Chrysophanol, aloe-emodin, Thrachrysone, rhein, emodin	24.1	7.11
27	<i>Catharanthus roseus</i> (L.) G. Don	Apocynace ae	Madagascar periwinkle/ Nithyakalya ni Sudukadum alli	Diabetes [101]	Root, Shoot Extract s/ Shrub	Ursolic acid, oleanolic acid, ajmalicine, alstonine, vinca rodine, vincoline, vinamidine,leurocolombine, vincathicine, vincubine, leurosine, vindoline, catharanthine, lochnerine, tetrahydroalstonine, roseoside, vincedine, vincedicine, tabersonine.	41.4	7.11





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28	Centella asiatica (L.) Urb.	Apiaceae	Indian penny word/ Vallarai	Antimicrobial, Astringent, Brain Tonic, Cardiac Problems, Diabetes, Diuretic, Fever, Head Ache, Leprosy, Skin Diseases [86]	Leaves/ Herb	Asiatic, centic, centellic, centoic, pectic, madasiatic acids, carotene, centellose, hydrocotylin, saponins, vallerine, indocentelloside, brahmoside, brahminoside, isothankuniside, medecassoside, thankcuriside, brahmic, and thankunic acids, β- caryophyllene, trans-β- farnesene, germacrene D,	34.5	66.91
29	Cissus quadrangulari s L.	Vitaceae	Veldt Grape/ Perandai	Controls blood sugar [96]	Leaves Stem/ Herb	Ketosteroids, sitosterol, alphaamyrin, $\alpha$ -ampyrone, tetracyclic triterpenoids	44.8	7.11
30	Cleome viscosa L.	Cleomacea e	Wild mustard/ Naivelai, Naikkaduku	Earache, Eye Trouble, Skin disease [97]	Leaves, Seed/ Herb	Macrocyclic, diterpene, cleomaldeic acid, cleomeolide,	24.1	21.32
31	Clitoria ternatea L.	Fabaceae	Butterfly pea/ Sangupoo	Antimicrobial activity, Eye diseases and Headache [106]	Leaves/ Climbe r	Tannins, resins, starch, taraxerol, taraxerone	20.7	21.32
32	Coccinia grandis (L.) Voigt	Cucurbitac eae	Ivy gourd/ Kovai	Blood purification [76]	Fruit/ Climbe r	Lupeol, cucurbitacin B	34.5	7.11
33	Commelina benghalensis L.	Commelin aceae	Tropical Spiderwort/ Kannankolai	Anti-Inflammatory, Diuretic, Laxative, Leprosy, Swelling, Wounds [104]	Whole plant/ Herb	n-octacosanol, ntriacontanol, n- dotriacontanol. stigmasterol, beta-sitosterol and campesterol.	31.0	34.31
34	Curcuma aromatica Salisb.	Zingiberac eae	Wild Turmeric/ Kasthoorima njal	Skin diseases [117]	Tuber or Rhizom e/ Herb	Sesquiterpenes including curdione and cerumol, d- camphene, d-camphor, ar- curcumene, beta-curcumene and xanthorrhizol	24.1	7.11
35	Cynodon dactylon (L.) Pers.	Poaceae	Bermuda grass/ Arugampul	Cold, blood purification [101]	Whole plant/ Grass	Ferulic, syringic, p-coumaric, vanillic, p-hydroxybenzoic, O- hydroxyphenyl acetic Acids	48.3	14.22
36	Cyperus rotundus (L.)	Cyperacea e	Nut grass/ Koraikizhan gu	Fever, Wounds, Stomach Pain, Toothache [101]	Whole plant/ Grass	α-Cyperone, β-selinene, cyperene, patchoulenone, kobusone, isokobusone	41.4	31.37
37	Datura metel L.	Solanaceae	Devil's trumpet/ Umathai	Anticancer, Antimicrobial [106]	Leaves/ Herb	Alkaloids, tropane derivatives, hyoscine, hyoscyamine, hyoscine, hyoscyamine, micotianamine, $\beta$ -sitosterol, triterpene, daturaolone, daturadiol hyosane, hyoscyamine, daturaolone, fastusic acid, $\beta$ -Me-sterols.	51.7	14.22





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38	<i>Delonix elata</i> (L.) Gamble	Fabaceae	White Gulmohur/ Vatanarayan an	Antimicrobial, Antioxidant, Cold, Joint Pains [97]	Leaves/ Tree	Leucocyanidin, tannin, lupeol and beta-sitosterol, and free Ohproline, zeaxanthin.	20.7	28.43
39	Eclipta alba L.	Asteraceae	Bhringraj/ Vellai karisalan gani	Asthma, Cold, Cough, Intestinal Worms, Jaundice, Skin Diseases, Swelling, Ulcer, Urinary Problems, Wounds [111]	Whole plant/ Herb	Stigmasterol, a-terthienyl methanol, wedelolactone, de- Me-wedelolactone, small amount of 2-formyl-terthienyl.	20.7	50.25
40	Euphorbia hirta L.	Euphorbia ceae	Asthma- Plant/ Paalattam chedi	Regulate body temperature [76]	Leaves/ Herb	Cycloarternol, 24-methylene- cycloarternol, $\beta$ -sitosterol, euphorbol hexacozonate, $\beta$ - amyrin acetate, 1-hexacosanol, ingeno-triacetate, tinyaloxin, campesterol, stigmasterol and quercitin	37.9	7.11
41	Evolvulus alsinoides (L.)	Convolvul aceae	Dwarf Morning Glory/ Vishnukrant hi	Dysentery, Epilepsy, Fever, Insanity [96]	Whole plant/ Herb	Evolvine, $\beta$ -sitosterol, stearic, oleic, linoleic acids, pentatriacontane, triacontane	24.1	24.26
42	Ficus racemosa L.	Moraceae	Cluster fig/ Aththi maram	Edema, Astringent, Blood Disorders, Diabetes, Leucorrhoea, Sore Throat, [104]	Root, Fruits/ Tree	Ceryl behenati gluanol-OAc, lupeol and its $\alpha$ -OAc, $\beta$ -amyrin, $\beta$ -sitosterol; Leaf: $\beta$ -amyrin, $\beta$ - sitosterol, gluanol-OAc	27.6	62.75
43	Ficus religiosa L.	Moraceae	Ashwattha tree/ Arasamaram	Asthma, Diabetes, Diarrhea, Epilepsy, Gastric Problems, Inflammation [101]	Whole plant/ Tree	β-Sitosteryl-Dglucoside, vitamin K, n-octacosanol, methyl oleanolate, lanosterol, stigmasterol	31.0	45.59
44	Grewia tiliifolia Vahl	Malvaceae Juss.	Dhaman/ Unnu	Dysentery [84]	Leaves, Stem, Bark/ Tree	Quercetin, kaempferol, pelargonidin, naringenin	20.7	7.11
45	Gymnema sylvestre R. Br.	Apocynace ae	Gurmar/ Sirukurincha n	Constipation, Cough, Diabetes, Digestion Problems, Fever, Jaundice, Malaria, Snakebite, Vomiting [118]	Leaves/ Shrub	Gymnamine, hentriacontane, non-acosane, pentatriacontane, tritriacon, butyric, formic and tartaric acids, β-amyrin, lupeol; stigmasterol, saponins- gimnemasides,	27.6	55.64
46	Heliotropium indicum L.	Boraginace ae	Indian turnsole/ Thel kodukku	Anti-Inflammation, Antiseptic, Eyes Irritation, Pimples, Skin Diseases, Sores, Ulcers, Wounds [81]	Leaves Young shoots/ Herb	Alkaloids—indicine, echinatine, supinine, heleurine, heliotrine, lasiocarpine and lasiocarpine-N- oxide.	20.7	47.3







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47	Hemidesmus indicus (L.) R. Br.	Apocynace ae	Indian sarsaparilla/ Nannari	Antipyretic, Diabetes, Diarrhoea and Dysentery, Leprosy, Skin Diseases, Stomachache [109]	Whole plant/ Shrub	Coumarino-lignoids, hemidesmine, emidine, indicine	41.4	38.48
48	Hibiscus rosa- sinensis L.	Malvaceae Juss.	China rose/ Semparuthi	Blood Purification [76]	Roots, Leaves Flowers / Shrub	Cyclopropanoids, methyl sterculate, 2-hydroxysterculate, malvalate, β-sitosterol	31.0	7.11
49	<i>Ipomoea</i> <i>staphylina</i> Ro em. & Schult.	Convolvul aceae	Lesser Glory/ Onaankodi	Analgesic [97]	Whole plant/ Shrub	Phenolics, flavonoids, steroids, tannins, saponins and terpenoids	20.7	7.11
50	Jatropha gossypifolia L.	Euphorbia ceae	Bellyache Bush/ Siria Amanakku	Diabetes, Laxative, Stomach Problem [97]	Whole plant/ Shrub	Triterpenes, a trihydroxy ketone and corresponding diosphenol, diterpenes, jatropholone A and jatrophatrione, diterpene, jatrophone, phorbol derivatives, jatropholones A and B, hydroxyjatrophone and hydroxyisojatrophone.	20.7	17.16
51	Lawsonia inermis L.	Lythraceae	Egyptian Privet/ Maruthani	Regulate body temperature [76]	Seeds and Leaves/ Shrub	Naphthoquinones, lawsone, coumarins, tannins	34.5	7.11
52	<i>Leucas aspera</i> (Willd.) Link	Lamiaceae	Common Leucas/ Thumbai	Carminative, antipyretic, febrifuge, antiseptic, jaundice, anorexia, dyspepsia, fever, respiratory and skin diseases [101]	Leaves/ Herb	Triterpenoid, leucolactone, sitosterol, stigmasterol, campesterol.	55.2	61.52
53	Mimosa pudica L.	Fabaceae	Humble plant/ Thoddal Vaddi	Antiseptic, Tuberculosis, Wounds [101]	Roots and Leaves/ Shrub	O-glycosyl flavonoids namely isoquercitrin, avicularin and apigenin-7-O- $\beta$ -D-glucoside and four C-glycosyl flavonoids, cassiaoccidentalin B, orientin and isoorientin	37.9	17.16
54	<i>Morinda</i> <i>coreia</i> Buch Ham.	Rubiaceae	Indian mulberry/ Nuna	Antibacterial [106]	Leaves/ Tree	Alizarin, nor-damnacanthol, ursolic acid, β-sitosterol, asperuloside, caproic acid	24.1	7.11
55	Murraya koenigii (L.) Spreng.	Rutaceae	Curry tree/ Karuveppilai	Strong and Natural hair [76]	Leaves/ Tree	Carbazole, girinimbine betacarotene, Koenigin, β- carotene, coumarin glucoside and scopolin	20.7	7.11
56	Ocimum sanctum L.	Lamiaceae	Holy Basil/ Thulasi	Asthma, cold, cough, kidney problems, and improving appetite [101]	Leaves/ Herb	Eugenol, carvacrol, nerol, luteolin, ursolic acid, apigenin-7- O-glucuronide, luteolin-7-O- glucuronide, orientin and molludistin.	31.0	27.21





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57	Pedalium murex L.	Pedaliacea e	Bara Gokhru/ Yanai nerunc	Kidney stone, Urinary irritations, Uterine and Puerperal diseases [97]	Seeds and Leaves/ Herb	Flavonoids pedalitin, glucoside (pedaliin), diometin, dinatin, nonacosane, tritriacontane, triacontanoic acid, sitosterol- beta-D-glucoside, rubusic acid, luteolin, caffeic, protocatechuic, p-coumaric and ferulic acids, dinatin, quercetin and quercetin- 7-glucoside.	24.1	17.16
58	Pergularia daemia (Forsskal) Ch iov.	Apocynace ae	Pergularia/ Uttamani	Anthelmintic, Anti- Pyretic, Expectorant, Infantile Diarrhoea, Jaundice, Laxative [119]	Leaves and Root/ Herb	Coroglaucigenin, uzarigenin, hentriacontane, $\beta$ -amyrin, betaine, 5 $\beta$ -stigmast-7(8)-en-3 $\alpha$ - ol, 5 $\beta$ -stigmast-8(14)-en-3 $\alpha$ -ol, cardiac glycosides are D- cymarose, D-glucose, L- oleandrose, D-sermentose,3 $\beta$ - hydroxyfriedelan-7-one, lupeol and its acetate, oleanolic acid, putranjivadione, $\beta$ -sitosterol, lupeol, $\alpha$ -amyrin acetate, $\beta$ - sitosterol	31.0	42.65
59	Phyllanthus emblica L.	Phyllantha ceae	Goose Berry/ Nelli	Blood Pressure, Sugar related diseases [113]	Fruits/ Tree	Vitamin C, zeatin, zeatin riboside, phyllembin Phyllembin, gallic, ascorbic acid and proanthocyanidin	37.9	10.05
60	Phyllanthus maderaspatens is L.	Phyllantha ceae	Madras Leaf- Flower/ Nila nelli	Antispasmodic, Carminative, Diabetes, Diuretic, Flu, Gall and Bladder Calculus, Head Ache, Jaundice, Laxative, Liver Disease, Menstrual Problem, Oedema [103]	Plant/ Herb	Phyllanthin, hypophyllanthin, niranthin, nirtetralin, phyltetralin, quercetin, quercitrin, astragalin, rutin, kaempferol and amarulone	27.6	85.29
61	Phyllanthus niruri L.	Phyllantha ceae	Stonebreaker / KeelkaiNelli	Jaundice, Liver Diseases, Hepatitis, Kidney Disease, Oedema, Diarrhoea and Dysentery, Cough and Chest Pain, Wounds [96]	Whole Plant/ Herb	Lignans, lanthin, niranthin, phyltetralin	20.7	64.46
62	Plumbago zeylanica L.	Plumbagin aceae	Ceylon leadwort/ Venkodivelli	Antibacterial, Cancer, Antiseptic, Appetizer, Diarrhoea, Diuretic, Headache, Leprosy, Rheumatism, Skin Disease, Sudorific, Tumors [97]	Roots/ Shrub	Plumbagin	20.7	76.96





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63	Ricinus communis L.	Euphorbia ceae	Castor/ Ammanaku	Eye related issues [76]	Seeds and Leaves/ Shrub	Albumin, ricin, ricinine, ricinoleic acid	20.7	7.11
64	Sida acuta Burm. f.	Malvaceae	Horn bean leaved sida/ Kurunthotty	Dandruff, Diabetes, Fever, Headache, Leucorrhoea, Swellings, Tuberculosis, Uterine Disorders [97]	Roots and Leaves/ Shrub	Phenethylamine, ephedrine, siephedrine, vasicinol, vasicinone, vasicine, choline, hypaphorine and betaine, alpha- amyrin, ecdysterone, alkaloid cryptolepine	20.7	45.59
65	Solanum nigrum L.	Solanaceae	Blacknight- shade/ Manathakkal i	Heart, lungs, liver diseases, itches, ulcer and stomach problems [101]	Leaves/ Herb	Solasonine, $\alpha$ -and $\beta$ -solanigrine, $\alpha$ -and $\beta$ -solamargine; steroidal sapogenins, diosgenin, tigogenin, solasodine and solasodine	31.0	38.48
66	Solanum trilobatum L.	Solanaceae	Solanum/ Thuthulai	Antimicrobial activity, cough, Asthma, Cold [101]	Leaves/ Shrub	Solasodine, beta-solamarine	34.5	20.1
67	Syzygium cumini (L.) Skeels	Myrtaceae	Indian black plum/ Naval	Dysentery, Diabetes, Leucorrhoea, Menstrual problem, Stomach problem [101]	Seeds and fruits/ Tree	Bergenin, gallic acid, ethyl gallate, anthocyanins, citric, malic, ellagic and gallic, acids, $\beta$ - sitosterol, kaempferol, quercetin, friedelin and betulinic acids	27.6	31.37
68	Tridax procumbens L.	Asteraceae	Coat-button/ Kenatrupasa n, Vettukkaya puntu	Cuts and Wounds, Skin Ailments [120]	Leaves/ Herb	Arachidic, behenic, lauric, linoleic, linolenic, myristic, palmitic, palmitoleic and stearic acids, dotriacontane, 9- oxoheptadecane, 10- oxononadecane; β-amyrin, β- amyrone, lupeol	31.0	10.05
69	Vitex negundo L.	Lamiaceae	Chaste tree/ Nocchi	Headache [76]	Leaves/ Shrub	Malic Acid, Alkaloids and Resin, Iridoids, Lignan, Ecdysones, Iridoid Glucoside, Acetyl Oleanolic Acid, Sitosterol, Isomeric Flavanones and Furanoeremophilane	37.9	7.11
70	Wrightia tinctoria (Roxb) r.b	Apocynace ae	Dyer's Oleander/ Vetpalai	Skin diseases [111]	Bark and Leaves/ Tree	Cycloartanes, cycloartenone and cycloeucalenol, alpha- and beta- amyrin, beta-sitosterol, ursolic acid, oleanolic acid, terpene, wrightial, and lupeol, 3-O- rhamnoglucoside,	20.7	7.11
71	Ziziphus mauritiana La m.	Rhamnace ae	Chinese date/ Ilantai	Anthelmintic, Anodyne, Astringent, Asthma, Cephalalgia [103]	Leaves and Root/ Tree	Amphibine H and Nummularine K	31.0	35.54




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Figure 1: Graphical representation of number of medicinal plants belonging to various families used in the treatment of different diseases/conditions



Note: A taxa may be reported in more than one ailment category

Figure 2: Graphical representation of Number of medicinal plants used for the treatment of ailment categories.





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## Figure 3: Life forms of reported medicinal plants used by the indigenous people Tamil Nadu



Figure 4: Percentage of plant parts used by the indigenous people Tamil Nadu.





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**RESEARCH ARTICLE** 

# Assessment of Knowledge, Attitude and Practice of Diabetes Mellitus Patients to Improve the Quality of Life By Using Pictograms in a Tertiary Care Hospital of Salem District

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## ABSTRACT

A prospective interventional comparative study was carried out for a period of 6 months to assess the use of pictograms as a patient counseling tool to convey information regarding medication use and lifestyle changes to in-patients with diabetes. The secondary objectives were to assess the socio-demographic factors and to assess the knowledge of the patients regarding their medications. 100 patients were enrolled in the study on the basis of inclusion and exclusion criteria and were allocated into intervention and control groups (each 50 Patients) using simple random sampling method. The patients in intervention group were counseled using pictograms accompanied with plain language and verbal counseling was used for the control group. The knowledge of patient's regarding their prescribed anti-diabetic medications were assessed pre-counseling and post counseling using KAP questionnaire. The data obtained was subjected to statistical analysis. The mean KAP score in the intervention group improved significantly from 5.38±3.34 to 12.7±1.62. Post-counseling assessment of KAP demonstrated a significant improvement in the scores of the overall study population with a p-value of <0.001. However, greater improvement was observed in the intervention group as compared to the control group.

Keywords: Diabetes, KAP, Pictograms, Patient Counseling, Lifestyle Modification.





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## INTRODUCTION

Diabetes Mellitus (DM) is a group of metabolic disorders characterized by Hyperglycemia, Glycosuria, Hyperlipidemia, Negative Nitrogen Balance and sometimes Ketonaemia, which is associated with abnormalities in carbohydrate, fat and protein metabolism and results in chronic complications including microvascular, macrovascular, and neuropathic disorders. Type II Diabetes Mellitus accounts for 80-90 of all diabetes cases. This form of diabetes is characterized by insulin resistance and at least initially, a relative lack of insulin secretion. Most individuals with type 2 diabetes exhibit abdominal obesity which itself causes insulin resistance. In addition, hypertension, dyslipidemia, is often present in these individuals. This clustering of abnormalities is referred to as the "insulin resistance syndrome" or the "metabolic syndrome." Because of these abnormalities, patients with type 2 diabetes are at increased risk of developing macro vascular complications [1]. Diabetes can be effectively controlled by proper use of medication and incorporating healthy lifestyle changes. The progression of disease and complications can result from lack of knowledge about the disease due to low health literacy, improper medication use, and patient's perception towards the disease condition, unhealthy lifestyle and lack of counseling. A key step to improve the level of health communication understood by patients and their families is by providing adequate patient counselling material and tools to patients [2-4] Patient counseling is an important part of the pharmaceutical care process and is useful in improving the knowledge, attitude and practice of the patients towards their disease management. There are several barriers which have to be overcome so as to convey the intended counseling messages. The elderly population is at high risk of not being able to understand their prescription instructions and also verbal and written medication information are poorly comprehended by elderly owing to limited health literacy [5-8]. Pictograms are easy, understandable graphic symbols which are able to convey the information to all, regardless of being illiterate, elderly, or visually impaired. Pictograms help in comprehension of the intended information by overcoming barriers such as low levels of literacy and communication barriers such as linguistic differences, limited linguistic ability, etc [9-10]. Knowledge, attitude and practice pertaining to the use of medications have an effect ultimately on the success of the treatment. 'Knowledge' includes awareness regarding the medication name, indication, frequency, side-effects and special instructions. Inadequate knowledge regarding medications is likely to influence its use. Furthermore, many studies have shown that implementing lifestyle modifications and controlling modifiable risk factors helps in decreasing the risk and development of further complications in diabetic patients [11-13]. The study involves the assessment of the knowledge, attitude and practice of diabetes mellitus patients to improve the quality of life by using pictograms in a tertiary care hospital of Salem district.

## MATERIALS AND METHODS

A prospective Interventional study was conducted in the VMKVMC & H, Salem. Diabetes patients of both genders above the age 18 to 80 years were included in the study. The data of 100 patients were recorded during the time period of nine months from September 2019 to May 2020. Patients were interviewed using a KAP questionnaire (Proforma) which was pre-designed and consisted of 15 questions. The scores were obtained and the patients were counselled regarding their prescribed anti-diabetic medications and lifestyle changes using pictograms-based counselling in intervention group and verbal counselling in control group. Post counselling, the KAP questionnaire was again given to the patients and the scores were obtained. The Statistical software namely SPSS 15.0 were used for the analysis of the data. 'P value' less than 0.05 were considered to be statistically significant. Microsoft word and Excel have been used to generate graphs, tables etc. ANOVA, Student t test and Chi square/ Fisher Exact test were used in our study.





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## **RESULTS AND DISCUSSION**

The study that describes about the assessment of knowledge attitude and practice of diabetes mellitus patients to improve the quality of life by using pictograms in a tertiary care hospital of Salem district. Out of 100 patients, majority of them were found to be between 61-70 years of age 22-24%, followed by 20% with the age group of 51-60, least percentage 10-14% were found in the age group of 71 -80 years. Which shows that most of the patients were in age group between 61-70 years were diagnosed with daibetes mellitus. In our study, 100 patients were enrolled in both groups, out of which 56 (56%) patients were males and 44 (44%) patients were female. Male patients constituted 58% in intervention group, 54% in control group of the study populations whereas female patients were 42% in intervention group, and 46% in control group. In intervention group as well as control group, the number of male patients was found to be more than the number of female patients. The more number of males may be justified due to presence of risk factors like smoking and alcohol consumption.

The Study showed that the social economic status in both groups based on No Social habits, Smoker, Alcoholic and both Smoker and Alcoholic were 40%, 24%, 16 % & 20%, whereas in Control group were showed 42%, 30%, 16% & 12% respectively. In our study the patients were classified according to education in both groups based on, illiterate, able to read & write, primary education and secondary education, most of them was illiterate, in intervention group the percentage were 52%, 28%, 14% & 6% and in control group the percentage were 48%, 32%, 16% & 4% respectively. The socio economic status of the patients was classified in to groups as Poor and Lower middle. Majority of patient's status was Poor (62%) and followed by Lower middle (38%). The occupational status of two groups of patients were classified based on daily wages, farmer, homemaker and shopkeeper, in the intervention group the percentage were 34%, 20%, 36% & 10% and in control group percentage were 30%, 24%, 30% & 16% the respectively. The patients were classified according to type of diet followed, in both groups the Majority of patients followed non-vegetarian diet. In the study group the patients were distributed based on physical activity done, majority of patients doing physical activity (i.e. Exercise) was very less in their lifestyle. Patients were interviewed using a KAP questionnaire which was pre-designed and consisted of 15 questions.

The scores were marked, 0-7 as Poor, 8-11 as Satisfactory and 12-15 as Good, and the patients were counselled regarding their prescribed anti-diabetic medications and lifestyle changes using pictograms-based counselling in intervention group and verbal counselling in control group. Post counselling, the KAP questionnaire was again given to the patients and the scores were obtained. The pre-counselling knowledge, attitude and practice (KAP) of patients regarding their prescribed anti-diabetic medications were assessed and the scores obtained revealed that 74% patients in the intervention group and 70% control group had poor scores. This was consistent with the results of a similar study conducted by Anas Najjar, where they found that the average level of knowledge for participants was less than the adequate level considered in their study. In this same study, least score (16.87%) was reported for the knowledge of side effects of the drug. Also in a previous study conducted by Sara Modig<sup>14</sup>, it was found that only 6% of the elderly patients knew about the side-effects and risks associated with their medications. In our study, only 21% had knowledge about the side effects of the medications and this is consistent with the results of the above studies. Only 55% believed that taking medications properly will help in improving their health condition. Willingness to change lifestyle habits in order to improve health condition was expressed by 75% of the study population. Post-counselling assessment of KAP demonstrated a significant improvement in the scores of the overall study population with a p-value of <0.001. However, greater improvement was observed in the intervention group as compared to the control group. The mean KAP score in the intervention group improved significantly from 5.38±3.34 to 12.7±1.62. Similar results were observed in the study conducted by Uday Venkat Mateti<sup>15</sup>, where the post interventional pictogram-based patient information leaflets (P-PILs) knowledge-based user-testing scores significantly improved.





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## CONCLUSION

Post counselling, 100% patients in the intervention group were satisfied with their prescribed medications. Postcounselling, majority (93%) of the study population agreed with the need for counselling aids along with prescriptions. Our study has shown that pictograms were useful in improving the knowledge in the population. There was a greater impact of counselling on the parameters and greater improvement in intervention group when compared to control group. From the above study, it may be concluded that, pictograms plays important role in illiterate patients. The most of the patients unknowing of medicines had adjective improvement after they were educated about preventive measures and medications. It was also observed that the impact of pictogram-based counselling was greater than that of verbal counselling.

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## Table: 1 Age wise distribution of two groups of patients

		Intervention	Group (n=50)	Control G	roup (n=50)
S. No	Age group	Number of Patients	Percentage (%)	Number of Patients	Percentage (%)
1	18-30	6	12	5	10
2	31-40	8	16	7	14
3	41-50	10	20	9	18
4	51-60	10	20	10	20
5	61-70	11	22	12	24
6	71-80	5	10	7	14
Μ	lean ± SD	50.72±15.72		52.95±15.87	

P = 0.9886

#### Table: 2Gender wise distribution of two groups of patients

Condon	Intervention G	Group (n=50)	Control Group (n=50)					
Gender	Number of Patients	Percentage (%)	Number of Patients	Percentage (%)				
Male	29	58	27	54				
Female	21	42	23 46					

P = 0.687

## Table: 3 Social Habits wise distribution in two groups of patients

Contal Habita	Intervention C	Group (n=50)	Control Group (n=50)		
Social Habits	Number of Patients Percentage (%)		Number of patients	Percentage (%)	
No	20	40	21	42	
Smoker	12	24	15	30	
Alcoholic 8		16	8	16	
Smoker/ Alcoholic	10	20	6	12	

P = 0.7155

## Table: 4 Education wise distributions of two groups of patients

Educational Loval	Intervention (	Group (n=50)	Control Group (n=50)		
Educational Level	Number of patients Percentage (%)		Number of patients	Percentage (%)	
Illiterate	26	52	24	48	
Able to Read	14	20	16	22	
& Write	14	20	10	32	
<b>Primary education</b>	7	14	8	16	
Secondary	2	6	2	4	
education	3	0	2	4	

**P** = 0.9233





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able: 5 Socio economic status wise distributions in two groups of patients						
CEC	Intervention G	Group (n=50)	Control Group (n=50)			
565	Number of patients	Percentage (%)	Number of patients	Percentage (%)		
Poor	32	64	30	60		
Lower middle	18	36	20	40		

P = 0.6803

#### Table: 6 Occupational status wise distributions of two groups of patients

Occupational	Intervention Gr	oup (n=50)	Control Group (n=50)		
Status	Number of patients Percentage (%)		Number of patients	Percentage (%)	
Daily wages	17	34	15	30	
Farmer	Farmer 10		12	24	
Homemaker	18	36	15	30	
Shopkeeper	Shopkeeper 5		8	16	

P = 0.7358

#### Table: 7 Diet wise distribution of two groups of patients

True of dist	Intervention	Group (n=50)	Control Group (n=50)		
Type of diet	Number of patients Percentage (%)		Number of patients	Percentage (%)	
Vegetarian	Vegetarian 7 14		10	20	
Non-Vegetarian 43		86	40	80	

P = 0.4245

#### Table: 8 Physical activity wise distributions of two groups of patients

Physical Intervention G		Group (n=50)	Control	Group (n=50)
activity	Number of patients	Percentage (%)	Number of patients	Percentage (%)
Yes	11	22%	12	24%
No	39	78%	38	76%

P = 0.7358

## Table: 9 KAP Score distribution in two groups of Patients

VAD Saara	Pre-Counselling		Post Counselling	
KAF Score	Number of patients	Percentage (%)	Number of patients	Percentage (%)
Intervention Group (n=50)				
0-7 (Poor)	37	74	2	4
8-11 (Satisfactory)	9	18	8	16
12-15 (Good)	4	8 40		80
Control Group (n=50)				
0-7 (Poor)	35	70	3	6
8-11 (Satisfactory)	11	22	31	62
12-15 (Good)	4	8	16	32
P Value (Chi Square)	0.88 <0.001*		1**	





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	Pre-Counselling			Post Counselling		
	( Patients wi	ith Positive r	esponse)	(Patients	with Positive	e response)
Parameters	Intervention group (n=50)	Control group (n=50)	Total (n=100)	Intervention group(n=50)	Control group (n=50)	Total (n=100)
Knowledge about the purpose of prescribed drugs	16(32%)	14(28%)	30(30%)	42(84%)	43(86%)	85(85%)
Knowledge about the side effects of prescribed drugs	13(26%)	10(20%)	21(21%)	47(94%)	39(78%)	86(86%)
Knowledge about the precautions and special instructions regarding the prescribed drugs	8(16%)	8(16%)	16(16%)	49(98%)	43(86%)	92(92%)
Satisfaction with the prescribed drugs	32(64%)	25(50%)	57(57%)	46(92%)	45(90%)	91(91%)
Belief that medications properly will help in improving the health condition	28(56%)	27(54%)	55(55%)	50(100%)	45(90%)	95(95%)
Willingness to change lifestyle habits to improve the health condition	40(80%)	35(70%)	75(75%)	46(92%)	44(88%)	90(90%)
Need for additional counselling aids along with prescription	23(46%)	18(16%)	41(41%)	50(100%)	43(86%)	93(93%)

## Table: 11 Comparison of KAP Score in two groups of Patients

KAP Score	Intervention Group	Control Group	Total	P Value
Pre-Counselling	5.38±3.34	5.62±3.42	5.5±3.38	0.9472
Post Counselling	12.7±1.62	10.42±2.57	11.56±2.09	< 0.001**
Difference	7.32±2.47	4.80±2.99	6.06±2.73	< 0.001**

Student t test

## Table:12 KNOWLEDGE, ATTITUDE AND PRACTICE QUESTIONNAIRE (KAP)

Knowledge, Attitude and Practice Questionnaire		<b>Pre-Counseling</b>	Post Counseling	
Knowledge Questionnaire (YES=1;NO=0)				
1	Can you name the disease you are suffering from?			
2	Can you identify the drugs you are taking?			
3	Do you know the purpose of the prescribed drugs?			
4	Do you know how the drugs have to be taken?			
5	Do you know how long the drugs have to be taken?			





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6	Do you know the precautions to be taken while taking drugs?			
7	Do you receive enough information about your drugs when it is dispensed to you?			
8	Do you stop the drugs before the given regimen?			
9	Do you know about the side effects of the drugs?			
10	Are you satisfied with your prescribed drugs?			
Att	itude Questionnaire (YES=1;NO=0)			
11	Would you like to change your life style habits to improve your health outcome?			
12	Do you think you can improve your health condition if you take your medications properly?			
13	Would you like additional counseling aids along with prescriptions?			
Pra	Practical Questionnaire (YES=1;NO=0)			
14	Do you take your drugs regularly?			
15	What would you do if you miss a dose?			
Tat	al George C. 7 - Door , 9, 11 - esticitatory, 12, 15 - good			





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**RESEARCH ARTICLE** 

# Phytochemical Analysis and *In-vitro* Anti Inflammatory and Anti-Bacterial Study of Marine Algae *Ulva lactuca* L

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## ABSTRACT

The oceans cover about three fourth of the earth's surface and contains millions of hidden treasures. Seaweeds and marine algaes with their diverse bioactive compounds have opened up potential opportunities in pharmaceutical and agri-food processing industries. The current study design was to evaluate the preliminary phytochemical nature, antibacterial, *in-vitro* anti-inflammatory, total antioxidant potential of blue green algae *Ulva lactuca L*. Preliminary studies indicated the presence of flavonoids, carbohydrates, saponins, tannins, proteins and phenols in the methanolic extracts of *Ulva lactuca*. Antibacterial activity was shown by the methanolic fraction exhibiting zone of inhibition against 2 human pathogenic bacteria. However, it was less compared with the standard drug ampicillin. The methanolic extract of *U. lactuca* also demonstrated good antioxidant capacity and *In-vitro* anti-inflammatory action in heat induced haemolysis. This may be due to the flavanoids present in the algae which is having good antioxidant action. Our current results indicate that the various bioactive constituents detected in the algae maybe responsible for its antibacterial effect and *In-vitro* anti-inflammatory effects. Thus, we can safely say that *U. lactuca* may be a potential candidate for development of future antibacterial and anti inflammatory compounds. However, still further studies and standardization of algal research may be required to develop them as medicines.

Keywords: Antibacterial; Antioxidant; In-vitro Anti inflammatory; Phytochemical study; Ulva lactuca L





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## INTRODUCTION

Earth is the only known living planet held the life and is originated in water. The earth is also known as the watery planet. Around three-fourth or roughly 71% of the earth's surface is enclosed with water, which contains enormous resources of many potential therapeutic agents [1]. In 2013 alone, over 1000 pharmacologically active compounds of marine origin were characterized worldwide, with potential value against cancer, viruses, bacteria, fungi, hypertension, high cholesterol and other diseases. The pursuit for bioactive compounds from marine organisms in recent decades has produced an abundance of extracts with pharmaceutical and industrial applications [2]. One of the sources of new potential compounds in marine resources is algae. Algae are the first photosynthetic cellular plants from which most of all the plants have orginated. Ulva Linnaeus genus (Ulvaceae, Ulvales) is ubiquitous genera broadly disseminated in oceans. Currently, 128 species (accepted taxonomically) have been listed all around the world [3].Class: Ulvophyceae, Order: Ulvales, Family: Ulvaceae. Fronts short, usually boarder than long, blades more or less ovate, at times lacinate. Fronts attached from a broad base, generally deeply and irregularly split, light to dark green in color, delicate in texture, margins plane orruffled, membrane 40-50µ thick usually 40µ,cells in section nearly square with rounded angles or slightly elongated, chloroplast is cup shaped, and grows attached to rocks in the littoral region. From an economic perspective, the use of Ulva species for different applications has been largely pronounced: bioremediation, bioenergy, food and feed [4]. Ulva lactuca L. (Family: Ulvaceae) have been used in medicine due to various biological activities including, anti-oxidant, anti-inflammatory, anti-microbial, antiulcer, anticancer, antibacterial, antiviral, laxative, antifungal, anti-coagulant, anti-nociceptive, anti per oxidative, antihyperlipidemic, hepato-protective, anti-protozoal, leishmanicidal, hypercholesterolemia, immune stimulant and antiadhesive properties [5].

Chronic stress and a mode of life associated with numerous stress events are well-thought-out as risk factors for various diseases, including disorders of the digestive, circulatory, neuroendocrine, and immune systems [6].Main target for reactive oxygen radicals is the liver, which contains large amounts of polyunsaturated fatty acids (PUFAs), which are particularly susceptible to free-radical attacks [7]. *Ulva lactuca* Lspecies is categorized by a high content of lipid compounds, of which more than 80% are stated to the category of membrane-active components (phospholipids and neutral lipids). One significant element of the phospholipid fraction is the high content of n-3 PUFAs[8, 9].The antioxidant property of species of the genus *Ulva*are important since this make them candidates for several pathologies in which the oxidative stress is convicted (neurological disorders, atherosclerosis, hypertension, inflammation, acute respiratory distress, idiopathic pulmonary fibrosis, asthma, cancer, etc.)[10]. The evolution of antibacterial biomolecules in conjunction with bacteria over millions of years may provide them with the potential to astonished strains such as methicillin resistant *Staphylococcus aureus* (MRSA) and fluoroquinolone resistant Pseudomonas. Micro and macro algae, such as diatoms and seaweeds, have established indigenous systems to combat pathogenic bacteria and other microbes, ubiquitous to the ocean environment [10]. Aim of the present study is the development of marine algae into viable drug formulations is final phase for drug development which may be useful for the whole human population and to check their anti-inflammatory and antibacterial property.

## MATERIALS

*U. lactuca* (collected from the sea shore of Kollam district), *E. coli* (ATCC 8739)and *B.subtilis* (ATCC 6633) (NCIM,CSIR, Pune, Maharashtra), Methanol, Alsever's solution, Sulphuric acid, Ammonium molybdate, Citric acid,Sodium hydroxide, Potassium dihydrogen phosphate (Nice chemicals, Kochi), Ampicillin, RBC suspension, Aspirin, Nutrient broth (HiMedia laboratories private Ltd, Bengaluru, Karnataka), Agar agar (Research lab fine chem industries, Mumbai, Maharashtra).





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## **METHODS**

## Collection of plant material and extraction

The marine algae *U. lactuca* used for the pharmacological investigation of the activities, were collected during low tide by hand picking from the coast of Kollam, Kerala. The collected seaweed was cleaned thoroughly to remove the epiphytes and extraneous matter. The necrotic parts of the plants were also removed. The samples were washed about 3 to 4 times with sea water and in fresh water. The samples rinsed with sterile distilled water and shade dried. The dried samples grounded to fine powder. Then extracted by soxhelet apparatus using petroleum ether to remove the fatty layer and then by methanol and finally evaporated to dryness. The crude methanolic extracts were used for various screening activities.

## Preliminary qualitative phytochemical investigation

The methanolic algal extract of Ulva lactuca was subjected to qualitative phytochemical investigated for depicting the active constituents present in it. The tests were carried out by standard methods [11, 12].

## **Test for Alkaloids**

Mayer's test: To few drops of Mayer's reagent, methanolic extract was added. Formation of white creamy precipitate. Wagner's test: To 1ml of methanolic extract a few drops of Wagner's reagents was added. Reddish brown precipitate. Hager's test: To 1ml of methanolic extract few drops of Hager's reagent was added. Formation of yellow precipitate confirms the presence of alkaloids. Dragendroff's test: To methanolic extract 1 ml of Dragendroff's reagent was added. Formation of orange or orange red precipitate indicates the presence of alkaloids.

## **Test for Phenols**

Ferric chloride test To 1ml of methanolic extract 1ml 5% ferric chloride was added. The dark bluish black color. Test for Tannins: 2ml methanolic extract was dissolved in water, to this 2 drops of diluted ferric chloride was added. A dark green or blue green color.

## **Test for Flavanoids**

Shinoda test To of methanolic extract 10 drops of concentrated hydrochloric acid followed by small piece of magnesium were added and heated. Formation of pink or reddish brown.

## **Tests for Carbohydrates**

Molisch test To the extract few drops of freshly prepared 20 % alcoholic solution of  $\alpha$ -naphthol was added ,shaken well and 2 ml of concentrated sulphuric acid was added along the sides of the test tube. Appearance of red-violet ring indicates the presence of carbohydrates, which disappears on addition of excess of alkali. Benedict's test To the extract 5 ml of Benedict's solution was added and heated on a water bath. Formation of brick red color. Fehling's test: 10 mg of methanolic extract was dissolved in 1 ml of water. To this 1 ml of each Fehling's A and Fehling's B solutions were added. Formation of brick red color indicated the presence of reducing sugars. Tollen's test 10 mg of methanolic extract was dissolved in 1 ml of water, to this 1 ml of tollen's reagent was added and heated on a water bath. Formation of black precipitate or black silver mirror along the sides of the test tube indicates the presence of reducing sugars.

## **Test for Steroids**

Liberman Burchard's test: To 2ml extract add 2ml acetic anhydride and 1 ml of concentrated sulphuric acid along the sides of the test tube. Formation of green color.



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#### **Test for Proteins**

Biuret test: To 1 ml of methanolic extract, few drops of Biurets reagent was added and heated. Formation of violet red color. Million's test To 1 ml of methanolic extract, few drops of Million's reagent were added. Formation of white precipitate which turns to red on heating.

## **Test for Saponin**

50mg of methanolic extract was diluted in water made up to 20ml. The suspension was shaken in a graduated cylinder for 15 min. A 2cm layer of foam indicates the presence of saponin.

## *In-vitro* anti-inflammatory analysis

Determination of total antioxidant capacity: Weighed and dissolved in methanol. Prepared the reaction mixture contains 0.6M sulphuric acid, 28mM sodium phosphate and 1% ammonium molyb date in to the test tubes. Mixed the sample solution and the reaction mixture. Incubated the test tubes at 95°C for 90 min. Then cool it in room temperature. Sample absorbance was measured at 650 nm using spectrophotometer against a blank solution. Citric acid is used as the standard [13].

#### Membrane stabilization method

5ml fresh blood was collected from a healthy volunteer who has not taken NSAIDs for past 2 week. blood was transferred to test tubes, equal amount of alsever's solution. Then the mixture was centrifuged at 3000 rpm for 10 min in a refrigerated centrifuge. After centrifugation supernatant was discarded, collected the cell mass and transferred in to test tubes. It was then washed with isosaline (0.85% (w/v NaCl). Resultant was diluted to make 10% v/v using phosphate buffer saline [14, 15].

#### Heat induced haemolysis

Mixed the RBC suspension mixture and algal sample. Resulted solution heated for 30 min at 56°C. Then it was centrifuged at 2500 rpm for 10 min at room temperature. Supernatant was collected absorbance read at 560 nm. Aspirin was used as the standard. Then the % hemolysis and % membrane stabilization was determined.

## Anti- bacterial analysis

Agar well diffusion method: Bacterial stock culture stored at 4°C.Inoculated to form active culture at 37°C.It was then sub cultered in fresh nutrient medium at 37°C.Nutrient agar medium was prepared, then autoclaved at 15 lbs pressure (121°C) for 15 min. Immediately cooled to room temperature. Cooled medium was poured in to sterile petriplates to a uniform depth of 4 mm. And then sterile cork borer was added into it and allowed to solidify the medium. Added the test organism into the solidified agar petriplate and the cork borer was removed from the plate. To the formed well added the antimicrobial agent. The petriplates are incubated at 30-35°C for two days. Zone of inhibition was measured. The % inhibition can determined by the following equation.

% inhibition = (1  $\div$  diameter of zone of inhibition in mm) ×100 [16, 17]

## RESULTS

## Preliminary qualitative phytochemical analysis

The preliminary qualitative phytochemical analysis of methanolic extract of marine algae *U. lactuca* showed positive result for phenols, tannins, carbohydrates, flavanoids, proteins and saponins and negative for alkaloids & steroids. These are listed

## In-vitroanti inflammatory screening of extract

Total antioxidant capacity: Depicted in table no. 2 and the graph showing it is fig no. 1



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#### Membrane stabilization method & heat induced hemolysis

Membrane stabilizing effect and Heat induced hemolysis are listed in table no. 3 and fig no. 2.

#### Anti-bacterial analysis

The anti-bacterial activity of the algal extract were tested against the pathogenic bacteria *E.coli* and *B. subtilis* they were compared with standard antibiotic ampicillin by measuring the zone of inhibition (ZI) diameter and expressed in mm showed in table no. 4.

## DISCUSSION

The inhibition of heat induced Human RBC (HRBC) membrane lysis is taken as a measure of the anti-inflammatory activity. The methanolic extract of *U. lactuca* was effective in inhibiting heat induced hemolysis of HRBC at different concentrations. The total antioxidant activity determines the amount of the antioxidants available in the extract. The methanolic extract is rich in antioxidants as evidenced by the preliminary phytochemical studies & total antioxidant capacity. The membrane stabilization method is an optimal method for determining the *in-vitro* anti-inflammatory action. Antioxidants are broadly known to be effective in inflammatory conditions [46]. Since the progress of majority of the inflammatory diseases have a link with free radical generation, antioxidants may have protective role in these conditions. The phyto constituents in *Ulva lactuca* such as polysaccharides, flavanoids etc are rich as antioxidants, this maybe the reason for their *in-vitro* anti-inflammatory action. The inhibition of the bradykinin pathway may be responsible for its *in-vitro* anti-inflammatory effect [18]. It has revealed maximum inhibition of 24.04% at 500 µg/ml. As the membrane stabilization increases with increase in the concentration of the extract. The anti-inflammatory activity of the extract is concentration dependent.

The methanolic extract (250 & 500 µg/ml) showed considerable action against the gram positive & gram negative human pathogenic bacteria B. subtilis & E. coli respectively when compared through standard drug ampicillin (30 µg/ml). E. coli and B. subtilis commonly causes diarr hoeal and respiratory infections; from this test the anti-microbial effect of Ulva species against these bacteria clearly illustrates its therapeutic effect against various infections. This may be due to the various bioactive constituents in the algae which permit it to survive in an environment which is harsh [19]. They are exposed to a combination of light and high oxygen concentrations. These features can lead to the formation of free radicals and other strong oxidizing agents but seaweeds seldom suffer any serious photodynamic damage during metabolism. This fact infers that seaweed cells have some protective mechanisms and bioactive compounds [20]. Purification of such bioactive compounds will discover its activity against various other diseases too. The results of this work indicates the presence of various bioactive constituents in the preliminary studies of the crude extracts that play an indispensable role in its anti-microbial activity, anti-oxidant activity and invitro antiinflammatory activity. This algae U. lactuca possess other various effects such as anticancer, antiviral, antifungal, hepato protective etc. But the degree of evidence required for substantiating the mechanism of the various pharmacological activities of these algae is still somewhat unknown or insufficient. However, further studies are required and recommended to identify and characterize the specific active compounds, as well as the evaluation of the toxic aspects.

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Sl. No.	chemical	Tests	Methanol extract	
		Mayer's test	-	
1	Test for	Wagner's test	-	
1	Alkaloids	Hager's test	-	
		Dragendroff's test	-	
2	<b>Test for Phenols</b>	FeCl₃ test	+	
3	Test for	FeCl₃ test	+	
	Tannins			
4	Test for Flavonoids	Shinoda test	+	
		Molisch's test	+	
-	Test for	Fehling's test	+	
5	Carbohydrate	Benedict's test	+	
		Tollen's test	+	
6	Test for	Liberman Burchard's test	_	
	Steroids			

#### Table no. 1: Phytochemical screening





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7	Test for	Biuret test	+
	Proteins	Million's test	+
8	8 Test For Saponins Foam test		+

#### Table no. 2: Total antioxidant capacity

Sl.No.	Concentration(µg/ml)	% inhibition by extract	% inhibition by standard
1	100	$14.33 \pm 0.88$	$34.00 \pm 0.09$
2	150	$33.50 \pm 1.02$	$73.00 \pm 0.08$
3	200	$52.00 \pm 0.96$	$83.00 \pm 0.09$
4	250	$84.00 \pm 0.99$	$92.67 \pm 0.07$

#### Table no. 3: Membrane stabilizing effect and Heat induced hemolysis

	Concentration	% hemolysis		% membrane stabilization	
SI.No (µg/ml)	Test	Std	Test	Std	
1	100	$85.18\pm0.04$	$70.61 \pm 0.02$	$14.82\pm0.08$	$29.39 \pm 0.02$
2	125	$84.47 \pm 0.03$	$69.56 \pm 0.01$	$15.53 \pm 0.05$	$30.44 \pm 0.03$
3	250	$77.11 \pm 0.02$	$67.02\pm0.03$	$22.89 \pm 0.08$	$32.98 \pm 0.02$
4	500	$75.96 \pm 0.01$	$45.26 \pm 0.04$	$24.04 \pm 0.09$	$54.74 \pm 0.03$

#### Table no. 4: Anti-bacterial activity of methanolic extract of Ulva lactuca L

Sample/		Concentrations (µg)			
Sample/	Pathogens	250		500	
Diug		ZI	%I	ZI	%I
U. lactuca	B. subtilis	15.18±1.29	16.97±1.23	18.32±0.44	20.25±1.30
Methanol Extract	E. coli	18.61±1.21	20.67±1.24	21.37±0.38	23.85±1.26
		ZI		%	J
Ampicillin	B. subtilis	19.04±1.11		22.25±1.30	
(30 µg)	E. coli	23.42	7±1.14	25.05	±1.64









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**RESEARCH ARTICLE** 

# Impact of Industrial Revolution 4.0 on the Labor Market in Vietnam

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## ABSTRACT

Industrial Revolution 4.0 is taking shape and has a strong impact on the global labor market. The strength of the system connecting everything and artificial intelligence as well as automation technology is changing the labor market structure of countries in the world in general and of Vietnam in particular. For the labor market, the Industrial Revolution 4.0 has created many opportunities and challenges that require managers to catch up in time to have appropriate directions and solutions to develop the labor market, and meet the requirements of the current national development career.

Keywords: Industrial Revolution 4.0, labor market, employment, Vietnam

# INTRODUCTION

In the context of the industrial revolution 4.0 happening strongly in the world, no one can foresee how the world will change, because of its enormous scale, scope and complexity. The country must be more proactive in response to the strong effects of the era of smart industry and modern technology. The Industrial Revolution 4.0 is developing at an exponential rate, many of which have not been envisioned, posing many problems that affect every field, especially labor and employment sectors. In the early years of the 21st century, Vietnam has initially taken advantage of the achievements of the Industrial Revolution 4.0 to actively contribute to the development of the labor market, create jobs and ensure social security for workers, but it is also posing many challenges for labor market development in the context of deep and broad integration into the international market, so the issues need to be fully identified. The opportunities and challenges facing the strong impact of the 4.0 revolution on the labor market in Vietnam in the process of international integration.





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Based on the analysis of positive impacts and challenges of the Industry 4.0 on labor market development in Vietnam, the article proposes major solutions to develop the labor market in the context of industrial revolution 4.0 in Vietnam.

## Summary of industrial revolution 4.0

K. Marx once judged: the difference between economic eras is not what it produces but how it produces, and what labor documents. Based on this, he determined that the mortar that built rice with water was the era of feudal society, the steam engine was the period of capitalism. Steam engines reflected the results of the Industrial Revolution 1.0 (from 1784). Industrial Revolution 2.0 (from 1870) taking iron and steel as a criterion has brought civilized life, productivity increased many times compared to before. Industrial Revolution 3.0 (since 1969) with the criterion is that computers, internet and eco-engineering have brought industrial society to information society and enriched the way of receiving human information, providing a fast and cheap communication tool between enterprises or within enterprises, between production and business units and consumers ... has become an important channel for people to conduct economic activities and how to enjoy.

Entering the early years of the 21st century, the term industrial revolution 4.0 or the fourth industrial revolution has been mentioned a lot on media and social networks. The term "industrial revolution 4.0" was first mentioned at the Technology Exhibition Fair in Hannoverm (Germany) and after officially being included in the High-Tech Strategic Action Plan adopted by Germany in 2012; officially recognized the concept and content at the 46th World Economic Forum (WEF), January 20, 2016. Klaus Schwab said: "The fourth industrial revolution formed on the foundation of the digital revolution and incorporates many technologies is driving an unprecedented rapid transformation of the model in economic, corporate, social and personal aspects. It not only changes what we are doing, our way of doing things, but also who we are in the job" (Klaus, S, 2018: 14 -15).

On May 4, 2017, Prime Minister Nguyen Xuan Phuc signed Directive 16/CT-TTg on strengthening the capacity to access the Industry 4.0, stating: "Industry 4.0 with the development trend based on on the highly integrated platform of the digital - physical - biological connection system with the breakthrough of the Internet of Things and Artificial Intelligence is fundamentally changing the production of the world " (Prime Minister, 2017: 2). Industrial Revolution 4.0 is the combination of technology in the fields of physics, digital technology and biology, creating completely new production possibilities and having a profound impact on economics, politics, and society of the world. Four key features of the Fourth Industrial Revolution can be generalized: Firstly, based on a combination of new sensor technology, big data analytics, cloud computing and internet of things connectivity will drive the development of automation machines and smart production systems Secondly, using 3D printing technology to produce products completely by unifying production lines without the need to assemble auxiliary equipment - this technology also allows people to print new products using non-traditional methods, bypass intermediaries and reduce production costs as much as possible. Thirdly, nanotechnology and new materials create new material structures that are widely applied in almost all fields. Fourthly, artificial intelligence and cybernetics allow people to control remotely from space, time, and interact faster and more accurately. Vietnam is moving rapidly from the "golden population" structure to the aging population. Industrial revolution 4.0 should be seen as an opportunity for us to develop the labor market, increase labor productivity based on scientific and technical applications, and effectively utilize the Golden population structure in the present. Therefore, the application of the achievements of the industrial revolution 4.0 has the ability to open up new opportunities for socio-economic development in general and for the development of Vietnam's labor market in particular.

## Impact of the industrial revolution 4.0 on the world labor market

The Industrial Revolution 4.0 has a great impact on the overall socio-economic life, from the global scope to the regional and national levels, especially the manufacturing sector. The world economy is entering a period of growth mainly based on the motivation without a ceiling, which is technology and innovation, instead of growth mainly





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based on the inputs that always have a ceiling such as capital, labor and natural resources. The explosion of information systems on the internet and the ability to access vast, timely and accurate information have helped to allocate resources more effectively. Technological breakthroughs help new materials and energy sources be invented at a cheaper price than traditional materials, saving production costs. Industrial Revolution 4.0 has a special impact on the change of labor markets of many countries, although it has just started, it has been disrupting the traditional labor market structure in many countries. At the World Economic Forum held in 2016 in Switzerland, scientists warned that, under the influence of the industrial revolution 4.0, the labor market will be seriously challenged because of the imbalance between labors of supply and demand. The demand for high quality labor will increase, the demand for unskilled and middle and low skilled workers will decline rapidly. The 2016 World Economic Forum predicted that industrial revolution 4.0 would create about 2 million new jobs in the high-tech and automation industries, but would disappear about 7 million jobs in history industries. Employing a lot of unskilled and low-skilled workers (Klaus, S, 2018: 123).

In developed countries, workers are faced with the fact that artificial intelligence is gradually replacing people in many fields. A 2013 Frey & Osborne study predicted that 47% of jobs in industry, construction and agro-forestryfishery in the US will be replaced by robots. Instead of investing in low-cost labor countries, some investors have returned to the United States to take advantage of robotics, artificial intelligence and low transportation costs (Klaus Schwab, 2018, p.150). By the end of 2015, the Bank of England forecasts that about 95 million traditional workers will lose their jobs within the next 10-20 years in the US and the UK alone - equivalent to 50% of the workforce in the two countries (Vu Xuan Hung, 2017). Similarly, the World Economic Forum's report predicts that 5 million jobs in 15 developed and emerging economies could be lost due to the potential impact of the Industrial Revolution 4.0 on the US, Germany, and France, China and other countries (Klaus, S, 2018: 75). Labor in the ASEAN region is also facing a strong labor structure change. In some labor-intensive industries such as textiles and clothing, robots are being introduced into production lines to work with people. According to ABD and ILO reports, two-thirds of 9.2 million textile and footwear workers in Southeast Asia are at risk, of which 88% of Cambodian and 64% of Indonesian workers are at risk. The engine was replaced by robots under the impact of the automation wave in the industry. Jobs such as the operator of the telecommunications, banking, insurance, or securities industries are also likely to disappear in the future when the automatic answering system is applied (ADB & ILO, 2016). The Industrial Revolution 4.0 and the formation of the ASEAN Economic Community have removed the hard border of labor markets among countries in the region, making the labor market in the bloc more vibrant, promoting job creation for each member state. However, due to uneven development, the skilled and skilled labor force mainly moves into Singapore, Malaysia and Thailand (ADB & ILO, 2016). The rest, most of the moving workers within ASEAN are lowskilled, unskilled workers and facing the risk of unemployment as the impact of the industrial revolution 4.0 becomes more extensive.

#### Opportunities and challenges for Vietnam's labor market under the impact of industrial revolution 4.0

As well as its impacts on the world labor market, Industrial Revolution 4.0 brings both opportunities and challenges to the development of the Vietnamese labor market. The opportunities that this revolution brings may include the development of technology spaces that help to connect labor demand and supply directly and quickly compared to the traditional labor market. These technology spaces are easy to use, for example, smartphones help connect the community easily, thereby creating completely new ways of consuming goods and services. In addition, new technologies lower barriers, enabling businesses and individuals to produce wealth, material, change the working environment as well as create new career opportunities for worker. Currently, about 52% of Vietnam's population use the internet, this is an opportunity to create more jobs in the field of information technology in the near future (Phan, T. T,2017). In fact, the demand for labor in the information technology industry in Vietnam increases rapidly, but the human resources of the information technology industry is inadequate, unable to meet social requirements. According to VnEconomy: In 2019, the number of information technology human resources needed is 350,000, but the shortage is about 90,000. In the next two years, while the number of manpower needed is estimated at 400,000 people by 2020 and 500,000 people by 2021, corresponding to the shortage of information technology personnel of





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100,000 employees (in 2020) and 190,000 (2021). From a market perspective, technology will change production methods, resulting in a change in human resources to implement that production method. There are jobs that are lost but there are jobs that require adaptation to meet the new requirements. Thus, the Industrial Revolution 4.0 will cause the labor market to have a change in labor structure, resource structure, structure of labor qualifications, with different requirements on labor skills. In particular, workers must be more resilient to respond to new jobs and avoid rejection. Besides the opportunities, the Industrial Revolution 4.0 also poses many challenges to Vietnam's labor market in the coming time, such as:

Firstly, pressure on improving the qualifications of workers. The labor force of our country today is mainly lowskilled workers. Survey data from the General Statistics Office from 2019 to the present shows that, although the number of workers who have not yet received technical and professional training in our country, despite the downtrend, still accounts for the majority (about 70%) of the labour force. Meanwhile, the demand for unskilled labor in Vietnam is forecast to decline sharply in the near future. Specifically, the ILO warns: in the next 10 years, about 70% of jobs in labor-intensive industries in the country, such as leather and footwear, electronics assembly, seafood processing, retail services (industry only) textiles and clothing is about 86%) ... at high risk of being replaced by modern machinery and equipment (Le, T. C, 2016).

Furthermore, the quality of the labor force of the group of "skilled workers" is still not high, failing to meet the market's requirements in terms of both professional skills and foreign language skills. According to a JICA survey on the quality of Vietnamese labor in Japanese-affiliated enterprises, among 2,000 Vietnamese information technology students, only about 90 candidates, equivalent to 5%, pass the survey in terms of expertise, of which only 40 candidates have enough English proficiency to work. According to Vietnam's 2017 E-Commerce Report, 24% of businesses said that it was difficult to recruit personnel with information technology skills and training expertise. Compared with other countries in the region, the technical and professional qualifications of our labor force are also much lower. The trained labor force in our country is only approximately 20% while countries such as Singapore are 61.5%, Malaysia is 62%, the Philippines is 67% (Vu, Q. V, 2017).

Secondly, Industry 4.0 has transformed labor structure in economic sectors. With the industrial revolution 4.0, traditionally labor-intensive occupations will gradually disappear and new jobs will appear. Industrial Revolution 4.0 has introduced automation systems and intelligent robots. These systems will gradually replace manual labor in the whole economy, putting great pressure on the labor market. Developing countries will face labor surplus and rising unemployment. Currently, Vietnam's labor force is relatively abundant but mainly low-skilled workers, so it is easily replaced by machines. The simple, repetitive jobs that most Vietnamese untrained workers are undertaking will gradually be replaced by machines in the future. According to estimates by the International Labor Organization, up to 86% of the workers in the textile and footwear industries of Vietnam are at high risk of losing their jobs within the next 15 years. In addition to the gradual loss of traditional professions that use a lot of labor, the Industry 4.0 also appeared many new professions, associated with the characteristics of this revolution such as electronics, telecommunications, digitalization, computer technician, cyber security, 3D printing ... In the future, workers who lose their jobs due to the development of robots and automation technology will move to these new industries. However, it is not easy to change careers, especially those that require a lot of knowledge.

Thirdly, the labor market is strongly segmented. In the industrial revolution 4.0, cheap labor is no longer a competitive advantage of the countries in the world. A series of old occupations will be lost and the international labor market will be strongly divided between low-skilled and high-skilled labor. Along with that, the introduction of artificial intelligence (intelligent robots) also reduces the need for low-skilled labor use. In particular, the industrial revolution 4.0 not only threatens the jobs of low-skilled workers, but even intermediate-skilled workers will be affected, if they are not equipped with these new skills - creative skills. With the rapid technological development in the future, the need for highly skilled and skilled labor is an inevitable requirement. From raising the quality requirements of human resources, the industrial revolution 4.0 has also changed the requirements and methods of





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training human resources. Training high-quality human resources to prepare for industrial revolution 4.0 has become an urgent issue that many countries around the world are concerned about. Fourthly, the pressure on improving the innovation capacity of the workforce. According to the 2018-2019 Global Competitiveness Report, Vietnam is ranked 56/140 countries overall, but the component indicators related to innovation are very low; in which Technology absorption capacity index ranked 121; The complexity of the production process is 101; The quality of scientific research organizations is 95. These figures show that the innovation capacity of our labor force is still limited, while this is a decisive factor in the Industrial Revolution 4.0. The report "Assessment of Science, Technology and Innovation in Vietnam" of the World Bank and Organization for Economic Co-operation and Development (OECD) clearly shows that very few Vietnamese enterprises carry out R&D (research and development), or if any, funding for R&D activities only accounts for a very small part of the enterprise's financial resources. R&D statistics and related information are often fragmented, outdated and incompatible with international standards. R&D connection between businesses and public research institutions is almost unavailable. Until now, Vietnam has hardly created any technology of national stature and export ability. The acquisition of new technology through the operation of FDI enterprises is also not effective.

Fifthly, the pressure on increasing labor productivity. One of the major constraints of our labor market is low labor productivity. According to the General Statistics Office of Vietnam, Vietnam's labor productivity in the period of 2011-2018 increased by an average of 4.8% per year, higher than the average rate of Singapore (1.4%/year); Malaysia (2%/year); Thailand (3.2%/year); Indonesia (3.6%/year); Philippines (4.4% / year). As a result, Vietnam has narrowed the gap to ASEAN countries with higher levels of development. If in 2011, the labor productivity of Singapore, Malaysia, Thailand, and Indonesia in turn was 17.6 times higher than Vietnam's labor productivity; 6.3 times; 2.9 times and 2.4 times, by 2018 this relative distance will decrease to 13.7 times, respectively; 5.3 times; 2.7 times and 2.2 times. However, the current level of labor productivity in Vietnam is still very low compared to other countries in the region, notably, the absolute gap continues to increase. According to PPP 2011, labor productivity of Vietnam in 2018 reached 11,142 USD, only equal to 7.3% of Singapore's productivity; 19% of Malaysia; 37% of Thailand; 44.8% of Indonesia and 55.9% of labor productivity of the Philippines. The difference in labor productivity (based on PPP 2011) of Singapore and Vietnam increased from 132,566 USD in 2011 to 141,276 USD in 2018; similarly, Malaysia's from 42,397 USD to 47,545 USD; Thailand from 14,985 USD to 18,973 USD (General Statistics Office of Vietnam, 2019). This low productivity is seen as an inevitable consequence of low quality of the labor force and weak capacity for innovation. Therefore, improving labor productivity is an urgent requirement for the domestic labor market to develop and meet the new requirements of the economy under the influence of the industrial revolution 4.0.

In the coming time, the process of globalization of production with the division and labor cooperation takes place increasingly widely between countries in the region and around the world. When we implement the new-generation free trade agreements, the barriers of economic space, goods, services, capital, science and technology, labor market are removed, the competition between countries became increasingly fierce. Currently, ASEAN has an agreement on the natural movement of human resources, and there is an agreement to recognize each other on official practice certificates for 8 free-moving occupations: auditors, architects, engineers, dentists, doctors, nurses, investigators and travelers. The recognition of mutual qualifications in occupational skills will be one of the very important conditions in the implementation of labor mobility between Vietnam and other countries in the region. But this will also be a challenge for Vietnam, because the number of skilled workers in our country is still modest, forced to accept migrant workers from other countries with higher qualifications. Next time, if the qualifications of Vietnamese workers are not improved to meet the requirements, we will lose immediately on "our country".

## Solutions for developing our labor market in the context of Industrial Revolution 4.0

To seize the opportunities and solve the pressures placed on the labor market in the context of Industry 4.0, first of all, Vietnam needs to build high quality human resources. On that basis, appropriate policies are needed to encourage the improvement of workers' innovation and creativity as well as to create necessary policies and technical infrastructure for the developing labor market has ability to connect with the world labor market. *Firstly*,





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the solution group builds high-quality human resources. The State needs to quickly develop and implement the national qualification framework according to international and regional practices. In the short term, it is possible to develop a regional standard framework; In the long run, international standards will be targeted. On that basis, building output standards of each level of education, especially tertiary and vocational training on the basis of the national qualification framework. When developing output standards of education levels, it is necessary to conduct research and practice surveys of the requirements of the domestic and foreign labor markets in order to closely follow the needs of the economy and in line with international standards. Renew the content of the program, the form of enrollment and organize the training of general education, vocational training and higher education. Promote decentralization of training institutions in the direction of increasing financial autonomy, independence of training methods, and encouraging the participation of enterprises and employers in the training process. The content of the training program should combine theory and practice in parallel but need to focus on practical skills and promote creative initiative of learners. Encourage online training forms to increase opportunities for participating in professional training for employees.

In addition, the ministries, departments and branches should coordinate the evaluation and management of training quality according to regional and international standards. Expand and develop the system of national vocational skill evaluation and certification associated with vocational training institutions. At the same time, updating and supplementing national vocational technical standards that have been developed in the period of 2011-2015 ensure compatibility with standards of ASEAN and APEC. The State also needs to negotiate with other countries to recognize the skills and skills of workers, to ensure our country's labor force has the opportunity to access the world labor market. In addition, it is necessary to continue supporting budgets, mobilizing social resources, calling for investment to form a network of high-quality training institutions capable of training a number of industries and trades recognized by ASEAN and international countries. The Government should have policies to encourage, create the environment and create favorable conditions to attract talented teachers, experienced scientists at home and abroad to participate in the process of human resource training and research. Researching science and technology at Vietnam's education and training establishments. Promote training and retraining of teachers at all levels according to national and international standards.

Secondly, the group of solutions to improve the innovation and creativity of the labor force. The State should accelerate the process of institutional improvement on innovation, such as the legal framework on enterprises, the Competition Law and the conditions to access finance ... These legal frameworks need to be completed and stabilized so that businesses can feel secure to invest in research and development activities. The State adopts tools such as direct capital support or tax incentives to encourage enterprises to undertake R&D. The Government should promote the implementation of policies to attract FDI enterprises to invest in the production and trading of products with a high concentration of gray matter and facilitate these activities to spread to domestic enterprises. Public - private partnership programs on R&D and innovation should be encouraged to focus and utilize resources, and at the same time strengthen cooperation between state research institutions and domestic and FDI enterprises. It is necessary to avoid spreading investment, pouring capital into many research facilities belonging to different channels such as the Ministry, the Ministry of Science and Technology, the Department of Science and Technology ... on the same research issue. Develop a clear strategy for division of labor among state research agencies to ensure there is no overlap, lack of resources, and the scale does not reach the optimal level in R&D research. For universities and research facilities, it is necessary to clearly identify their strengths, needs and concerns to identify the research focus and spearhead.

Thirdly, the solution group strengthens the supply-demand connection for the labor market. The state needs to improve the legal framework for the developed labor market. It is necessary to develop and improve laws such as the Employment Law, the Minimum Wage Law, the Labor Relations Law, the Occupational Safety and Health Law, the Law on Social Insurance, the Law on Unemployment, the Law on Vocational Training ... In accordance with market rules, protecting the legitimate interests of workers and employers, and creating favorable conditions for employees to participate in the labor market, improving Qualification, meet the needs of the market. In addition, the





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State needs to consider and ratify conventions of the International Labor Organization related to the labor market. The Government, primarily the Ministry of Information and Communications, should coordinate with the Ministry of Labor, Invalids and Social Affairs to develop a system to provide career-oriented information, an employment service system and an information system. The labor market makes it easy for employees and employers to grasp information and connect with each other. It is necessary to step up the application of modern technology to connect domestic and international labor supply and demand.

## CONCLUSION

Over the past years, Vietnam has taken advantage of the positive effects of the industrial revolution 4.0 to develop the domestic and international labor market to meet the requirements of socio-economic development. However, the industrial revolution 4.0 also poses many challenges to the development of the labor market, requiring Vietnam to synchronously implement the above solutions to develop our country's labor market in the context of industrial revolution 4.0, contributing to building a sustainable society, for human development.

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**RESEARCH ARTICLE** 

# Utilization of Blood and Blood Components in a Tertiary Care Hospital, Salem, Tamilnadu – A Prospective Observational Study

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## ABSTRACT

Blood components are one of the mean by which the increasing demand and short supply can be met with. Blood is an expensive, scarce resource for saving the life many needy persons. As there are no alternatives to human blood till now, though there are presence of some RBC and platelets substitutes but they are not still available. It is well known that errors in blood transfusion practices can lead to serious consequences for the recipient in terms of morbidity and mortality. The guidelines provides a standardize approach to transfusion so that the potential for errors is minimized and the administration of safe and efficacious blood products in the health care setting is maximized. They have protocol for the investigation and treatment of adverse reaction and provide guidelines for the use of specialized blood products. The patient with acute blood loss should receive effective resuscitation immediately and the need for transfusion is estimated. Ordering the blood for transfusion must be recorded by the clinicians. Trained staff must monitor patient undergoing transfusion and respond immediately if there are any signs of adverse effect.

Keywords: Utilization, Blood, Blood components, Prospective.





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## **INTRODUCTION**

Blood is a fluid connective tissue that helps in delivering necessary substances such as nutrients and oxygen to the cells and transport metabolic waste products away from the same cells. Blood consists of four components, plasma, red blood cells, white blood cells and platelets. There are no substitutes to the blood. The main reason to donate blood is to save lives. In fact, every two seconds of every day, someone needs blood. Some blood cannot be manufactured outside the body and has a limited shelf live, the supply must constantly be replenished by blood donors.37% of population is eligible to donate blood, yet 5% actually donate. Most of them are still in a trail phase [1,2]. The purpose of blood transfusion is to replace the lost blood, to increase the flow rate of cardiac, to increase blood elements, to replace the missing clotting factors and immune system elements. Blood transfusion was first performed by James Blundell in 1818 [3]. It has been estimated that the patients admitted to intensive care unit in the developed world receive blood transfusion. The blood components implies separation of whole blood into various components like packed red cells (PRBC), platelets rich plasma, fresh frozen plasma, cryoprecipitate and leucocytes [4-8]. Every blood bank should formulate its own guidelines in relationship to local requisitions from various healthcare providers so that there is no delay in supply of the required product and also there is no undue wastage. Auto transfusion (autologous blood transfusion) is a unique approach of providing the patients with their ownblood and it helps to avoid the use of allogenic blood. Hence this study was designed to evaluate the transfusion practices in a tertiary care hospital over a period of 6 months and to analyze the utilization pattern of each blood products on age group, gender and disease condition requiring transfusion [9].

## METHODOLOGY

The Prospective study was conducted to evaluate the utilization of blood and blood related components in a tertiary care hospital of Salem district over a period of 6 months from November 2018 – April 2019 by visiting the departments and collecting the case sheet from patients and recording the details required to evaluate. We collected the details from 440 patients to evaluate the utilization of blood and blood related components. We recorded the patients name, age, gender, blood components needed, indication, department where the patients admitted and from where they got the needed blood products.

## **RESULTS AND DISCUSSION**

440 patients were included in this study. The cases were collected from the department of VMKV Medical College & Hospital Salem district Tamil Nadu. The purpose of this study is to evaluate the utilization of the blood and blood related products. Out of 440 patients, 170 (38.6%) patients were male and 270 (61.4%) patients were female.

## Distribution based on age

The age wise distribution was made among the patients with different age groups such as 0-20, 21-40, 41-90, 41- 60, 61 - 80 and 80 - 100 The number of patients present in each age group was 26 (6%), 158 (36%), 85 (19%), 126 (29%) and 45 (10%) respectively.

## Distribution based on overall request by the Departments

The overall distribution of blood and blood components was analyzed in departments such as Surgery, General medicine, Gynaecology, Paediatrics, Orthopaedics and Others was 50 (11.36%), 108 (24.5%), 130 (29.5%), 16 (3.6%), 74 (16.8%) and 62 (14.1%).





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#### Amount of blood and blood components utilized

The amount of blood and blood components used for 440 patients was shown. The units used by the patients were Whole blood 17,200 ml (14.5%), Packed red cells 97,320 ml (82.1%), Platelets 1300 (1.1%) and Fresh frozen plasma 2700 (2.3%).

#### Blood components utilized based on months

The patient's details were collected from November 2018 to April 2019. Total number of patient's month wise is November 63 (14%), December 44 (10%), January 82 (19%), February 111 (25%), March 80 (18%) and April 62 (14%)

#### Blood transfusion based on diagnosis

Based on the disease conditions of the patient blood was transfused. The number of patient transferred blood and blood components are anemia 141 (32%), abnormal uterine bleed 72 (16.3%), carcinoma 28 (6.3%), diabetic foot ulcer 18 (4%), tuberculosis 11 (2.5%), thyroid diseases 18 (4%), orthopaedics 92 (21%), gastric diseases 20 (4.5%) and others 40 (9%). A prospective study was conducted to analyze the utilization of blood and blood products in a tertiary care hospital, Salem, Tamilnadu from November 2018 to March 2019 for 6months. Among 440 patients, 170 (38.6%) were male and 270 (61.4%) were female. Out of this female has the majority of blood transfused. The patients in the ward both male (62.4%) and female (85.2%) has the highest blood transfusion done among the ICU, Operation theatre and casualty. The patient's blood transfusion was categorized based on the age, 0-20 (6%), 21-40 (36%), 41-60 (19%), 61-80 (29%), 81 – 100 (10%). In the department wise, Gyneacology (29%) patients have highest blood transfusion done. The packed red cells (82.1%) were highly consumed among the other blood products. On February 25% of patients transfused blood and the anemia patients (32%) has majority of blood transfused. The pattern of blood and blood products utilization was conducted to help in minimizing the wastage of blood components and there is no wastage of blood and blood components and all the blood collected for transfusion were utilized properly during the study period. Blood and blood components are a very important resource and hence should be used in a justifiable manner. The pattern of utilization of blood and blood components from a tertiary care hospital is surveyed from the reports of monitoring blood and blood components as the blood bank is attached to the hospital. This helps in minimizing the wastage by case of allocation of reserved but unutilized blood components bought from the blood bank is utilized in the period of the study.

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## Table 1: Distribution based on gender

Gender	No. of patients	Percentage (%)
Male	170	38.6
Female	270	61.4

#### Table 2: Age wise distribution

Age	No. of patients	Percentage (%)
0 - 20	26	6
21 - 40	158	36
41 - 60	85	19
61 - 80	126	29
81 - 100	45	10

#### Table 3: Overall request based on Departments

Department	Number of request	Percentage %	
Surgery	50	11.3	
General medicine	108	24.5	
Gyneacology	130	29.5	
Paediatrics	16	3.6	
Orthopaedics	74	16.8	
Others	62	14.1	

#### Table 4: Utilized amount of blood and blood components

Blood components	Amount/quantity (ml)	Percentage %	
Whole blood	17,200	14.50	
Packed red cells	97,320	82.10	
Platelets	1300	1.10	
Fresh frozen plasma	2700	2.30	

#### Table 5: Utilization based on month

Month	Ward	ICU	ICU Casualty Operation theatre		Percentage (%)
November	46	8	7	2	14
December	30	7	6	1	10
January	58	10	14	0	19
February	98	5	7	1	25
March	56	15	9	0	18
April	50	7	3	2	14



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#### Table 6: Blood transfusion based on diagnosis

Diseases	Total no. of patients	Percentage (%)	
Anemia	141	32	
Abnormal uterine bleed	72	16.3	
Carcinoma	28	6.3	
Diabetic foot ulcer	18	4	
Tuberculosis	11	2.5	
Thyroid diseases	18	4	
Orthopaedics	92	21	
Gastric diseases	20	4.5	
Other	40	9	





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**RESEARCH ARTICLE** 

# Vertical Stratification and Feeding Guilds of Birds in *Prosopis juliflora* Dominated Habitat in Udaipur, Rajasthan, India

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## ABSTRACT

The aim of this study was to analyze vertical stratification and feeding guilds of birds in *Prosopis juliflora* dominated habitat in Udaipur district. Total 4431 birds individual were recorded, they belonging to 37 species, 22 families and 4 feeding guilds namely- frugivore, insectivore, nectivore and omnivore. The maximum number of individuals were belongs to insectivore (1672) followed by granivore (1667), omnivore (778), furgivore (246) and minimum number of individuals were recorded to nectivore (68). Furgivore birds were restricted only in above canopy area due to maximum number of *Prosopis juliflora* seeds were present in above canopy areas. Earth surface contain high amount of seeds and grain as compared to other strata, leads to maximum grainvore birds observed at ground level. Significant difference in average feeding guild were observed at above canopy, p<0.0001. It was observed that different feeding guild in above canopy was 246 compared to 29.87 $\pm$ 24.348 in insectivore, grainvore 66.63 $\pm$ 71.552, nectivore 13, and omnivore 28.75 $\pm$ 36.204. Pearson product correction was positively observed between different canopies including above and under canopy (r=0.364), above and ground (r=0.534), inside and under (r=0.534) and under & ground (r= 0.507).

Keywords- Vertical stratification, Prosopis juliflora, canopy, feeding guild, Udaipur.

## INTRODUCTION

All available resources utilization by birds communities were shown due to limited availability of food and habitat. Resources partitioning causes avoidance of prey-predator competition and increase chance of individuals survival (Cody, 1974). Vertical stratification is a spatial division of birds on the basis of canopy preference (Mac Author and





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Mac Author, 1961). Mac Author & Mac Author (1961), correlated tree height canopy cover and bird's diversity influence bird's distribution towards canopy preference. Tramer (1969) also studied response of bird's population towards canopy layering (Mac Author and Mac Author, 1961; Tramer, 1969). Inter and an intra specific interaction including competition, habitat utilization, predator prevention and all these factors are responsible for resource partitioning and avoidance of predator risk and reduce competition in ecosystems (Meserve, 1977; Holbrook, 1979; Ren et al., 2001). Vertical stratification may reduce inter specific competition among animals groups and enhance degree of co-existence within different species in similar habitat (Schoener 1974; Carmeron and Kincaid 1982; Barry et al., 1984). Resource partitioning play significant role in the creation of microhabitats and providing equal opportunities of play functional role within same habitat and by different species, on the basis of different resources requirement and niche separation (Tokeshi 1998; Diaz, 2006). Horizontal and vertical habitat partition creates diverse ecological niche for species survival, all of these species in same ecological community co-exists through niche separation on the basis of stratification among habitat (Tokeshi 1998; Diaz, 2006). Habitat examined to be particular locality, sites of environment where animals were living and performing all functional roles necessary for survival (Mac Author, 1972). Various attributes like 'spatial and temporal variation' consequently influenced species diversity, density and distribution pattern of animals in ecosystem (Jones, 2001; Johnson 2007). Vertical and horizontal were main components of habitat gradient which creates habitat heterogeneity, results of heterogeneity leads to species diversity among ecosystem (Kristanm, 2007; Zozaya et al., 2011).

Relationship between birds and habitat provides important information about health of ecosystem and habitat quality. Birds are important bio-indictor taxa towards changes among environment system and also hold important position in food web and food chain (Cody, 2001; Okes *et al.*, 2008; Wood *et al.*, 2013). Vegetation diversity, density and co-existence were main factors responsible for richness of birds (Cody, 2001). The vegetation distribution pattern significantly influences the vertical distribution of birds (Pearson, 1975; Jayson and Mathew, 2003). Height of Vertical distribution of birds can determine the abundance of birds in particular habitat (Roth, 1976; Robin and Davidar, 2002; Naka, 2004). Most of studies on resource partitioning were focused to asses availability of resources, interaction of prey and predator, beak size, foraging behavior (Burton, 1972; Wilson 1972), prey abundance (Gross-custard, 1970) and pattern of habitat utilization by animals (Pearson, 1971; Schoener, 1967; Schoener and Schoencer, 1971). Food requirement was not only factor responsible for various stratification among animals also required undisturbed habitat for reproduction and nesting places (Burger, 1978). Coexisting species having separate niches or ecological needs for their survivals by avoiding inter specific competition, performing various functional strategies like partitioning of resources along temporal, spatial and behavioral niches axes separation (Cody 1974; Sochoener, 1974). Study have been made for patterns of canopy preference, feeding guild and resource partitioning by bird's community in *Prosopis juliflora* dominated area in Udaipur region, Rajasthan.

## MATERIALS AND METHODS

Birds were observed along line transect in *Prosopis juliflora* dominated habitat in Udaipur. Total four transects were designed for study of vertical stratification and resource portioning by birds, weekly observation were taken throughout study period (May, 2019 to June, 2020) in early morning and late evening. Transects length was not fixed due to cutting of trees by villagers due to fulfill demands of fuel and fodder, approximate transects were 100 to 250 meter in length in *Prosopis juliflora* dominated area. Birds were recognized by using standard field guild Birds of Indian subcontinent and Birds of Rajasthan (Grimmet *et al.*, 2011 and Vyas R. 2014). The relationship between common bird species abundance and height of *Prosopis juliflora* were analyzed with various statistical tests including Pearson correlation, box plot by using SPSS and R software.

*Prosopis juliflora* dominated area divided into four canopies - according to their height and Canopies- Above canopy, inside canopy, under canopy and ground.



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- 1. Above canopy- is an upper most part of tree.
- 2. Inside canopy- Central part and branching area of tree, below and above canopy.
- 3. Under canopy- It is almost all parts of tree above ground level.
- 4. Ground- On earth surface and open ground areas in Prosopis juliflora dominated habitat.

## **RESULT AND DISCUSSION**

Animal organization hold and occupy their position by the availability and distribution of resources in habitat; resources partition occurring in animal community due to avoidance risk of direct competition and increase species co-existence & survivorship in ecosystem (Diamond, 1973; Simberl off, 2004; Blake, 2007). Almost 8.7 million animal's species co-exists on earth and many species live together and share same habitats for its survival (Mora *et al.*, 2011). When different species live and share similar habitat for activities like- food, shelter, foraging and resting leads to species complexity among ecosystem (Sechoener, 1974). For every species, the ecological niches are defined for each and every it does fulfill requirements with different resources in same habitat areas (Townsent *et al.*, 2008). When resources partitioning occurs in any direction in ecosystem, these types niche called multidimensional resource partition (Schoener, 1974). Schoener (1974) suggested that multidimensional niche concept is required for fulfill demands of diets and living habitats (Schoener, 1974). Spatial isolation of species may result different foraging habitat (Pita *et al.*, 2010) or foraging at different canopy on tree (Vieira and Montano-Filho, 2008; Voigt, 2010). Availability of food and resources depends upon the characteristics of habitat quality in spatial and dietary dimension (Townsend *et al.*, 2008). Spatial heterogeneity such as vertical stratifications and complexity determine the pattern of animal distribution and reduces inter & intra specific competitions due to niche segregation and increase degree of co-existence (Vieira and Monteiro-Filho, 2003; Carvalho *et al.*, 2013).

Present study indicates vertical stratification and distribution of birds in Prosopis juliflora dominated habitat in Udaipur district on the basis of their distributions and feeding guilds. During study we recorded total 37 species of birds belonging to 22 families. Birds were categorized into four groups on the basis of feeding behavior, namely frugivore, insectivore, granivore and nectivore. Maximum bird species belonging to insectivore (15) followed by omnivore (12), Granivore (8) and minimum species belonging to nectivore (1) and frugivore (1) species (Table-1). We recorded total 4431 birds species in all canopies namely- Above, inside, under and ground. Out of these frugivore birds restricted in only above canopy areas. Total 1667 birds individuals belonging to granivore; out of them maximum birds were observed in ground level (850) followed by above canopies (533), inside canopy (150) and minimum observed at under canopy area. Maximum numbers of granivore birds at ground indicate high abundance and density grains and seed present on earth surface as compared to other canopies strata. Maximum insectivore bird was observed at inside canopy (544) followed by ground (501), above canopy (448) and minimum in under canopy (179) region. During study minimum number of bird's species belonging to frugivore and nectivore. Nectivore and frugivore were poorly distributed in Prosopis juliflora dominated habitat, only single species of 68 individuals of purple sunbirds were reported. Rose ring parakeet belongs to frugivore feeding guilds, total 246 individuals were reported in above canopy area of Prosopis juliflora. 12 bird's species and 778 individuals were observed to omnivore guilds, out of them 345 were observed at above canopy followed by 320 grounds, inside canopy 75 and 38 at under canopy strata.

There is a significant difference in average feeding guild in the above canopy, p<0.0001. It was observed that average feeding guild for frugivore in above canopy is 246 compared to  $29.87\pm24.348$  in Insectivore, granivore  $66.63\pm71.522$ , nectivore (13) and omnivore  $28.75\pm36.204$ . There was no significant difference in average feeding guild in the inside canopy, p=0.2777. It was observed that average feeding guild for granivore in inside canopy  $18.75\pm20.429$  compared to  $36.27\pm54.255$  in insectivore, nectivore 53, and omnivore  $6.25\pm9.668$ . There were no significant difference in average feeding guild in the under canopy, p=0.34. It was observed that average feeding guild for granivore in the under canopy was  $16.75\pm19.107$  compared to  $11.93\pm18.699$  in insectivore, nectivore 2, and omnivore  $3.17\pm6.043$ . There were



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no significant difference in average feeding in the ground, p=0.054. It was observed that average feeding guild for granivore in the ground is  $10.625\pm116.319$  compared to insectivore  $33.4\pm40.023$  and omnivore  $45.16\pm67.289$  (Table-2). A Pearson product correlation was run to determines relationship between different canopies (above, inside, under and ground). There was a statically positive correction observed between above and under canopy (r=0.364), in between above and ground (r=0.534), in between inside and under canopy (r=0.534) and under & ground (r=0.507).

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#### Table1. Birds species recorded at different canopies in Prosopis juliflora dominated habitat

Srno	Family	Common Namo	Zoological Namo	Feeding
51.110	Fainity	Common Name	Zoological Name	guild
1.	Upupidae	Green bee eater	Merops orientalis	Insectivore
2.	Columbidae	Eurasian Collared dove	Streptopelia decaocto decaocto	Granivore
3.	Cisticolidae	Common Tailor bird	Orthotomus sutorius guzuratus	Insectivore
4.	Nectarinidae	Purple sunbird	Nectarinia asiaticus asiaticus	Nectivore
5.	Passeridae	House sparrow	Passer domesticus indicus	Insectivore
6.	Ploceidae	Baya weaver	Ploceus philippinus philippinus	Granivore
7.	Hirundinidae	Common Swallow	Hirundo rustica	Insectivore
8.	Pycnonotidae	Red vented bulbul	Pycnonotus cafer	Omnivore
9.	Timaliidae	Seven sister babbler	Turdoides malcokmi	Granivore
10.	Turdidae	Indian Robin	Saxicoloides fulicatus cambaiensis	Insectivore
11.	Psittacidae	Rose ring parakeet	Psittacula krameri parvirosnis	Frugivore
12.	Phasianidae	Indian Peafowl	Pavo cristatus	Omnivore
13.	Charadriidae	Red wetted lapwing	Vanellus indicus indicus	Insectivore
14.	Columbidae	Laughing dove	Streptopelia senegalensis cambayensis	Granivore
15.	Ardeidae	Cattle egret	Bubulcus ibis	Insectivore
16.	Columbidae	Red collared Dove	Streptopelia tranquebarica	Granivore
17.	Corvidae	House crow	Corvus splendens splendens	Omnivore
18.	Cisticolidae	Common chip chaff	Phylloscopus collybita	Insectivore
19.	Cuculidae	Asian koel	Eudynamys scolopaceus scolopaceus	Omnivore
20.	Sturnidae	Brahmin starling	Sturnus pagodarum	Omnivore
21.	Sturnidae	Asian Pied starling	Gracupica contracontra	Omnivore
22.	Phasianidae	Indian Grey Francolin	Francolinus pondicerianus	Omnivore
23.	Cuculidae	Greater cukkal	Centropus sinensis sinensis	Omnivore
24.	Leiothrichidae	Jungle babbler	Turdoides malcokmi	Granivore
25.	Corvidae	Jungle crow	Corvus macrorhynchos	Omnivore
26.	Dicruridae	Black drogue	Dicrurus macrocercus minor	Insectivore
27.	Columbidae	Rock pigeon	Columba livia intermedia	Granivore





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Upupidae	Common hoopoe	Upupa epops		

28.	Upupidae	Common hoopoe	Upupa epops	Insectivore
29.	Laniidae	Bay bake shrike	Lanius vittatus nargianus	Insectivore
30.	Corvidae	Rufus tripe	Dendrocitta vagabunda	Omnivore
31.	Muscicapidae	Siberian stone chat	Saxicola maurus maurus	Insectivore
32.	Estrildidae	Silver bill	Spermestes fringilloides	Insectivore
33.	Cisticolidae	Ashy perinea	Prinia socialis stewarti	Insectivore
34.	Cisticolidae	Plain perinea	Prinia inornata inornata	Insectivore
35.	Columbidae	Spotted dove	Streptopelia chinensis chinensis	Granivore
36.	Estrildidae	Red Munia	Amandava amandava	Omnivore
37.	Sturnidae	Common Myna	Acridotheres tristis	Omnivore

#### Table 2- Canopy and feeding guilds wise distribution of bird's groups

Canopy	Frugivore (N=1)	Granivore (N=8)	Insectivore (N=15)	Nectivore (N=1)	Omnivore (N=12)	Total (N=37)	p value
Above Canopy	246	66.63±71.522	29.87±24.348	13	28.75±36.204	42.84±55.308	< 0.0001
Inside canopy	0	18.75±20.429	36.27±54.255	53	6.25±9.668	22.22±38.267	0.277
Under Canopy	0	16.75±19.107	11.93±18.699	2	3.17±6.043	9.54±15.802	0.347
Ground	0	106.25±116.319	33.4±40.023	0	26.67±22.861	45.16±67.289	0.054







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**RESEARCH ARTICLE** 

# Isolation and Identification of Bioactive Compound from Essential Oil of *Cannabis sativa* and Its Fungi toxic Efficacy against Pathogens of Paddy Plants

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## ABSTRACT

Essential oils extracted from ten angiospermic plants were screened against *Cochliobolus miyabeanus* and *Fusarium moniliforme*, the pathogens of paddy plants. The oil extracted from the young leaves of *Cannabis sativa* proved to be fungi toxic at  $1.0 \times 10^3 \mu l/l (v/v)$  concentration. The bioactive antifungal compound was isolated from the essential oil of *Cannabis sativa* and identified on the basis of IR, NMR and UV data. The Minimum Inhibitory Concentration (MIC) of bioactive compound against the test fungi was also determined.

Keywords: Essential oil, Cochliobolus miyabeanus, Fusarium moniliforme, Bioactive compound.

# INTRODUCTION

Synthetic chemical fungicides that combat seed borne pathogenic fungi can increase crop yields and provide stability of crop production and market quality. However, chemical fungicides are very costly and cause serious problems. Indiscriminate use of chemical fungicides has resulted in the development of fungicide resistant pathogenic strains (Staub, 1991) and accumulation of fungicide residues in the food chain above safe limits (Khoshoo, 1986; El-Nahhal, 2004.). During the last decades there has been a global awareness that excessive and improper use of chemical fungicides is hazardous to the health of humans, animals, and the environment, therefore an extensive research on fungicides of plant origin is being carried out. Plants are the reservoir of biological active compounds to combat various pathogens. During recent years plants and plant products specially, essential oils have been found to possess antifungal efficacy (Dubey & Tripathi, 1987; Singh & Tripathi, 1999, Burt, 2004). Several bioactive compounds are widely distributed in plants which have been reported to exert multiple biological effect, including antioxidant, anti-inflammatory and anti-carcinogenic (Ganga Rao *et al.*, 2011). Essential oils are generally assumed to be more


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acceptable and less hazardous to the health and environmentally safe and could be used as alternative remedies for treatment of plant diseases (Chuang *et al.*, 2007). The penetrating effect of essential oils can also be exploited to control deep seated seed borne pathogens. Keeping this in view, a project was undertaken to evaluate the antifungal efficacy of the essential oils coupled with isolation and identification of their bioactive compounds in order to explore the possibility of their use as an alternative to synthetic chemical fungicides which are used as seed dressers. In the present communication our findings on antifungal efficacy of the essential oil of *Cannabis sativa* and its bioactive compound are reported

## MATERIALS AND METHODS

#### **Isolation of Essential Oil**

Five hundred grams of young leaves of *Cannabis sativa* was surface sterilized by dipping in 2 % sodium hypochlorite solution for 5 minutes and thoroughly washed with sterilized double distilled water and finally chopped into small pieces before subjecting to hydro distillation in a Clevenger's apparatus. The volatile fraction thus obtained after hydro distillation for 8-10hours, exhibited two distinct layers: an upper aromatic oily layer and a lower colourless aqueous layer. The amount of oil thus recovered was noted in terms of per cent recovery on fresh /dry weight basis according to the material used. The oil was stored at low temperature  $(4 - 6^{\circ}C)$  for further use.

#### Test fungi and Growth Conditions:

The essential oil extracted from *Cannabis sativa* was assayed for fungitoxic activity against the fungal strains *Cochliobolus miyabeanus* and *Fusarium moniliforme*. These fungi were grown on PDA plates at  $27^{\circ}C \pm 2^{\circ}C$  and maintained with periodic sub – culturing at 4°C. Both of these fungi are pathogens of paddy plants.

#### Fungi toxic evaluation of Cannabis sativa essential oil

The fungi toxic efficacy of essential oil extracted from *Cannabis sativa* was determined against the test fungi by 'Poisoned Food Technique' (Arora and Dwivedi, 1979). For treatment sets, 1 ml of the essential oil was mixed with 9 ml of molten PDA medium in a pre sterilized Petri plate and the contents were agitated in a circular mode in order to mix the essential oil homogeneously. In control sets, 1 ml of sterilized double distilled water was added in place of the essential oil. A fungal disc (5 mm in diameter) cut from the periphery of 7 days old culture of different test fungi with the help of flame sterilized corkborer, served as inoculums. The plates were incubated for 7 days at  $27 \pm 2^{\circ}$ C. Colony diameters in mutual perpendicular directions were measured on the seventh day in assay plates. Fungitoxicity was recorded in terms of the percent inhibition of mycelial growth and calculated using the following formula (Vincent 1947):

Percent Inhibition = 
$$\frac{dc - dt}{dc} \times 100$$

Where,

dc = average diameter of fungal colony in control sets

dt = average diameter of fungal colony in treatment sets

The experiments were repeated twice and each set contained four replications.

#### Isolation of Bioactive compound

In order to isolate the bioactive antifungal compound, the oil was subjected to column chromatography. A clean and dried pyrex glass column was packed with silica gel 'A' using acetone as solvent. 10 ml of the oil was placedat the top of the column. The column was eluted with ethyl acetate, diethyl ether, chloroform, and ethyl alcohol. Elutants were collected as fractions of 10 ml. Total 64 fractions were collected and tested for their antifungal activity against both the test fungi employing modified paper disc techniques of Tripathi and Dixit (1977). Ethylacetate: actone (1: 1) fractions completely inhibited the mycelial growth of both the test fungi. These fractions were therefore, pooled



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together and subjected to TLC using hexane:ethyl alcohol (4 : 1) as solvent. The TLC of the pooled fraction when developed in an iodine chamber exhibited the presence of single circular spot with Rf 0.66. The fraction was therefore subjected to distillation under reduced pressure. The removal of solvent resulted in the isolation of an oily liquid with camphor like odour. The boiling point of this water-soluble liquid was found to be  $172 \pm 1^{\circ}$ C. Identification of compound 'A' was made on the basis of data obtained from UV, IR and NMR studies. Confirmation of the compound isolated was made by mixed boiling point determination and super imposible I. R.

## RESULTS

Essential oils extracted from ten plants at 1.0 X 10<sup>3</sup> µl/l, 2.0 X 10<sup>3</sup> µl/l and 3.0 X 10<sup>3</sup> µl/l concentrations were screened against *Cochliobolus miyabeanus* and *Fusarium moniliforme*. Only the oil of *Cannabis sativa* exhibited complete inhibition of the mycelial growth of both the test fungi at all concentrations (Table: 1). The minimum amount of oil needed for complete inhibition of growth (i.e., MIC) of fungi was 1.0 X 10<sup>3</sup> µl/l (v/v) the vapors emitted by the oil at this dose proved cidal to the test fungi (Table: 2). the IR spectra of the compound 'A' isolated from the oil (Figure. 1 A) showed absorption bands at 2960 cm<sup>-1</sup>, 2920cm<sup>-1</sup> for aliphatic C-H stretching; 1380 cm<sup>-1</sup>, 1365 cm<sup>-1</sup> for geminal dimethyl group  $\sum_{c \in CH_3}^{CH_3}$  and 1455 cm<sup>-1</sup> for aliphatic C-H bending vibrations. These data suggested that the compound under investigation is an aliphatic compound and contains a geminal dimethyl group. The NMR spectra of the compound 'A' demonstrated (Figure : 1 B)the presence of a six proton sharp doublet at  $\delta$  1.15 (J= 10Hz), a three proton singlet at  $\delta$  1.20, eight proton broad singlet at  $\delta$  1.40 –  $\delta$ 2.15 and one proton heptet at  $\delta$ 2.55. doublet at  $\delta$ 1.15 is indicative of the presence of a geminal dimethyl group in the molecule. The peak at  $\delta$ 1.20 is due to the presence of a methyl group attached to a tertiary carbon atom. Absorption peaks at  $\delta$ 1.40 to  $\delta$ 2.15 indicated the presence of four methylene units of a cyclohexane ring.

The methine proton of a geminal dimethyl group  $\mu^{-c} \subset_{CH_3}^{CH_3}$  resonated as a distorted heptet at  $\delta 82.55$ . These NMR data suggested that the compound is derivative of cyclohexane and contains a methyl group and an isopropyl group at para positions. The UV spectra of the compound 'A' did not show absorption band above 240 nm (Figure: 1 C). This suggested the absence of chromophoric group like c = 0 aromatic ring etc. On the basis of IR, NMR and UV spectra, the compound 'A' was identified as 1, 4 – cincole. The boiling point of the compound  $172 \pm 1^{\circ}$ C recorded herewith also confirms the boiling point of 1, 4 – cincole. Mixed boiling point determination exhibited no depression in boiling point. The IR of authentic 1, 4 – cincole sample was found more or less super imposable to the IR of the isolated liquid. The identity was thus confirmed to be the 1, 4 – cincole. The Minimum Inhibitory Concentration (MIC) of 1, 4 – cincole against the test fungi was recorded table: 3.

## DISCUSSION

Essential oils have traditionally been used for centuries for their antifungal properties (Rios & Recio, 2005). There are enough references that higher plants emit volatile substances which keep the air remarkably free from pathogenic organisms. Essential oils from various angiospermic plants have been reported by different workers to possess fungitoxicity (Chandra *et al*, 1982, Tripathi *et al*. 1986, Chaudhary *et al*. 1995, Singh & Tripathi, 1999). The essential oils of *Cymbopogon citratus*, *Caesulia axillaris* and *Mentha arvensis* have shown fumigant activity against storage fungi in wheat, specifically *Aspergillus flavus* and the insect pests, *Sitophilus oryzae* and *Tribolium castaneum* (Varma and Dubey, 2001). Sahayarani (2003) reported that wintergreen oil effectively inhibited the spore germination of a powdery mildew pathogen of *Phyllanthus niruri*. Aromatic plants such as members of the Asteraceae, Lamiaceae, Rutaceae, and Verbenaceae contain essential oils which have bioactivity against several fungi (Lahlou 2004). The antifungal activity of the essential oils can be accounted for the presence of chemically different active constituents (Mahadevan 1982). Tripathi *et al*,(1986) isolated p-cymene as fungitoxic factors of *Trachyspermum* oil and recorded their fungitoxicity against *Aspergillus flavus* and *A. niger*. Dubey *et al*, (1990) reported geraniol as active antifungal principle of oil *Zanthoxylum alatum*. Nakahara *et al*. (2003) reported geraniol,  $\alpha$ -pinene,  $\beta$ -pinene, myrcene, and





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linalool as bioactive antifungal substances of oil *Cymbopogon nardus* and *Corymbia citriodora*. Essential oil of *Pelargonium graveolens* with high presence of citronellol and geraniol was found to be highly active against *Rhizoctonia solani* (Bouzenna and Krichen 2013). In the present study, the fungi toxicity of the essential oil of *Cannabis sativa* of family cannabaceae is being reported against the fungi *Cochliobolus miyabeanus* and *Fusarium moniliforme* causing diseases on paddy plants. The bioactive antifungal compound 1, 4 – cineole was isolated, identified and studied for its antifungal efficacy against the test fungi. The present study thus clearly reveals that essential oil from the leaves of *Cannabis sativa* may prove an ideal antifungal fumigant. However *in vivo* trials are pre-requisite before making any commitment regarding its practical utility as fumigant, seed protectant or seed disinfectant.

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## CONCLUSION

Synthetic chemical fungicides are effective in controlling plant diseases, but these are very costly, non-biodegradable, carcinogenic, pollutive, hazardous to the health of humans and animals. Therefore, it is a pressing need of this era to develop new models of fungi-toxicants, procurable from renewable resources, easily biodegradable, non-toxic and non-pollutive. Plants and their products especially essential oils are considered as the best natural weapon to control fungal diseases on economically important crop plants. These are environmentally safe, biodegradable, non-toxic to humans & animals and have no side effects on crops. The present study reveals that among the essential oils tested, *Cannabis sativa* oil showed significant antifungal activity against the mycelial growth of test fungi. Further, bioactive antifungal compound was isolated, identified as 1, 4 – cineole and studied for its antifungal efficacy against the test fungi. The results suggest the promising potential of essential oil of *Cannabis sativa* and its bioactive compound 1, 4 – cineole for the use as a fungi-toxicant to control the pathogens of paddy plants. However, before making any suggestion regarding the practical utility of *Cannabis sativa* oil and its bioactive antifungal compound on a commercial basis, *in vivo* investigations are required.

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Table : 1 Screening of essential oils for their fungitoxicity									
		V:-14	Percent inhibition of mycelial growth						
Essential oil	Part		Cochliobolus miyabeanus			Fusarium moniliforme			
Tested	Used	Tielu	1 X 10 <sup>3</sup>	2 X 10 <sup>3</sup>	3 X 10 <sup>3</sup>	1 X 10 <sup>3</sup>	2 X 10 <sup>3</sup>	3 X 10 <sup>3</sup>	
			μ1/1	μ1/1	μ1/1	μ1/1	μ1/1	μ1/1	
Aegle marmelos Linn.	Logwoo	0.2	10	25	75	10	25	80	
(Rutaceae)	Leaves	0.2	19		75	10	35	80	
Ageratum conyzoides Rh.	Dhimanaa	0.02	25	40	100	25	20	100	
(Asteraceae)	Rhizome	0.02	25	40	100	25	38	100	
Alpinia carinata Linn.	Dhimanaa	0.2	10	42	02	20	40	02	
(Zingiberaceae)	Rhizome	0.3	1.3 19	42	05	20	42	03	
Cannabis sativa	Lograd	1.0	100	100	100	100	100	100	
Linn. (Cannabaceae)	Leaves	1.0	100	100	100	100	100	100	
Carum carvi Linn.	Emit	0.8	15	21	61	15	20	19	
(Apiaceae)	rruit	0.0	15	51	61	15	30	40	
Chenopodium album Linn.	Logwoo	0.2	21	20	E 4	21	20	6E	
(Chenopodiaceae)	Leaves	0.2	21	20	34	21	20	65	
Curcuma amada Roxb.	Phizomo	0.0	25	20	25	20	22	18	
(Zingiberaceae)	KIIIZOIIIe	0.9	23	29		29	32	40	



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<i>Lantana camara</i> Roxb. (Verbinaceae)	Leaves	0.5	20	22	53	20	28	56
Ocimum basilicum Linn. (Labiateae)	Leaves	0.4	28	68	82	28	63	85
Pavonia odorata Willd. (Malvaceae)	Root	0.2	23	68	80	28	66	88

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Table : 2 Minimum Inhibitory Concentration (MIC) of Cannabis sativa oil						
Concentration of oil	Percent Inhibition of Mycelial growth					
(µl/l)	Cochliobolus miyabeanus Fusarium moniliforme					
$3.0 \times 10^3$	100	100				
2.5 X 10 <sup>3</sup>	100	100				
2.0 X 10 <sup>3</sup>	100	100				
$1.5 \times 10^3$	100	100				
1.0 X 10 <sup>3</sup>	100	100				
$0.9 \times 10^3$	100	95.0				
0.8 X 10 <sup>3</sup>	72.0	82.0				

Table :3         Minimum Inhibitory Concentration (MIC) of 1, 4 - Cineole						
Concentration of oil	Percent Inhibition of	Percent Inhibition of Mycelial growth				
(µl/l)	Cochliobolus miyabeanus	Fusarium moniliforme				
$1.0 \times 10^{3}$	100	100				
$0.9 \times 10^{3}$	100	100				
$0.8 \times 10^{3}$	100	100				
$0.7 \times 10^{3}$	100	100				
0.6 X 10 <sup>3</sup>	91	93				
$0.5 \times 10^{3}$	78	80				









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**RESEARCH ARTICLE** 

# Environmental Impact of Heavy Metals in River Kodaganar of Dindigul District - A Review

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## ABSTRACT

There are more than 3000 tanneries spread all over India of which about 80% of the tanneries are in cottage and under small scale sector industries. These small scale industries play a major role in polluting environment by discharging the untreated tannery effluent and sludge to the adjoining land areas and water bodies for many years. The major tanning industries in India are located in the states of Tamil Nadu, Andhra Pradesh, Uttar Pradesh, Bihar, Gujarat, Maharashtra, Karnataka, Punjab, Rajasthan and West Bengal. The tannery industry uses basic chromium (Cr) sulphate [Cr (H<sub>2</sub>O)<sub>5</sub>(OH)SO<sub>4</sub>] for tanning process which is the major cause for high influx of chromium to the biosphere, accounting for 40% of the total industrial use. The environmental impact of heavy metals in River Kodaganar of Dindigul district was studied under ten zonesand analyzed in detail.

Keywords: ANOVA, heavy metals, tannery effluent.

## INTRODUCTION

The tannery effluent, sewage and agriculture waste water are continuously discharged into the river without any treatment. This in turn affects the quality of water and soil in the river. Soil is the main source of agriculture on the banks of the river but this soil is polluted by the tannery effluent water. There are about 110 elements in the periodic table out of which 83 are metals. Most of these metals occur in small trace amounts in water, sixty-eight of these metals have a density five times to water and hence termed as heavy metals. The addition of the metal ions to natural water systems involves all anthropogenic activities ranging from large tannery industries to activities at home. There are 35 metals that concern us because of occupational or residential exposure;23 of these are the heavy elements : antimony, arsenic, bismuth, cadmium, cerium, chromium, cobalt, copper, gallium, gold, iron, lead, manganese ,mercury, nickel, platinum, silver, tellurium, thallium, tin, uranium, vanadium and zinc. Interestingly, small amounts





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of these elements are common in our environment and diet and are actually necessary for good health, but large amounts of any of them may cause acute or chronic toxicity (poisoning). Even the vegetation along the road side of the industries are much affected [1]. The NAQI is much useful in defining the status of air in the affected areas [2]. Heavy metal toxicity can result in damaged or reduced mental and central nervous function, lower energy levels and damage to blood composition, lungs, kidneys, liver and other vital organs. Long-term exposure may result in slowly progressing physical, muscular and neurological degenerative processes that mimic Alzhemier's disease, Parkinson's disease, muscular dystrophy and multiple scleroses. Allergies are common and repeated long-term contact with some metals or their compounds may even cause cancer. For some heavy metals, toxic levels can be just above the background concentrations naturally found in nature. Therefore, it is important for us to inform ourselves about heavy metals and to take protective measures against excessive exposure. In most parts of the United States, heavy metal toxicity is an uncommon medical condition; however it is clinically significant illness and reduced quality of life.In small quantities in milligrams, certain heavy metals are nutritionally essential for a healthy life. Some of these elements are referred to as trace elements (eg. iron, copper, manganese and zinc). These elements are commonly found naturally in food stuffs, in fruits and vegetables, and in commercially available multivitamin products. Heavy metals are also common in industrial applications such as in the manufacture of pesticides, batteries, alloys, and electroplated metal parts, textile dyes, steel and so forth. Many of these products are in our homes and actually add to our quality of life when properly used.

## EXPERIMENTAL

Ground water is the main source of drinking water in Dindigul [3]. The use of groundwater has increased for its good quality [4]. The water in and around Dindigul is polluted due to the increasing tanning units. There are 26 elements which are widely distributed in the human body and these are classified into three groups as in Table-1

- a) The Essential Elements: These are carbon, hydrogen, nitrogen, oxygen, sodium, potassium, calcium, magnesium, manganese, copper, zinc, iron, fluorine, cobalt and chlorine.
- b) Less Essential Elements: These are Barium, strontium, bromine, chromium, tin and nickel.
- c) Non-Essential Elements: Aluminum, lead, cadmium, silver and bismuth.

#### ANALYSIS OF HEAVY METALS

A list of different parameters are analysed and the methods of analysis is given below in Table-2. Water analysis for three heavy metals is presented in three different seasons for a period of two years (2018-19 and 2019-20). Calculations were carried out season-wise namely pre-monsoon, monsoon and post-monsoon.

#### STATISTICAL ANALYSIS

The statistical significance of heavy metals of surface water sample was brought out by Analysis of Variance (ANOVA).

#### Chromium

In order to find out the variation of Cr in the river water, Analysis of Variance (ANOVA) is carried out and the results are given below for two different period of study namely 2018-19 and 2019-20. Significant at 5 per cent level. It is portrayed from the computed results of ANOVA for the year 2018-19 that the season alone has significant role in explaining the variation of Cr in water. It is also observed that there is also interaction between season and distance in causing Cr level of variation in the study area. Significant at 5 per cent level. It is shown from the computed results of ANOVA for the year 2019-20 that the season alone has significant role in explaining the variation of Cr level in water. Moreover there is also interaction between season and distance in causing Cr variation.





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#### Copper

In order to test the variation of Cu in the river water, Analysis of Variance (ANOVA) is carried out and the results are given below for two different period of study namely 2018-19 and 2019-20.Significant at 5 per cent level. The above computed results of ANOVA for the year 2018-19 show that the season alone has significant role in explaining the variation of Cu in water. It is also observed that there is also interaction between season and distance in causing Cu level of variation in the study area Significant at 5 per cent level. It is found from the computed results of ANOVA for the season alone has significant role in explaining the variation of Cu level in the season alone has significant role in explaining the variation of Cu level in water. Moreover there is also interaction between season and distance in causing Cu level variation.

#### Zinc

In order to find out the variation of Zn in river water, Analysis of Variance (ANOVA) is carried out and the results are given below for two different period of study namely 2018-19 and 2019-20. Significant at 5 per cent level. It is portrayed from the computed results of ANOVA for the year 2018-19 show that the season as well as the distance has no significant role in explaining the variation of Zn in water. It is also observed that there is no interaction between season and distance in causing Zn level of variation. Significant at 5 per cent level. It is shown from the computed results of ANOVA for the year 2019-20 indicate that the season as well as the distance has no significant role in explaining the variation of Zn level in water. Moreover there is no interaction between season and distance in causing Zn level in water. Moreover there is no interaction between season and distance in causing Zn level in water.

## **RESULTS AND DISCUSSION**

The salient findings of the present investigation are summarized as follows; most of the tannery industries are discharging untreated effluents in the Kodaganar River without any treatment. They contain very toxic chemicals and heavy metals like chromium, copper and zinc. These heavy metals contaminate the Kodaganar river water along with other hazardous chemicals. These chemicals have decreased the quality of water. The effluent which are discharged continuously get accumulated in the river bed making the water unsuitable for domestic usage. Laboratory investigation reveals that the water quality parameters including heavy metals confirm the degradation of river water quality in the polluted zone. The river water near the effluent disposal stations in the high polluted zone (Z<sub>3</sub>) namely Pallapatty, Ponmandhurai pudhupatty, Kottapatty recorded high values of heavy metals than the standard value.

'Cr'-Among metals Chromium ranks 24<sup>th</sup> in order of abundance in the earth's crust, with an average concentration of 0.2 p pm. Chromium in nature cause harm to humans and its permissible limit is 0.02 ppm. It is shown that the computed results of ANOVA for the year 2018-19 explain that the season alone has significant role in explaining the variation of available chromium in water. It is also observed that there is also interaction between season and distance in causing chromium level of variation in Dindigul district. It is inferred that the computed results of Analysis of Variance for the year 2019-20 indicate that the season alone has significant role in explaining the variation of chromium level in water. Moreover there is also interaction between season and distance in causing chromium level is used in the season alone has significant role in explaining the variation of chromium level in water. Moreover there is also interaction between season and distance in causing chromium level is used to be the season alone has significant role in explaining the variation of chromium level in water. Moreover there is also interaction between season and distance in causing chromium level of variation in Dindigul district.

Cu' - Excess of Copper in human body is very toxic and it causes hypertension and produces pathological changes in brain tissues. Excessive ingestion of 'Cu' is responsible for specific disease of the bone. In the present study the level of 'Cu' is found to be higher than the standard value. It is shown that the computed results of ANOVA for the year 2018-19 explain that the season alone has significant role in explaining the variation of available copper level in water. It is also observed that there is also interaction between season and distance in causing copper level of variation in Dindigul district. It is inferred that the computed results of Analysis of Variance for the year 2019-20 indicate that the season alone has significant role in explaining the variation of copper level in water. Moreover there





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is also interaction between season and distance in causing copper level variation in the study zones of Dindigul district.

'Zn' – Zinc plays an important role in protein synthesis and at high concentration it is found to be toxic to all living organisms. Zinc, show fairly low concentration in surface water and in natural sources and its permissible limit in water is 0.5 mg/L. It is shown that the computed results of ANOVA for the year 2018-19 explain that the season as well as the distance has no significant role in explaining the variation of available zinc level in water. It is also observed that there is no interaction between season and distance in causing zinc level in water shown in the study area. It is inferred that the computed results of Analysis of Variance for the year 2019-20 indicate that the season as well as the distance has no significant role in explaining the variation of zinc level in water. Moreover there is no interaction between season and distance for the year 2019-20 indicate that the season as well as the distance has no significant role in explaining the variation of zinc level in water. Moreover there is no interaction between season and distance for the year 2019-20 indicate that the season as well as the distance has no significant role in explaining the variation of zinc level in water. Moreover there is no interaction between season and distance in causing zinc level in water.

## CONCLUSION

The study deals with the analysis of water for three heavy metals namely chromium, zinc and copper in three different seasons (pre-monsoon, monsoon, post-monsoon) for a period of two years (2018-19 and 2019-20) in the ten sampling stations. The statistical significance of heavy metals of the surface water samples was brought out by Analysis of Variance. The ANOVA results for the year 2018-19 indicates that the season alone has significant role in explaining the variation in chromium and copper. Season as well as distance has no significant role in explaining the variation in chromium and copper. Season as well as distance has no significant role in explaining the variation in chromium and copper. Season as well as distance has no significant role in explaining the variation in chromium and copper. Season as well as distance has no significant role in explaining the variation in chromium and copper. Season as well as distance has no significant role in explaining the variation in chromium and copper. Season as well as distance has no significant role in explaining the variation in chromium and copper. Season as well as distance has no significant role in explaining the variation in chromium and copper. Season as well as distance has no significant role in explaining the variation in zinc. The river water near the effluent disposal stations in the high polluted zone  $Z_3$  namely, Ponmandhurai pudhupatty, Kottapatty, Pallapatty recorded high values of heavy metals than the standard values.

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Demonster	BIS				
Parameter	P (mg/L)	E mg/L			
Fe	0.3	1.0			
Zn	5	15			
Cr	0.05	0.05			
Cu	0.05	1.5			
Cd	0.01	0.01			
Pb	0.05	0.05			
Ni	-	0.02			
Ar	0.05	0.05			
Note : P - Permissible Limit		Excessive Limit			

#### Table 1 Drinking water quality standards



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## Table 2 Analysis of Heavy Metals

Sl.No	Heavy metals	Method of Analysis
1	Chromium	Spectrophotometric method
2	Copper	Spectrophotometric method
3	Zinc	Spectrophotometric method

#### Table 3. Season-wise Classification

Season	Months		
	May		
Dra moncoon	June		
r re monsoon	July		
	August		
N.	September		
	October		
Monsoon	November		
	December		
	January		
Destaura	February		
Post monsoon	March		
	April		

#### Table 4. Station-wise Classification

S.No	Station	Sample
1	Athoor	<b>S</b> 1
2	Veerakal	S <sub>2</sub>
3	Pithalapatty	S <sub>3</sub>
4	Ponmandurai Pudhupatty	S4
5	Kottapatty	S <sub>5</sub>
6	Pallapatty	S6
7	Ramaiyanpatty	S7
8	Laksmanapatty	S <sub>8</sub>
9	Vedasandur	S9
10	Alagapuri Dam	S10

#### Table 5. Zone wise Classification

Zones	Classification of the study area			
Zone-I (Non-Polluted Zone)	Villages which are not influenced by tannery effluent in the river bank.			
Zana II (Lass Dallastad Zana)	illages which are little far from the point of pollution by the tannery			
Zone-II (Less Polluted Zone)	effluents in the river bank			
Zone-III (Highly Polluted	Villages which are ware near to the point of pollution			
Zone)	vinages which are very hear to the point of pollution			
Zone-IV (Low Polluted Zone)	Villages which are far from the point of pollution			



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#### Table 6. Chromium Results for 2018-19

Basis of variation	Summation of Squares	Deviation of F	Variance across group	F-statistics	Importance of F
Period	0.008	2	0.004	9.999	0.001
Location	0.147	9	0.016	42.567	0.000
Relations	0.155	11	0.014	36.645*	0.000
Left over	0.007	18	0.000		
Totality	0.162	29	0.006		

\* Significant at 5 per cent level.

#### Table 7. Chromium Results for 2019-2020

Basis of variation	Summation of Squares	Deviation of F	Variance across group	F-statistics	Importance of F
Period	0.014	2	0.007	8.566	0.002
Location	0.169	9	0.019	23.106	0.000
Relations	0.183	11	0.017	20.463*	0.000
Left over	0.015	18	0.001		
Totality	0.198	29	0.007		

\*Significant at 5 per cent level.

#### Table 8. Copper Results for 2018-19

Basis of	Summation of	Deviation of	Variance	Estatistics	Importance of
variation	Squares	F	across group	r-statistics	F
Period	0.000	2	0.000	9.000	0.002
Location	0.000	9	0.000	53.280	0.000
Relations	0.000	11	0.000	45.229*	0.000
Left over	0.000	18	0.000		
Totality	0.000	29	0.000		

Significant at 5 per cent level

#### Table 9. Copper Results for 2019-20

Basis of variation	Summation of Squares	Deviation of F	Variance across group	F-statistics	Importance of F
Period	0.000	2	0.000	7.314	0.005
Location	0.000	9	0.000	7.079	0.000
Relations	0.000	11	0.000	7.122*	0.000
Left over	0.000	18	0.000		
Totality	0.000	29	0.000		

\* Significant at 5 per cent level.



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Table 10. Zinc Results for 2018-19

Basis of variation	Summation of Squares	Deviation of F	Variance across group	F-statistics	Importance of F
Period	3.696	2	1.848	30.178	0.000
Location	46.718	9	5.191	84.765	0.000
Relations	50.414	11	4.583	74.840*	0.000
Left over	1.102	18	0.061		
Totality	51.517	29	1.776		

\* Significant at 5 per cent level.

## Table 11. Zinc Results for 2019-20

Basis of variation	Summation of Squares	Deviation of F	Variance across group	F-statistics	Importance of F
Period	16.701	2	8.350	50.077	0.000
Location	42.350	9	4.706	28.218	0.000
Relations	59.050	11	5.368	32.193*	0.000
Left over	3.002	18	0.167		
Totality	62.052	29	2.140		

\* Significant at 5 per cent level.







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**RESEARCH ARTICLE** 

# Mathematical Modeling of Shared Transportation Problem

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## ABSTRACT

This paper discusses the mathematical techniques of how to deliver transportation services to disabled and elderly people. This idea forms an example of what is called the "shared transportation problem", also sometimes known as "dial-a-ride problem". The associated minimum cost problem was solved by framing various constraints which produce the optimal route to meet the objective of transportation services and make useful decision.

**Keywords**: Binary Flow Variables, Time Variables, Load Variables, Pairing Constraints, Precedence Constraints, Compatibility Constraints, Window Constraints.

## INTRODUCTION

The problem of providing healthcare advice is of prime importance especially in this pandemic period. Several researches were conducted in concerning about healthcare situations and various solutions were offered either to implement new ideas or to improve the existing conditions. Towards this objective, this paper focuses on addressing transportation services to disabled and elderly people more efficiently. We assume that each healthcare program has been put in place to help disabled and elderly people to meet their transportation needs. The program is accessed by a patient phoning in a request to be picked up and transported to a health client at a certain time. To save costs, transportation is shared and consists of a fleet of buses serving transport requests. The overall optimal schedule can be maintained even if some trips have to follow longer routes, as long as customers are picked up and dropped off on time.

#### Modeling the Problem

The problem can be modeled by the *pick-up and delivery problem with time windows* (PDPTW). The PDPTW is a vehicle routing problem that deals with finding an optimal set of routes for a fleet of vehicles in order to serve a set of



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transportation requests. A transportation request is defined by a pair of locations: a person or a package has to be picked up at the pickup location and delivered at the delivery location. Each location is associated with a specific time interval allocated for the visit to that location. This interval is known as the time window of the location. Each vehicle has a capacity constraint. The solution to the problem consists of a set of routes and schedules. A route is a sequence of locations to be served by one vehicle. A schedule for a route is the sequence of times when each location on the route will be serviced.

#### **Describing the Problem Mathematically**

More formally, the problem may be described as follows. Let the number of vehicles be m and the number of customers be n. We enumerate the vehicles  $V = \{1, 2, \ldots, m\}$ . Each vehicle v has a start location s(v) and an end location e(v), usually called depots. Since there are *n* customers, we have *n* pick-up locations and *n* drop-off locations. We label these locations as  $P^+ = \{p+(i) : i = 1, 2, ..., n\}$  and  $P^- = \{p-(i) : i = 1, 2, ..., n\}$ , where  $p^+(i)$  is the pick-up location for customer *i* and  $p^-(i)$  is the drop-off location for customer *i*. Let *N* be the set of all locations:  $N = P^+ \cup P^- \cup \{s(v) : v \in V\}$ V  $\cup$  { $e(v) : v \in V$ }. We enumerate N in the order N = { $p^+(1), p^+(2), \ldots, p^+(n), p^-(1), p^-(2), \ldots, p^-(n), s(1), s(2), \ldots, s(m), s(n), s($  $e(1), e(2), \ldots, e(m)$ , so a customer picked up at location  $i \in N$  is dropped off at location  $i + n \in N$ . The required time window for location  $i \in N$  is  $[a_i, b_i]$ , meaning the customer must be picked up or dropped off between time  $a_i$  and  $b_i$ . For each two distinct stop locations  $i, j \in N$ , we let  $t_{i,j}$  and  $c_{i,j}$  represent direct travel time and travel cost from location *i* to location *j*. Let the maximum load of vehicle v be  $Q^v$ . Three types of variables are used in this mathematical formulation: binary flow variables  $X_{i,j}^{\nu}$ , time variables  $T_i$ , and load variables  $L_i$ . The binary flow variable  $X_{i,j}^{\nu}$  has value 1 if vehicle v travels from node i to node j. The time variable T<sub>i</sub> is the time when node i is serviced, and the load variable L<sub>i</sub> is equal to the load in the vehicle after servicing node i. The optimization problem for this PDPTW can be represented as the integer programming problem as given below:

Minimize 
$$\sum_{v \in V} \sum_{i \in N} c_{i,j} X_{i,j}^{v}$$
(3.1)

subject to the following constraints:

$$\begin{split} \sum_{v \in V} \sum_{j \in N} X_{i,j}^{v} = 1, \ i \in P^{+} \qquad (3.2) \\ \sum_{j \in N} X_{i,j}^{v} - \sum_{j \in N} X_{j,i}^{v} = 0, \ i \in P, v \in V \ (3.3) \\ \sum_{j \in P^{+}} X_{s(v),j}^{v} = 1, \ v \in V \ (3.4) \\ \sum_{i \in P^{-}} X_{i,e(v)}^{v} = 1, \ v \in V \ (3.5) \\ \sum_{j \in N} X_{i,j}^{v} - \sum_{j \in N} X_{j,n+i}^{v} = 0, \ i \in P^{+}, v \in V \ (3.6) \\ T_{i}^{v} + t_{i,n+i}^{v} \leq T_{n+i}^{v}, \ i \in P^{+}, v \in V \ (3.7) \\ X_{i,j}^{v} = 1 \Longrightarrow T_{i}^{v} + t_{i,j}^{v} \leq T_{j}^{v} \ i, \ j \in P, v \in V \ (3.8) \\ X_{s(v),j}^{v} = 1 \Longrightarrow T_{s(v)}^{v} + t_{s(v),j}^{v} \leq T_{j}^{v}, \ j \in P^{+}, v \in V \ (3.9) \end{split}$$



(3.8)



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$$\begin{split} X_{i,e(v)}^{v} =& 1 \Longrightarrow T_{i}^{v} + t_{i,e(v)}^{v} \le T_{e(v)}^{v}, \ i \in P^{-}, v \in V \ (3.10) \\ a_{i} \le T_{i}^{v} \le b_{i}, \quad i \in P, v \in V \ (3.11) \\ a_{s(v)} \le T_{s(v)}^{v} \le b_{s(v)}, \quad v \in V \ (3.12) \\ a_{e(v)} \le T_{e(v)}^{v} \le b_{e(v)}, \quad v \in V \ (3.13) \\ X_{i,j}^{v} =& 1 \Longrightarrow L_{i}^{v} + l_{j} = L_{j}^{v}, \ i \in P, j \in P^{+}, v \in V \ (3.14) \\ X_{i,j}^{v} =& 1 \Longrightarrow L_{i}^{v} - l_{j-n} = L_{j}^{v}, \ i \in P, j \in P^{-}, v \in V \ (3.15) \\ X_{s(v),j}^{v} =& 1 \Longrightarrow L_{s(v)}^{v} + l_{j} = L_{j}^{v}, \ j \in P^{+}, v \in V \ (3.16) \\ L_{s(v)}^{v} =& 0, \ v \in V \ (3.17) \\ 0 \le L_{i}^{v} \le Q^{v}, \ i \in P^{+}, v \in V \ (3.18) \\ X_{i,j}^{v} \in& \{0,1\}, \ i, j \in N, v \in V \ (3.19) \end{split}$$

We will now the reasoning for the 18 constraints provided through (3.2) to (3.19) to have better understanding of the problem. Constraint (3.2) states that each pick-up location is left by exactly one vehicle. Constraint (3.3) means that the number of vehicles coming to location *j* is equal to the number of vehicles leaving location *j*. Constraints (3.4) and (3.5) ensure that each route starts with a pick-up location and ends with a delivery location, not counting depots. Constraint (3.6), called the pairing constraint, deals with the fact that each pick-up location and its corresponding delivery location have to be served by the same vehicle. Less formally, a patient will be driven by one vehicle. Constraint (3.7), called precedence constraint, ensures that each pick-up site is located before its corresponding delivery location, in other words, patients have to be picked up before they can be dropped off. Constraints (3.8) – (3.10) represent compatibility between routes and schedules. Constraints (3.11)–(3.13) are time window constraints ensuring that each location is served within its own time window. Constraints (3.14) – (3.16) represent compatibility between routes and constraints.

Constraints (3.17)–(3.18) are capacity constraints ensuring that no vehicle is filled above capacity or has an occupancy that is negative. Constraint (3.19) conveys the fact that the binary flow variable  $X_{i,j}^{\nu}$  can either be 0 or 1 (binary values). Knowing the variables involved, we can solve this problem and find the minimum cost for the expression  $c_{i,j}X_{i,j}^{\nu}$ . The constraints described above thus helps us to solve the shared transportation problem by determining the optimal solution.





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## CONCLUSION

This paper provides us with the mathematical method of scheduling travel routes efficiently to meet our requirements. But the problem is that it contains so many variables. Hence the above problem is extremely complicated and most often cannot be solved by hand. However using sophisticated software tools one can readily solve this problem and arrive at a meaningful solution. The future scope of this work would be to consider functions which provide us methods to solve without the use of software tools. One proposed method for this is to use Branch and Bound Methods.

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RESEARCH ARTICLE

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# Ameliorative Effect of *Syzigium cumuni* Seed Powder on Histoarchitecture and Ultrastructure of Male Reprodutive Organ (Seminal Vesicle) of Hyperglycemic Swiss Albino Mice (*Mus musculus*)

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#### ABSTRACT

The purpose of study was to access the ameliorative effect of Syzigium cumuni seed powder on histoarchitecture & ultrastructure of accessory reproductive organ (seminal vesicle) of diabetic male mice Mus musculus .Hyperglycemic condition was induced in male mice by injecting Alloxan Monohydrate leading to deficiency in insulin secretion. Fixed dose of Syzigium cumuni seed powder were given along with food for three weeks. Histoarchitecture and SEM of seminal vesicle of control, diabetic and syzigium cumuni fed mice tissue were observed at a regular interval. Syzigium cumuni seed powder restores the histoarchitecture of pancreatic  $\beta$  cells and stimulates the secretion of pancreatic insulin . Syzigium cumuni seed powder treatment increased the number of spermatogenic cell in mice of Group-III when compared to that of diabetic animals Group-II. The configuration was restored and Leydig cells were rejuvenated in Syzigium cumuni seed powder treated diabetic group after 21 days. The spermatogenic cells are seen to be recovered after treatment in stipulated dose. Ultra structure of seminal vesicle among control groups animals (Group-I) after 21 day exposure and recovery periods have been observed. Ultrastructure of asseccory reproductive organ (seminal vesicle )of Hyperglycemic group animals (Group-II) after 21 day exposure and recovery periods has been observed. Ultra structure of accessory reproductive organ (seminal vesicle) of treated group animal (Group-III) after 21 days of exposure and recovery period has been observed. In the surface electron micrograph of control section stages of spermatogenesis were clearly seen as in control animals. Spermatozoa were in groups, attached to the inner portion of the lumen of the seminiferous tubules. In the present study, ultra micrograph of seminal vesicle, treated with alloxan monohydrate induced diabetes group of animals after 21 day showed substantive damages in normal ultra histological architecture. The complete cessation of spermatogenesis was observed and seminiferous tubules were lack of spermatozoa. Spermatogenic cells were disrupted and were seen as a lump in the seminiferous tubules under the scanning electron





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microscope. Some spermatogenic cells were highly eosinophilic, with shrinking cytoplasm and some had deep-staining pycnotic nuclei denoting cell death. Cytoplasmic vacuolization, cellular infiltration of acute inflammatory cells were seen in diabetic mice (Group-II) and it is found to be pronounced with after 21 days. *Syzigium cumuni* seed powder treatment increased the number of spermatogenic cell in mice of Group- III when compared to that of diabetic animals Group II, it was found to be increased with the exposure periods. The seminal vesicle configuration was retained and Leydig cells were almost rejuvenated in *Syzigium cumuni* seed powder treated diabetic group of days 21. Some abnormal Leydig cells are also present in few slides of days 21. The spermatogenic cells are seen to be recovered & glucose level were found to return to their normal levels.

Keywords: Diabetes, Histoarchitecture, Ultrastructure, Spermatogenesis, Syzigium cumuni, Seminal vesicle

## INTRODUCTION

Diabetes mellitus is condition in which the pancreas no longer produces enough insulin or cells stop responding to insulin that is produced, so that glucose in the blood cannot be absorbed into the cells of body. Over 380 million people are affected worldwide and the WHO has predicted in 1999 that diabetes will become seventh cause of death world wide by 2030. Diabetes mellitus is India's fastest growing disease. About 72 million cases recorded in 2017, figure expected to nearly double by 2025. Thus it is gaining the status of a potential epidemic in India with more than 62 million increased by 64% across India over the quarter centuary, according to Nov 2017 report by ICMAR, Institute for Health Metrics & Evaluation, both research institutes & the Public Health Foundation of India. Inactivity & excessive consumption of high calorie foods, exacerbate diabetes risk factors. For this reason, diabetes is often classed as a "Life Style Disease." Aim of present study deals with the investigation on the effect of diabetes on histological and ultra structural change occurring in reproductive organ (seminal vesicle) of male mice , Mus musculus and their possible recovery using Syzigium cumuni seed powder along with the food supplementation for 21 days. Over the centuries, Indian herbal drugs have served as a major source of medicines for the prevention and treatment of diseases including diabetes mellitus. It is estimated that more than 800 species of plant exhibit hypoglycemic properties, including many common plants such as bitter gourd, guduchi ,Carica papya, Syzigium cumuni etc. (Warier 1995, Mahmood et al., 2005). Syzigium cumuni, commonly known as jambul, black plum, Indian black berry belong to family myrtaceae. Black berry was originated in India which has now been spread to in many countries of South Western Asia & Eastern Africa.

## MATERIALS AND METHODS

#### Plant material

*Syzigium cumuni* seeds were collected fresh from plants grown in University Department of Botany campus, Bhagalpur, Bihar, India. Taxonomic identification was authenticated by the Department of Botany, T.M Bhagalpur University. The seeds were air dried, reduced to coarse powder with the help of mortar and pestle and kept in airtight container until the time of use.

#### **Experimental animal**

Swiss albino mice *Mus musculus* weighing about 30±5 gram were obtained from CDRI Lucknow. Mice were maintained at the Animal House of University Department of Zoology, T.M. Bhagalpur University under standard conditions and fed with standard diet. Food and water were given *ad libitum*. Rice husk was used as bedding material and changed daily. Animal handling was performed as per good laboratory practice (Work Manual, CDRI).







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The mice of 12 weeks of age were acclimatized in the laboratory condition for one week before the experiment (Zarrow et al., 1964 and Ahmad et al., 2008).

#### **Drugs and Chemicals**

The drug Alloxan-monohydrate was purchased from Loba Chemicals, Mumbai. All other chemicals used in the entire experiments were of analytical grade. Alloxan is most prominent chemical compound used in diabetogenic research. In research it is used for induction of Type 1 diabetes. Alloxan is an urea derivative which causes selective necrosis of the  $\beta$ - cells of pancreatic islets (Etuk et al., 2010). It has been widely used to induce experimental diabetes in animals such as rabbits, rats, mice and dogs by varying the dose of alloxan. The experimental animals were kept on fast before induction of diabetes. Diabetes was induced intraperitoneally by administrating alloxan-monohydrate (Dunn and Mc-letchie, 2004). Total dose of Alloxan monohydrate (450mg/kg/bw) was administered in three injections at intervals of 48 h (150mg/kg/bw) each time.

#### **Experimental Design**

The experimental mice were divided into three groups of 10 animals each. Group-I (Control) Group-II (Diabetic control) Group-III (Diabetic fed with *Sygizium cumini seed powder*). The total experimental protocol was maintained for 21 days (3 weeks) after induction of diabetes as per method suggested by Zarrow etal. 1964. Experiments were performed on the frequency of 7–14 and 21 days for all the test

suggested by Zarrow etal., 1964. Experiments were performed on the frequency of 7, 14 and 21 days for all the test animals.

#### **Histological Process**

At the end of the experiment animals were sacrificed and their organs were removed and fixed in Bouin's solution, and after overnight fixing, organ samples were then washed through a graded ethanol series, then dehydrated by passing the tissue through increasing percentage of alcohol, then cleared in xylene and embedded in paraffin and sectioning was done and stained with Haematoxylin Eosin and then mounted with DPX for histological assessment under light microscope (Pears,1985).Selected sections of testis of control and experimental groups are examined under low and high magnification respectively. (Fawcet and Bloom,1972 and Pears,1985).

#### Micro Anatomical Process for SEM

Control and treated Swiss Albino Mice (*Mus musculus*) were sacrificed under chloroform anesthesia and the seminal vesicles were removed immediately after dissection. After those seminal vesicle were transversely cut and exposed the tissues were rinsed in Phosphate buffer 5-10 minute along with tween solution for removal of mucous from the tissue. After rinsing in buffer, the tissues were fixed in 2.5% gluteraldehyde for 24 hr at 4°C.After fixation, the tissues were removed, rinsed in buffer and post-fixed in 1% OsO4 for 2 hr and again rinsed in 0.1 M Phosphate Buffer and dehydrated in graded acetones, followed by amyl acetate. Then tissues were dried by critical point method with liquid carbon monoxide. The tissues were cemented to metal Stub and coated with gold to a thickness of approximately 20mm and were examined under SEM.

## RESULT

Histology of accessory reproductive organ (seminal vesicle) of different test groups animals (Group-I, Group-II and Group-III) after 21 days of exposure and recovery periods have been observed. Histology of accessory reproductive organ (Seminal vesicle) of different test groups animals (Group-I, Group-II and Group-III) after 21 day exposure and recovery periods have been observed. In the present study, control HE stained 5µ section of Seminal vesicle (Group-I) showed highly convoluted unbranched tubular diverticulum of vas deferens with normal histological architecture. The cell of seminal vesicle is non ciliated, tall, columnar epithelial cell and population of non specialized basal round





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cell similar to those seen in proximal duct and ductules. Tall cells have characteristics of secretory cell, with large secretory vacuoles near their luminal surface and abundant rough endoplasmic reticulum were seen in control mice (Group-I). The male accessory sex organs are mainly dependent on androgen hormones for their normal growth, maintenance, and secretory function . In the present study, HE stained 5µ section of seminal epithelium of alloxan monohydrate induced hyperglycemic mice group (Group-II) after 21days showed severe damages in normal histological architecture. The present study demonstrated the deleterious effect of diabetes mellitus in the growth and function of the seminal vesicles. Diabetes induced a severe atrophy of the seminal vesicles which was demonstrated by significantly decreased weight of the organ and the alterations in the histological evaluation. This atrophy resulted in an inability of the organs to function normally to contract and secrete appropriate volume of seminal vesicular fluid with the necessary components. The diabetes-induced abnormal contractions of the seminal vesicular tissue can be attributed to: (a) the cytoplasmic atrophy of the muscle cells and the overall condensation of the muscle layer, (b) the decreased levels of testosterone, and (c) the excessive oxidative stress. The epithelium of seminal vesicle is non ciliated, tall, columnar epithelial cell and less population of non specialized basal round cell was observed. Tall cells have characteristics of secretory cell, comparatively smaller secretory vacuoles near their luminal surface and scarce rough endoplasmic reticulum were seen hyperglycemic mice were seen (Group-II). Syzigium cumuni seed powder treatment increased the number of spermatogenic cell in mice of Group-III when compared to that of diabetic animals Group-II. The luminal arrangement was restored and seminal vesicle cells were rejuvenated in Syzigium cumuni seed powder treated diabetic group after 21 days.

Ultra structure of accessory reproductive organ (Seminal vesicle) of control mice (Group-I) after 21 days of exposure have been observed. The surface electron micrograph of seminal vesicle of control mice showed pseudo stratified epithelium and consist of two types of cells basal cell and principal cell. Principal cells were the in majority within the seminal vesicle epithelium. Ultra structure of accessory reproductive organ (Seminal vesicle) of chemically induced hyperglycemic mice (Group-II) after 21 day exposure and recovery periods after treatment with Syzigium cumuni seed powder have been observed. In the chemically induced diabetic group (Group-II) observed severe ultra structural damage induced by hyperglycemia in seminal vesicle both in muscle layer and the epithelium. More specifically, highly condensed thicker internal circular muscular layer and slight disorganization of thin external longitudinal muscular layer was observed. In addition, cytoplasm of muscle cell in the internal muscular layer appeared to have a comparative shrinking when compared to the control. More over small vacuoles appeared in the smooth muscle cell while the nuclei of the muscle cell appeared to be hyper chromatic, probably as a result of vigorous response of cells to the diabetic induced damage, the number of viable spermatozoa was lesser in number (Plate-6.3.5). Syzigium cumuni seed powder treatment increased the number of spermatogenic cell in mice of Group-III when compared to that of diabetic animals Group II. Cytoplasm of muscle cell in the internal muscular layer appeared to be comparatively normal compared to the hyperglycemic mice. The nuclei of the muscle cell appeared to be normal, probably as a result of phytonutrients present in *Syzigium cumuni* seed powder.

## DISCUSSION

The present study inferred that significant alterations in the histological and ultra structural patterns in the seminal vesicle. Similar changes accompanied by the accumulation of immature cells within the tubular lumen were also observed under the influence of Alloxan monohydrate induced hyperglycemic mice. More conspicuous degenerative changes in testicular tissues and an increase in sperm head abnormalities were observed in H&E stained section of Alloxan monohydrate induced mice reported degenerative changes in the internal milieu of testes. The cytological changes observed in the acrosomal cap may hamper the potentiality of these cells to mature into functional sperm. The restoration of morphological features of the seminiferous tubules was observed when the mice fed with *Syzigium cumuni* seed powder at fixed dose (200mg kg<sup>-1</sup>bw<sup>-1</sup>) for three weeks in hyperglycemic mice recorded visible changes in the his to architecture of hyperglycemic mice towards normal. The hyperglycemia





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affects the spermatogenic cycle finally the morphology of spermatozoa was changed and retained in the epididymis. Diabetes effects include apparent deleterious consequences, such as lower sperm motility and count and an increase in detached sperm head that could help in the fertilization. Similar effects on testis were also reported when exposed to other toxic chemicals and ameliorated by some other herbs (methyl chloride- Working etal.,1985; endosulfan, phosphamidon and mannose - Khan and Sinha, 1996; *Calotropis procera* - Akinloye etal.,2002; *Rosmarinus officinalis* L. - Nusier etal.,2007; chlorpyrifos- Joshi et al.,2007, Chromium- Akunna et al., 2012 ). However, these effects were again retained after a short recovery period, suggesting that the changes caused by toxicants are mostly reversible (Ghosh and Surawanshi, 2001). More puzzling and of potential interest is the finding that the percentage of normal healthy sperm is increased following exposure and that this effect does not seem to be readily reversible. It may suggest that diabetes interferes with sperm capacitating, therefore rendering the cells more resistant to undergo the acrosome reaction (Arikawe et al., 2006). If this is indeed the case, the present results suggest that this effect may be long lasting and may potentially affect fertility at a longer time despite otherwise normal sperm parameters. Studies in mice models suggest mechanisms including oxidative stress, DNA damage to sperm, altered hormonal profiles, and abnormal progression through spermatogenesis (Desjardins, 1978)

## CONCLUSION

The present work indicates improvement recorded in histoarchitecture of seminal vesicle. Their morphoanatomical alteration caused by alloxan monohydrate induced hyperglycemia was successfully ameliorated. The seminal vesicle abnormalities were reduced by oral administration of *Syzigium cumuni* seed powder at fixed dose (200mg kg<sup>-1</sup>bw<sup>-1</sup>) for three weeks in different groups of mice (Group-III) used in this study suggesting its protective potential against histopathological alteration. It can be suggested that this *Syzigium cumuni* seed powder at fixed dose (200mg kg<sup>-1</sup> bw<sup>-1</sup>) could be useful in reducing the defects associated with Hyperglycemia. The study had shown that *Syzigium cumuni* seed powder has great potential in the prevention and treatment of diabetes. The optimum dosage for both conditions need to be established via clinical studies involving human subjects. Prior to this there is a need to ascertain its safety on prolonged consumption on vital organs of the mice, determine the acute, subchronic toxicity level as well as LD 50. These data are important for projecting the commercial and global use of *Syzigium cumuni* seed powder as a diabetic prevention and curative natural product

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Plate-1- autopsy of seminal vesicle of control mice



Plate-3-autopsy of seminal vesicle treated mice with *Syzigium cumuni* seed powder



Plate-5-SEM micrograph of seminal vesicle of Diabetic mice



Plate-2- autopsy of seminal vesicle of Diabetic mice



Plate- 4- SEM micrograph of seminal vesicle of control mice



Plate-6-SEM micrograph of *Syzigium cumuni* seed powder treated mice seminal vesicle



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**RESEARCH ARTICLE** 

# **Essentiality of Feed Security Bill in India**

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## ABSTRACT

Feed security is fundamental to the management, conservation and intensification for improving the productivity and profitability of livestock sector. Limited availability of natural resources and the growing demand for food and commercial crop are some of the major constraints in expanding the feed resources. Promoting efficient use of crop residue by value addition and adoption of new feed technologies will narrow the demand - supply gap of animal feed.

Keywords: crop, animal, food, economy, area, livestock

## INTRODUCTION

Animal husbandry plays an important multifarious role in the rural economy of the country. It provides lively hood support, employment generation opportunities, asset creation, recurring income and financial security especially to the rural poor. Productivity and profitability in the livestock sector is determined by quantity and quality of feed as it is the single largest recurring expenditure accounting for 65-70 % of the cost of production. Recently our parliament passed the food security bill for ensuring adequate human nutrition. In the same pattern we need a feed security bill for saving our livestock and for rural economy. It will also helps for effective implementation of food security bill.

#### Status of feed resources

India with only 2.29% of land area of the world, is maintaining nearly 17.4% of human and 10.7% of livestock population of the world. Scarcity of feed resources is one of the major constraints affecting the livestock development. The average cultivated area devoted to fodder production is only 2.5% of the total area and the pasture and grazing land comprises only 3.1% of the total area There is wide gap between demand and supply of all kinds of





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feed and fodder in India (Table 1). The deficit status of feed in India varies because of complex nature of feed reserve. Demand supply position of green and dry fodder surveyed by National institute of Animal Nutrition and physiology (NIANP). The imbalance balance in the demand and supply of fodder will present formidable challenge in coming year. Inadequate production of feed and fodder lead to malnutrition and subsequently the collapse of this sector. In the recent past central government implemented several programme of fodder development which includes establishment of central fodder and seed production farms, demonstration units and establishment of fodder banks

#### Importance of fodder in feed security

Availability of fodder has an important role in economizing the cost of production of livestock products especially of milk. In India the dairy animal feeding is overwhelmingly based on crop residues (Table.2) hence cultivation of nutritious and high yielding fodder is inevitable. With increase in number of animal population & shrinking land resources, the issue of providing adequate feed and forage become so acute. Cultivated fodder has an important role in meeting requirement of various nutrients & roughage to produce milk most economically. Profitable livestock farming depends mainly on adequate availability of fodder with reasonable price. Fodder not only meet nutrient requirement but fills the rumen to satisfy the animal. Fodder crops provide all the critical elements like highly digestible protein, carbohydrates, fats and minerals. Green fodders are a very good source of B-carotene (precursor of vitamin A).

As the area under fodder producing crops remained by and large at constant, the increasing requirement of fodder has to be met compulsory through improved productivity by development and use of high yielding varieties having better nutritive value, fodder conservation and its better utilization and improvement of pasture land. Therefore, at this stage, there is a need to focus more on research of development of forage varieties which are high yielding, pest resistant and having better nutritive value. The inadequate production and availability of quality seed yielding varieties of fodder crops is also acting as one of the major constraints in enhancing fodder production. Owing to increasing pressure of population on land and higher benefit-cost ratio, farmers shifting to food grains, oilseeds and cash crops and production of fodder remains highly neglected. The current priorities given by farmers to food grains, oilseeds and cash crops are likely to worsen supply position of fodder. There are several reports and studies showing demand and supply position of feed and fodder in the country.

#### **Strategy for increasing Forage Production**

While improving the forage resources, it is necessary to address the opportunities related to production and efficient use crop residues, increasing the fodder yield of cultivated fodder crops on agricultural lands as well as on wastelands and community pastures. The strategy should cover selection and breeding of high yielding and stress tolerant fodder crops and varieties, improving the yields through sustainable production practices, efficient conservation and strengthening the value chain of dairy and meat producers to provide various critical services required to optimise the income (Hedge 2010).

#### **Efficient Use of Crop Residues**

Although about 54% of the roughage need is met from various crop residues, no serious efforts are presently made to either increase the recovery percentage or quality of this fodder. Timely harvesting of crop residues, proper processing and storage can also enhance the quality of the forage and prevent wastage. Harvesting of stalk at appropriate time before it turns fibrous for direct feeding or converting into silage, can keep the nutritive value high while reducing methane generation by the ruminants. There are various methods of treating the crop residues before feeding, to improve its nutritional value. It has been reported that even chaffing of stalk before feeding, can reduce the emission of methane by 10% while saving the wastage by 25-30%. Further treatment of crop residues by way of soaking in water and treating with steam under pressure, can also improve the nutritive value and palatability. There are other methods like urea treatment in addition to molasses and physico-chemical methods like





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urea ammonization (Turnbull *et al.*, 2000) by storing the urea treated straw in anaerobic condition which can further improve the quality. Wastage of crop residues by way of burning and diverting its uses for industrial purposes or power generation should also be prevented on priority. The important reason for such wastage can be attributed to forage surplus conditions in certain pockets, particularly in areas where green revolution was launched successfully. To avoid such practices, it is necessary to convert cropresidue to compact feed blocks either directly or in addition to concentrates and minerals. Such blocks can be easily transported to different parts of the country which are facing fodder shortage. Establishment of National fodder bank with branches in all over the country is essential to save the surplus fodder and to distribute the same in scarcity. Incorporating the crop residue in total mixed ration (TMR) will also help to utilize the crop residue efficiently.

#### **Fodder Crops for Wastelands**

There are many hardy grasses and legumes like stylo, seratro, hedge lucerne, etc. which can be grown on wastelands without irrigation. There are many fast growing shrubs and trees which can be lopped regularly as fodder. Such tree species can be established on field bunds, home gardens and along farm boundaries. There are large stretches of degraded wastelands which are not only lying fallow and are underutilized but are also accelerating soil erosion, surface run off of rain water and hosting a wide range of pests and diseases. It is estimated that over 100 million ha in the country are presently underutilized. These lands include over 25-30 million ha of degraded forest lands, 45-50 million ha of agricultural lands unsuitable of crop production, 9-10 million ha wastelands while the rest are ravines, pasture lands and revenue wastelands. Development of these lands for forage production will not only ensure enhanced supply of superior quality forage but also help in conserving the natural resources and recharging ground water, while improving the bio-diversity. There is a need to develop suitable fodder shrubs, trees and grasses for development of pasture lands. Fodder species for introduction under agroforestry need to be shade tolerant and resistant to pests and diseases. Establishment of leguminous shrubs particularly in fruit orchards can even enhance the fruit production.

#### **Increasing Forage Yields**

Resource-poor farmers often cultivate forage on low productive soils to make use of the idle land and do not apply the required quantity of nutrients. Such farmers have several options to boost crop yields by applying low cost inputs such as soil amendments, organic manure and biofertilisers. Unfortunately, most of them do not bother to apply biofertilisers and soil amendments due to their ignorance and difficulty in procuring them. This problem can be tackled by an organized extension service, distribution of forage seeds and other inputs in the country. Serious thought should be given for developing a forage seed distribution network, at least in selected pockets where dairy husbandry has developed as an economic activity. There has also been a wide communication gap between the forage development programme and the livestock extension department. As a result, there is no free flow of information from either side.

#### Application of technologies for feed security

Intensive cattle development programs (cross breeding) adopted in India increased the productivity of milch animals. To exploit the production potential of cross bred animals, farmers are now using the concentrate feed and bypass nutrients. Feeding of bypass protein and fat improved the productivity of diarycattle (Sampath et al ., 1997).By pass amino acids especially lysine and methionine are being used in milch animals for maximum production and the response have been overwhelming. Recently hydroponic technology has been gaining popularization in farmers for cultivating the fodder. Hydroponic technology is suitable for farmers with limited land holdings. Feeding of concentrates and roughages together in mixed form result in steady supply of nutrients resulting better efficiency of nutrient utilization and improved production and this forms the basis of total mixed ration (TMR).Feeding of TMR improves the milk yield by 10-15% ,and the milk yield remains uniform over a longer period with a longer persistent peak yield (Walli,2009). Ensuring feed security of indian livestock needs a coordinated efforts of all the government departments, institutions and university related to animal husbandry.





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There is a strong need for better management of all classes of livestock in terms of scientific feeding programme. The potential and demand of animal industry in india is ever increasing and to exploit this potential better management of feed resources and feeding is mandatory with sufficient legislation for feed security.

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Year	Sup	ply	Den	nand
	Green	Dry	Green	Dry
1995	379.30	421	947	526
2000	384.50	428	988	549
2005	389.90	443	1025	569
2010	395.20	451	1061	589
2015	400.60	466	1097	609
2020	405.90	473	1134	630
2025	411.30	488	1170	650

#### Table: 1. Supply and demand of green and dry fodder in India (Million MT)

#### Table 2: Sources of Fodder in India

Sources	Quantity
Crop Residues	54%
Cultivated fodder	28%
Grasslands	18%

Source: Hegde (2006)



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**RESEARCH ARTICLE** 

# Medicinal Plant Diversity of Sacred Groves Located in Bhubaneswar, Odisha, India

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#### ABSTRACT

Sacred groves act as nature's storehouse for the perpetuation of wild species having considerable genetic and ecosystem variation. The present study has been carried out to assess the floristic composition, distributional pattern and present status of medicinal plants present in sacred groves of Bhubaneswar. A total of 120 medicinal plant species belonging to 109 genera under 52 families were recorded from the sacred groves of Bhubaneswar. Among them, dominant forms were herbs with 40 species followed by 34 trees, 19 shrubs, 18 climbers, 6 grasses, 2 parasites and 1 pteridophyte. Euphorbiaceae and Fabaceae with 8 species each are the two dominant families among the families of medicinal plant species present in sacred groves. *Phyllanthus* with 4 species is the dominant genus among the medicinal plants present in sacred groves located in different parts of Odisha, which can be explored by future investigations. Important medicinal plants need rapid documentation and conservation, thereby preventing their decline and exploitation by anthropogenic deforestation in sacred groves. Results of the present study are expected to create awareness among the present generation on the significance of sacred groves for conservation and continuation of rich flora and fauna thereby safeguarding genetic diversity.

Keywords: Medicinal plants, documentation, conservation, sacred groves, Bhubaneswar

## INTRODUCTION

From time immemorial medicinal plants or their secondary metabolites have been directly or indirectly playing a vital role in the human community to overcome diseases [1]. India is one of the megadiversity centers of the world





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which is gifted with a rich diversity of medicinal plant species. However, today many medicinal plants are facing the threat of extinction or serious genetic erosion, but detailed information is lacking. To address this issue, sacred groves have a definite role to play for the *in situ* conservation of medicinal plants. Sacred groves not only act as a treasury of medicinal plants but also harbour rare, endangered and endemic plants. For several decades, the vegetation of sacred groves is conserved by the local people as per their religious beliefs and socio-cultural practices. As these groves are maintained traditionally without government involvement, therefore, with the support of the local community these sites can be integrated into conservation networks, thereby supplementing the efficacy of the protected areas. Sacred groves are small fragments of native vegetation protected traditionally based on religious faith. In India, sacred groves occur in different parts viz. Western Ghats, Central India, and north-east India especially where the indigenous communities inhabit. These are known by various names given to them by the tribal people. These vegetation pockets are often considered as 'mini biosphere reserves' due to its self-conservation potential and plant diversity [2]. The spiritual and religious values play a prominent role in escalating sustainable utilization and restoration of biodiversity of the sacred groves. Furthermore, these groves act as a treasure house of wild gene pools supporting many potent medicinal plants.

Presence of wild relatives of cultivated species and important medicinal plants in the sacred groves aids in the crop improvement programs. However, in the current scenario, significant changes have taken place in the religious practices, vegetative structure and people's perception towards conservation of sacred groves. Therefore, a comprehensive understanding of the current position, structure and function of sacred grove is essential for assessing their role in the environment and developing strategies for their conservation. A review of the available literature reveals that the biodiversity of the sacred groves of Bhubaneswar has been very little explored due to religious customs, taboos and beliefs. Considering these cardinal points, the present study was undertaken to build up a scientific database of the diversity of medicinal plants present in selected sacred groves of Bhubaneswar.

## METHODOLOGY

#### **Description of Study Area**

Bhubaneswar, the capital of the East Indian State of Odisha lying in the eastern coastal plains is located in the Khurda district of Odisha covering a geographical area of 124.74 sq km and lies between 21°15 N latitude and 85°15 E longitude. It has an average altitude of 45 m above sea level. It is bounded by the Daya river to the South and the Kuakhai river to the east, the Chandaka Wildlife Sanctuary and Nandankanan Zoo lie in the western and northern parts of Bhubaneswar respectively. The climatic condition is tropical, specifically a tropical wet and dry climate. The south-west monsoon is the main source of rainfall in the state providing 80% of the precipitation. The average rainfall is 154 cm while the average temperature ranges around 12 °C in winter, 42 °C - 45 °C during summer. The humidity of air is generally high, especially in southwest monsoon and post-monsoon months. In the summer afternoons, the relative humidity varies between 25 - 40%. Winds are generally light to moderate. The soil is slightly acidic, red to black with sandy loam in texture. The soil type is laterite to alluvial. The three study sites (sacred groves), located in Bhubaneswar are (1) Khandagiri and Udayagiri the twin hills Udayagiri (Latitude 20°15′46″ N; Longitude 85°47′8″ E) and Khandagiri (Latitude 20°15′42″ N; Longitude 85°47′4″ E) are separated from each other by a narrow modern road between Bhubaneswar and Chandaka, (2) Dhauligiri (Latitude 20°11′32.63″ N; Longitude 85°40″ N; Longitude 85°50″ 21.35″ E) is a hillside lying on the banks of the river Daya and (3) Sikharchandi lies between 20°21′30″ N Latitude and 85° 49′40″ E Longitude [Fig. 1].

#### **Data Collection**

An extensive field survey was conducted in three study sites namely, Khandagiri-Udayagiri, Dhauligiri and Sikharchandi of Khurda district of Odisha from January 2017 to December 2019. Each site was surveyed three times in different seasons for the collection of plants in the flowering stage. Plants were photographed and the voucher specimens were collected for the herbarium preparation. Local people were interacted to know the medicinal uses of



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the plants occurring in the study sites. The basic information (local name, parts used, mode of use etc.) was recorded through questionnaires and discussion with the temple priest and rural inhabitants in and around the study area.

#### Identification and collection of voucher specimens

The specimens of medicinal plants were collected during field visits with the help of native peoples and their digital photographs were taken. The collected specimens were then dried and preserved as voucher specimens using the standard techniques [3]. The plant species were identified in consultation with the regional floras [4,5,6] and matching with authentic herbarium specimens housed in different Herbaria of Odisha. Ethnomedicinal uses of documented medicinal plants were cross-checked by consultation with the reports and books published by several workers [7,8,9]. The herbarium specimens were deposited in the Department of Botany, Utkal University, Bhubaneswar, Odisha.

## **RESULTS AND DISCUSSION**

During the investigation, 119 angiosperms (103 dicotyledonous species under 92 genera included in 44 families; 16 monocotyledonous species under 16 genera included in 7 families) and 1 pteridophyte were recorded from the sacred groves of Bhubaneswar (Table-1). Habit-wise grouping of medicinal plant shows 40(33%) are herbs followed by 34(28%) trees, 19(16%) shrubs, 18(15%) climbers, 6(5%) grasses, 2(2%) parasites and 1(1%) pteridophyte (Fig.2). Among the families of medicinal plant species present in sacred groves, Euphorbiaceae and Fabaceae with 8 species each are dominant followed by Apocynaceae (7), Poaceae (6) and Moraceae, Rubiaceae, Rutaceae with 5 species each (Fig-3). Phyllanthus is the dominant genus with 4 species followed by Cassia (3), Ficus (3), Ocimum (3) and Desmodium, Sida with 2 species each (Fig.4). Sikharchandi is rich in medicinal plants and important medicinal plant species include Gloriosa superba, Strychnos nux-vomica, Toddalia asiatica, Smilax zeylanica, Centella asiatica, Gymnema sylvestre, Hemidesmus indicus, Phyllanthus emblica, Andrographis paniculata, Biophytum sensitivum, Cissampelos pareira, Argyreia nervosa, Tinospora cordifolia, Plumbago zeylanica, Desmodium gangeticum, Paederia foetida, Acorus calamus, Evolvulus alsinoides, Aloe vera etc., Important medicinal plants occurring in Khandagiri-Udayagiri twin hills, include Gymnema sylvestre, Hemidesmus indicus, Catharanthus roseus, Kalanchoe pinnata, Oxalis corniculata, Phyllanthus virgatus, Tribulus terrestris, Cymbopogon flexuosus, Desmostachya bipinnata, Strychnos nux-vomica, Ricinus communis while medicinal plants found in Dhauligiri include Wedelia chinensis, Bombax ceiba, Phyllanthus reticulatus, Amaranthus spinosus, Saccharum spontaneum, Vetiveria zizanioides, Adiantum capillus-veneris, Toddalia asiatica etc., At present, groves are facing severe threats that are mostly human-induced. The major factors responsible for the deterioration of groves include habitat fragmentation and degradation, invasion of alien species, pollution, grazing, exploitation of natural resources etc. The alarming rate of population explosion and the rise in urbanization has resulted in the rapid decline of these sacred groves. Therefore, the need of the hour is to aware and involve native people in the conservation and management of sacred groves and exploring its potential for livelihood improvement. The results of the present study are expected to generate awareness among the present and future generations on the necessity and significance of conservation and management of the sacred groves and boosting bioprospecting for the benefit of humankind.

## CONCLUSION AND FUTURE PERSPECTIVES

Present studies reveal that sacred groves not only play a prominent role in the conservation of biodiversity but also act as a hub of valuable medicinal, food and fodder plants with enormous economic value. Moreover, they serve as a repository of threatened and endemic species that are associated with the ethnomedicinal knowledge. There is an urgent need to conserve sacred groves to avoid their degradation and deforestation. More emphasis should be given for their cultivation and domestication to prevent the extinction of potentially valuable species. The mutual relation between the indigenous people and the ecosystem like sacred groves is vanishing due to the loss of religious beliefs,



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commercialization, change in tradition and food habits. Many unexplored sacred groves are still present in different parts of the country, including Odisha, which needs to be documented for the protection and conservation of the wild germplasm. People's involvement, promoting ethnomedicinal knowledge, biodiversity conservation through proper identification, documentation and protection in the sacred groves is the need of the hour. Research on a greater scale is also required for scientific investigation in sacred groves for novel drug discovery.

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#### ABBREVIATIONS

EP: Euphorbiaceae, FB: Fabaceae, AP: Apocynaceae, PO: Poaceae, MO: Moraceae, RB: Rubiaceae, RU: Rutaceae, AM: Amaranthaceae, AN: Anacardiaceae, AD: Asclepiadaceae, AS: Asteraceae, LM: Lamiaceae, AR: Arecaceae, CS: Caesalpiniaceae, CV: Convolvulaceae, LL: Liliaceae, MV: Malvaceae, AC: Acanthaceae, CM: Combretaceae, MN: Menispermaceae, MM: Mimosaceae, MY: Myrtaceae, OX: Oxalidaceae, O: Others

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## TABLE-1: LIST OF IMPORTANT MEDICINAL PLANTS

Sl. No.	Name of species and Family	Local name	Habit	Distribution	Medicinal Uses
1	Abrus precatorius L. [Fabaceae]	Kaincha	Climber	Khandagiri- Udayagiri, Sikharchandi	<b>Seed:</b> nervous disorders; its paste applied in stiffness of shoulder joints, sciatica and paralysis. <b>Root:</b> jaundice, gonorrhoea, haemoglobinuric bile.
2	Acacia catechu (L.f.) Willd. <b>[Mimosaceae]</b>	Khaira	Tree	Sikharchandi	<b>Bark:</b> diarrhoea; decoction given internally in leprosy. <b>Khair gum:</b> leprosy, cough and diarrhoea; applied externally to ulcers, boils and eruption of the skin.
3	Achyranthes aspera L. [Amaranthaceae]	Apa- maranga	Herb	Khandagiri- Udayagiri, Sikharchandi	<b>Root:</b> rheumatism, lumbago, osteodynia, dysuria, post-partum haematometra and dysmenorrhoea; its paste is applied to clear opacity of the cornea.
4	Acorus calamus L. <b>[Araceae]</b>	Bacha	Herb	Sikharchandi	<b>Rhizome:</b> vitiated conditions of vata and kapha, stomatopathy, hoarseness, colic, flatulence, dyspepsia, helminthiasis, calculi, amenorrhoea, dysmenorrhoea, nephropathy, cough, bronchitis, epilepsy, depression and other mental disorders
5	Adiantum capillus- veneris L. [Adiantaceae]	Mayura- pankha	Pterido- phyte	Dhauligiri, Khandagiri- Udayagiri	<b>Aerial parts:</b> coughs, bronchitis, catarrh, sore throat and chronic nasal catarrh.
6	Aegle marmelos (L.) Corr. <b>[Rutaceae]</b>	Bela	Tree	Sikharchandi	<b>Root:</b> dysentery, dyspepsia, vomiting, uropathy, cardiopalmas, vitiated conditions of vata, intermittent fever, swellings and gastric irritability in infants. <b>Unripe fruit:</b> diarrhoea, dysentery and stomachalgia. <b>Leaf:</b> opthalmia, catarrh, deafness, inflammations, diabetes and asthmatic complaints
7	Aerva lanata (L.) Juss. ex Schult. [Amaranthaceae]	Paunsia	Herb	Khandagiri- Udayagiri, Sikharchandi	<b>Whole plant:</b> treat boils, cephalalgia, cough, strangury, diabetes and lithiasis.
8	Ageratum conyzoides L. <b>[Asteraceae]</b>	Poka- sungha	Herb	Khandagiri- Udayagiri, Sikharchandi	<b>Fresh plant juice and dried plant extract:</b> allergic rhinitis and sinusitis, in aqueous solution for nasal instillation.
9	Alangium salvifolium (L.f.)Wang. <b>[Alangiaceae]</b>	Ankula	Tree	Sikharchandi	<b>Root:</b> external application in acute case of rheumatism, leprosy and inflammation; external and internal application in case of bites of rabid dogs. <b>Fruit:</b> burning sensation and haemorrhages.
10	Aloe vera (L.)Burm.f. <b>[Liliaceae]</b>	Ghee - kuanri	Herb	Sikharchandi	<b>Leaf juice:</b> dyspepsia, amenorrhoea, burns, colic, hepatopathy, skin diseases, splenopathy, dropsy, constipation, abdominal tumors, spanomenorrhea, vitiated conditions of vata and pitta, sciatica, carbuncles, lumbago and flatulence
11	Amaranthus spinosus L. [Amaranthaceae]	Kanta - marisa	Herb	Sikharchandi	Whole plant: vitiated conditions of pitta, leprosy, hyperdipsia, hallucination, eczema, bronchitis, leucorrhoea, menorrhagia, abscesses, haemorrhoids, boils, strangury, nausea, flatulence, colic anorexia, intermittent fever, anaemia and general debility.
12	Anacardium occidentale L. [Anacardiaceae]	Kaju	Tree	Dhauligiri, Khandagiri- Udayagiri, Sikharchandi	<b>Gum (bark):</b> leprosy, ringworm, corns and obstinate ulcers. <b>Fruit</b> : vitiated conditions of vata and kapha, skin diseases, dysentery, anorexia and haemorrhoids.





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13	Andrographis paniculata (Burm.f.) Wall. ex Nees. [Acanthaceae]	Bhuin- nimba	Herb	Sikharchandi	<b>Leaf:</b> dysentery, diarrhoea, enteritis, fever, coryza, cough, sore throat, tonsillitis, bronchitis, osteodynia, arthralgia, menstrual and post-partum haemtometra, scrofula, hypertension and snake-bite.
14	Argyreia nervosa (Burm.f.) Bojer <b>[Convolvulaceae]</b>	Brudha- jaraka	Climber	Sikharchandi	<b>Root:</b> vitiated conditions of kapha and vata, wounds, ulcers, colic, dyspepsia, flatulence, constipation, cardiac debility, inflammations, cough, bronchitis, strangury, nervous weakness, cerebral disorders, synovitis, haemorrhoids, obesity, hoarseness, syphilis, anaemia, diabetes, tuberculosis, arthritis, leucorrhoea and general debility.
15	Artocarpus heterophyllus Lam. <b>[Moraceae]</b>	Panasa	Tree	Dhauligiri, Khandagiri- Udayagiri	<b>Leaf:</b> fever, boils, wounds, skin diseases, vitiated conditions of pitta and vata. <b>Unripe fruit:</b> vitiated conditions of kapha, dyspepsia and debility. <b>Ripe fruit:</b> vitiated conditions of vata, pitta and ulcers.
16	Asparagus racemosus Willd. [Liliaceae]	Satabari	Climber	Sikharchandi	<b>Tuberous root:</b> nervous disorders, diarrhoea, dyspepsia, dysentery, tumors, inflammations, vitiated conditions of vata and pitta, cough, hyperdipsia, opthalmopathy, nephropathy, hepatopathy, strangury, tuberculosis, bronchitis, gonorrhea, leprosy, abortion, epilepsy, hyperacidity, hypertension, cardiac and genera debility.
17	Azadirachta indica A.Juss. [ Meliaceae]	Nimba	Tree	Dhauligiri, Khandagiri- Udayagiri, Sikharchandi	<b>Bark:</b> vitiated conditions of pitta, hyperdipsia, leprosy, skin diseases, eczema, leucoderma, malarial fever, ulcers, wounds, tumor, vomiting, dyspepsia, cough, intestinal worms, hepatopathy, bronchitis, diabetes, amenorrhoea, haemorrhoids, syphilis and fatigue. <b>Leaf:</b> vitiated conditions of pitta, leprosy, leucoderma, skin diseases, dyspepsia, ulcers, opthalmopathy, intestinal worms, tuberculosis, boils, eczema and malarial and intermittent fevers.
18	Bambusa arundinacea (Retz.) Willd. <b>[Poaceae]</b>	Baunsa	Grass	Sikharchandi	<b>Root:</b> vitiated conditions of kapha and pitta, leprosy, skin diseases, burning sensation, discolorations, strangury, ringworm, urorrhea, arthralgia and general debility. <b>Leaves:</b> vitiated conditions of pitta, lumbago, opthalmopathy, diarrhoea, haemorrhoids, gonorrhea, amenorrhoea, dysmenorrhoea, wounds, skin diseases and fever.
19	Biophytum sensitivum (L.) DC. [Oxalidaceae]	Chota - lajakuli	Herb	Sikharchandi	<b>Whole plant:</b> strangury, urinary calculi, wounds, hyperdipsia, abscesses, gonorrhea, asthma, phthisis, stomachalgia and snake-bite.
20	Boerhavia diffusa L. [Nyctaginaceae]	Ghoda- puruni	Herb	Sikharchandi	Whole plant: inflammations, strangury, lumbago, leucorrhoea, opthalmia, myalgia, scabies, cardiac disorders, jaundice, anaemia, dyspepsia, cough, constipation, bronchitis and general debility
21	Bombax ceiba L. [Bombacaceae]	Similitula	Tree	Dhauligiri, Sikharchandi	<b>Gum:</b> dysentery; haemoptysis of pulmonary tuberculosis, influenza, menorrhagia, strangury, haemorrhoids and vitiated conditions of pitta. <b>Bark:</b> fomenting and healing wounds. <b>Leaf:</b> strangury and skin eruptions. <b>Flower:</b> skin troubles; spleno- megaly and haemorrhoids. <b>Young fruit:</b> calculus affections, chronic inflammations and ulceration of the bladder and kidney.





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22	Borassus flabellifer L. [ <b>Arecaceae</b> ]	Tala	Tree	Sikharchandi	<b>Root:</b> hyperdipsia, burning sensation, strangury and inflammation. <b>Fruit:</b> hyperdipsia, flatulence, colic, constipation, intestinal worms, leprosy, skin diseases, haemorrhages and haemoptysis.
23	Breynia vitis-idaea (Burm.f.) Fischer. [Euphorbiaceae]	Jajhangi	Shrub	Khandagiri- Udayagiri, Sikharchandi	<b>Leaf:</b> applied as a poultice to hasten suppuration. <b>Leaf juice</b> : given after parturition to prevent heamorrhages. <b>Dried leaves</b> : smoked like tobacco for relief in tonsillitis. <b>Bark</b> : heamorrhages.
24	Butea monosperma (Lam.) Taub. <b>[Fabaceae]</b>	Palasha	Tree	Sikharchandi	<b>Bark:</b> vitiated conditions of pitta and kapha, anorexia, dyspepsia, diarrhoea, dysentery, haemorrhoids, intestinal worms, ulcers, bone fractures, rectal diseases, dysmenorrhoea, gonorrhea, hepatopathy, tumors, hydrocele and diabetes. Leaf: pimples, boils, flatulence, haemorrhoids, inflammations, arthralgia and worm infestations, Flower: vitiated conditions of pitta and kapha, diarrhoea, fever, haemorrhoids, leprosy, skin diseases, hyperdipsia, arthritis, bone fracture, haemoptysis and very efficacious in birth control.
25	Calotropis gigantea R.Br. <b>[Asclepiadaceae]</b>	Arakha	Shrub	Dhauligiri	<b>Root, bark, leaf, flower, latex:</b> In Ayurveda, used in nervous and spleen disorders, leprosy, pruritus, abdominal disorders, piles, worm infestation, cough.
26	Calycopteris floribunda (Roxb.) Lam. ex Poir. [Combretaceae]	Dubapatri	Climber	Sikharchandi	<b>Leaf:</b> intestinal worms, colic, leprosy, malarial fever, dysentery, and ulcers and vomiting. <b>Fruit:</b> jaundice, ulcers, pruritus and skin diseases.
27	Carica papaya L. [Caricaceae]	Amruta- bhanda	Shrub	Khandagiri- Udayagiri	<b>Fruit:</b> vitiated conditions of vata, cough, bronchitis, stomachalgia, dyspepsia, anorexia, intestinal worms, haemoptysis, haemorrhoids, inflammations, splenomegaly, ringworm, skin diseases, psoriasis, urinary calculus and injures of the urinary tract.
28	Caryota urens L. <b>[Arecaceae]</b>	Salapa	Tree	Dhauligiri	<b>Tender leaf:</b> vitiated conditions of pitta. <b>Fruit pulp:</b> hyperdipsia and fatigue.
29	Cascabela thevetia (L.) Lippold [Apocynaceae]	Kaniara	Shrub	Dhauligiri, Khandagiri- Udayagiri	<b>Bark:</b> intermittent fever. <b>Kernel, bark and flower:</b> heart diseases.
30	Cassia fistula L. [Caesalpiniaceae]	Sunari	Tree	Khandagiri- Udayagiri, Sikharchandi	<b>Root:</b> skin diseases, tuberculous glands, syphilis and burning sensation. <b>Bark:</b> boils, pustules, leprosy, ringworm, colic, dyspepsia, constipation, fever, diabetes, strangury and cardiopathy. <b>Leaf:</b> vitiated conditions of vata, skin diseases, leprosy, ulcers and intermittent fevers. <b>Flower:</b> vitiated conditions of pitta, skin diseases, dry cough and bronchitis.
31	Cassia occidentalis L. [Caesalpiniaceae]	Ghoda- chakunda	Herb	Khandagiri- Udayagiri, Sikharchandi	Leaf: leprosy, erysipelas, pruritus, ulcers, cough, bronchitis, hiccough, asthma, fever pharyngodynia and hydrophobia. Seed: cough, strangury, bronchitis, hiccough, constipation, flatulence, dyspepsia and fever. Root: inflammation, diabetes, strangury, elephantiasis, ringworm, colic, flatulence, dyspepsia, epilepsy, convulsions and scorpion sting.





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32	Cassia tora L. [Caesalpiniaceae]	Dhola- chakunda	Herb	Khandagiri- Udayagiri, Sikharchandi	<b>Seed:</b> insomnia, headache, constipation, oliguria, cough, opthalmia, amblyopia, ocular congestion and hypertension. <b>Leaf:</b> pounded fresh leaves with the alcoholic /vinegar maceration is used externally to treat eczema and dermatomycosis.
33	Cassytha filiformis L. [Lauraceae]	Nirmuli	Parasite	Sikharchandi	<b>Stem:</b> Infusion of crushed stem treats dysmenorrhoea and postpartum bleeding in women.
34	Catharanthus roseus (L.) G.Don [Apocynaceae]	Sada-bihari	Herb	Khandagiri- Udayagiri	<b>Leaf:</b> oliguria, haematuria, diabetes mellitus and menstrual disorders. <b>Whole plant:</b> insomnia, cancer, diabetes, dysentery, blood pressure, anxiety, neurosis and cardiac tonic.
35	<i>Catunaregam spinosa</i> (Thunb.) Tirveng. <b>[Rubiaceae]</b>	Mahana	Tree	Khandagiri- Udayagiri	<b>Bark:</b> ostalgia during fever, diarrhoea, dysentery, bruises, cuts and vitiated conditions of vata. <b>Fruit:</b> vitiated conditions of pitta and kapha, pains, sprains, inflammations, gout, helminthiasis, skin diseases, leprosy, wounds, tumors, amenorrhoea, cough, bronchitis, colic, asthma, dysmenorrhoea, flatulence, constipation and fever.
36	Celosia argentea L. [Amaranthaceae]	Nahanga	Herb	Sikharchandi	<b>Seed:</b> blood diseases and mouth sores, for clearing the vision and for diseases of the eye. <b>Whole plant:</b> eczema, glandular swellings, ulcers, constipation, dysentery, menorrhagia, and dysuria.
37	<i>Centella asiatica</i> (L.) Urban <b>[Apiaceae]</b>	Thalkudi	Herb	Sikharchandi	<b>Whole plant:</b> fever, measles, haematenesis, epistaxis, diarrhoea, dysentery, constipation, leucorrhoea, dysuria, jaundice, dysmenorrhoea and varices.
38	<i>Cissampelos pareira</i> L. var. <i>hirsuta</i> (Buch- Ham. ex DC.) Forman [Menispermaceae]	Akanabind i	Climber	Sikharchandi	<b>Root:</b> dyspepsia, diarrhoea, dropsy, cough and urinary troubles like cystitis, in snakebite. <b>Leaf:</b> externally applied for itch.
39	Cleome viscosa L. [Capparidaceae]	Ana-sorisa	Herb	Dhauligiri, Khandagiri- Udayagiri, Sikharchandi	<b>Leaf juice:</b> otalgia. <b>Seed:</b> fever, diarrhoea, worm infestations, cardiac disorders and dyspepsia.
40	Clitoria ternatea L. <b>[Fabaceae]</b>	Aparajita	Climber	Sikharchandi	<b>Root:</b> opthalmopathy, tubercular glands, amentia, hemicranias, burning sensation, strangury, helminthiasis, leprosy, leucoderma, elephantiasis, inflammation, vitiated conditions of pitta, bronchitis, asthma, pulmonary tuberculosis, ascites, ulcers, visceromegaly and fevers. <b>Leaf:</b> otalgia, hepatopathy and eruptions.
41	Coccinia grandis (L.)Voigt <b>[Cucurbitaceae]</b>	Kunduri	Climber	Khandagiri- Udayagiri	<b>Root:</b> vomiting, burning sensation, uterine discharges. <b>Fruits</b> <b>and leaf:</b> vitiated conditions of kapha and pitta, inflammation, ulcers, wounds, cough, skin diseases, helminthiasis, dyspepsia, jaundice, hepatopathy, fever, leprosy, asthma, diabetes, stomatitis and anaemia.
42	Cocos nucifera L. <b>[Arecaceae]</b>	Nadia	Tree	Dhauligiri, Khandagiri- Udayagiri	<b>Root:</b> stomachache and blood in the urine. <b>Coconut oil:</b> rheumatism and back pains or as an ointment to maintain smooth, soft skin. <b>Green coconut juice:</b> given to women who have difficult pregnancies and to treat kidney problems.




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43	Costus speciosus (Koenig) Sm. [Zingiberaceae]	Gai-gobra	Herb	Sikharchandi	<b>Rhizome:</b> vitiated condition of kapha and pitta, burning sensation, flatulence, constipation, leprosy, helminthiasis, skin diseases, fever, hiccough, asthma, bronchitis, inflammations and anaemia.
44	Crotalaria verrucosa L. [Fabaceae]	Bali- jhumuka	Herb	Dhauligiri, Sikharchandi	<b>Root and leaf:</b> leprosy, diarrhoea, dysentery and blood disorders. <b>Leaf:</b> In Siddha, used in skin diseases.
45	<i>Cuscuta reflexa</i> Roxb. <b>[Cuscutaceae]</b>	Nirmuli	Parasite	Dhauligiri, Khandagiri- Udayagiri, Sikharchandi	<b>Plant:</b> jaundice, myalgia, cough, bronchitis, fever strangury, cephalalgia and paralysis.
46	Cymbopogon flexuosus (Nees ex Steud.) W. Watson <b>[Poaceae]</b>	Dhanwa- ntari	Grass	Khandagiri- Udayagiri	<b>Lemongrass oil:</b> revitalizes the body and relieves the symptoms of jetlag, clears headaches and helps to combat nervous exhaustion and stress-related conditions; respiratory infections such as sore throats, laryngitis and fever; cleanse oily skin and help close pores.
47	Cynodon dactylon (L.)Pers. <b>[Poaceae]</b>	Duba ghasa	Grass	Dhauligiri, Khandagiri- Udayagiri, Sikharchandi	<b>Plant:</b> vitiated conditions of pitta and kapha, wounds, hyperdipsia, burning sensation, haemoptysis, haematuria, haemorrhages, leprosy, conjunctivitis, cephalalgia, erysipelas, skin diseases, vomiting, diarrhoea, dysentery, strangury, abortion and general debility.
48	Dalbergia sissoo Roxb. [Fabaceae]	Sissoo	Tree	Sikharchandi	<b>Root:</b> diarrhoea and dysentery. <b>Leaf:</b> gonorrhea, menorrhagia, opthalmopathy, dyspepsia, colic, diarrhoea, dysentery, vomiting, haemorrhoids and burning sensation. <b>Bark and heart-wood:</b> leprosy, hyperdipsia, burning sensation, vomiting, skin diseases, leucoderma, scabies, ulcers, dyspepsia, scalding of urine, syphilis, gastropathy, helminthiasis, opthalmopathy, amenorrhoea etc.
49	Desmodium gangeticum (L.)DC. <b>[Fabaceae]</b>	Sala-parni	Herb	Sikharchandi	<b>Root:</b> vitiated conditions of vata, anorexia, fever, dyspepsia, haemorrhoids, dysentery, strangury, gout, inflammations, cough, asthma, bronchitis, cardiopathy and debility.
50	Desmodium triflorum (L.) DC. <b>[Fabaceae]</b>	Kuradia	Herb	Khandagiri- Udayagiri, Sikharchandi	<b>Plant:</b> vitiated conditions of pitta, cough, bronchitis, wounds abscess, sores, pruritus, erysipelas, dysentery, flatulence and burning sensation.
51	Desmostachya bipinnata (L.) Stapf <b>[Poaceae]</b>	Kusa	Grass	Khandagiri- Udayagiri	<b>Root:</b> asthma, jaundice, vitiated condition of pitta, hyperdipsia and homeopathy. <b>Culm:</b> dysentery, menorrhagia, jaundice, asthma, strangury, uropathy and skin eruption.
52	Euphorbia hirta L. [Euphorbiaceae]	Chita-kuti	Herb	Dhauligiri, Khandagiri- Udayagiri	<b>Aerial parts:</b> bronchitis and other respiratory tract conditions. <b>Latex:</b> application for warts. <b>Plant juice:</b> dysentery and colic.
53	Evolvulus alsinoides (L.)L. [Convolvulaceae]	Bichha- malia	Herb	Sikharchandi	Whole plant: In Ayurveda, it is used in anorexia, stomatitis, piles, abdominal disorders, sterility in female, haematenesis, insomnia, epilepsy, psychosis, skin diseases, and rejuvenator.
54	Ficus benghalensis L. <b>[Moraceae]</b>	Bara	Tree	Dhauligiri, Khandagiri- Udayagiri, Sikharchandi	Bark: burning sensation, haemoptysis, diabetes, haemorrhages, diarrhoea, dysentery, enuresis, ulcers, skin diseases, gonorrhea, leucorrhoea and hyperdipsia. Leaf: ulcers, leprosy, allergic conditions of skin, burning sensation and abscesses. Fruit: vitiated condition of pitta. Latex: neuralgia, rheumatism, lumbago, bruises, nasitis, ulorrhagia, ulitis, odontopathy,





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					haemorrhoids, gonorrhoea, inflammations, cracks of the sole and skin diseases.
55	Ficus racemosa L. <b>[Moraceae]</b>	Dimiri	Tree	Dhauligiri, Khandagiri- Udayagiri	<b>Root:</b> diarrhoea and diabetes. <b>Fruit:</b> haemoptysis and for treating leucoderma, menorrhagia, sprains, lymphadenitis and fibrousitis. <b>Latex:</b> piles and diarrhoea. <b>Leaf:</b> bilious affections.
56	Ficus religiosa L. <b>[Moraceae]</b>	Aswathha	Tree	Dhauligiri, Khandagiri- Udayagiri, Sikharchandi	<ul><li>Bark: its powder is a good absorbent for inflammatory swellings and good for burns. Leaf: wounds and skin diseases.</li><li>Dried fruit: pulverized and taken in water cures asthma.</li><li>Latex: neuralgia, inflammations and haemorrhages.</li></ul>
57	Gloriosa superba L. [Liliaceae]	Pancha- angulia	Climber	Sikharchandi	<b>Tuberous root:</b> inflammations, ulcers, bleeding piles, white discharge, skin diseases, leprosy, indigestion, helminthiasis, snake bites, baldness, intermittent fever and debility; considered useful in promoting labour and expulsion of the placenta.
58	Glycosmis pentaphylla (Retz.) DC. <b>[Rutaceae]</b>	Chaula- dhua	Shrub	Sikharchandi	<b>Leaf juice:</b> fever, liver complaints, vermifuge, eczema and other skin troubles. <b>Wood:</b> snake-bites
59	Gymnema sylvestre (Retz.)R.Br. <b>[Asclepiadaceae]</b>	Guda-mari	Climber	Sikharchandi	<b>Leaf:</b> diabetes, reduce glycosuria. <b>Plant:</b> constipation, cough, helminthiasis, inflammations, asthma, hepatosplenomegaly, vitiated conditions of vata, intermittent fever, bronchitis, dyspepsia, jaundice, cardiopathy, amenorrhoea, conjunctivitis and leucoderma.
60	Hedyotis corymbosa (L.) Lam. <b>[Rubiaceae]</b>	Ghara- podia	Herb	Khandagiri- Udayagiri, Sikharchandi	<b>Whole plant:</b> fevers, depression, jaundice, vitiated conditions of pitta, dyspepsia, colic, flatulence, constipation, strangury, leprosy, helminthiasis, skin diseases, cough, bronchitis and hepatopathy.
61	Helicteres isora L. [Sterculiaceae]	Modi- modika	Shrub	Sikharchandi	<b>Root and bark:</b> colic, scabies, emphysema, gastropathy, diabetes, diarrhoea, dysentery. <b>Fruit:</b> vitiated conditions of pitta, opthalmitis, colic, ulcers, flatulence, diarrhoea, dysentery, verminosis, wounds, haemorrhages and diabetes.
62	Hemidesmus indicus (L.)R.Br. var indicus <b>[Asclepiadaceae]</b>	Anant- mula	Climber	Sikharchandi	<b>Root:</b> vitiated conditions of pitta, burning sensation, leucoderma, leprosy, skin diseases, pruritus, asthma, bronchitis, hyperdipsia, opthalmopathy, hemicranias, epileptic fits, dyspepsia, helminthiasis, diarrhoea, dysentery, haemorrhoids, strangury, leucorrhoea, syphilis, abscess, arthralgia, fever and general debility. <b>Leaf:</b> vomiting, wounds and leucoderma. Stem: inflammations, cerebropathy, hepatopathy, nephropathy, syphilis, metropathy, leucoderma, odontalgi, cough and asthma. <b>Latex:</b> conjunctivitis.
63	Hibiscus rosa-sinensis L. <b>[Malvaceae]</b>	Mandara	Shrub	Khandagiri- Udayagiri	<b>Leaf:</b> treat postpartum relapse sickness, boils, sores and inflammation, good for hairs. <b>Petals infusion:</b> induce abortion, ease menstrual cramps and to help in child birth.
64	Holarrhena pubescens Wall. ex G. Don <b>[Apocynaceae]</b>	Korei	Tree	Khandagiri- Udayagiri, Sikharchandi	<b>Bark:</b> amoebiasis and diarrhoea. <b>Decoction of bark/leaf:</b> cures scabies
65	Ichnocarpus frutescens (L.) W.T. Aiton <b>[Apocynaceae]</b>	Shyama- lata	Climber	Sikharchandi	<b>Root:</b> vitiated conditions of pitta, fever, burning sensation, hyperdipsia, seminal weakness, vomiting, nephrolithiasis, strangury, skin diseases, leprosy, diabetes, pruritus, cephalalgia and general weakness.





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66	Indigofera linnaei Ali <b>[Fabaceae]</b>	Latahai	Herb	Sikharchandi	<b>Plant juice:</b> chronic venereal diseases. Decoction given in epilepsy and insanity. <b>Whole plant:</b> In Sidhha, used in fever, leucorrhoea and oliguria.
67	Jatropha gossypiifolia L. [Euphorbiaceae]	Baigaba	Shrub	Dhauligiri, Khandagiri- Udayagiri, Sikharchandi	<b>Root:</b> leprosy. <b>Latex:</b> ulcers. <b>Leaf:</b> intermittent fevers, boils and carbuncles, eczema and itches.
68	Kalanchoe pinnata (Lam.)Pers. [Crassulaceae]	Amara-poi	Herb	Khandagiri- Udayagiri	<b>Fresh leaf:</b> burns, wounds, impetigo, ulcer, phlegmon and congestive ophthalmial.
69	Lagerstroemia speciosa (L.) Pers. [Lythraceae]	Patali	Tree	Dhauligiri, Khandagiri- Udayagiri, Sikharchandi	<b>Decoction of dried fruit and leaf:</b> diabetes. <b>Root:</b> aphthae of the mouth.
70	Lannea coromandelica (Houtt.) Merr. <b>[Anacardiaceae]</b>	Moi/Jivala	Tree	Khandagiri- Udayagiri, Sikharchandi	<b>Bark:</b> cuts, wounds, bruises, ulcers, opthalmia, gouts, ulcerative stomatitis, odontalgia, sprains, diarrhoea and dysentery. <b>Leaf:</b> elephantiasis, inflammations, neuralgia, sprains and bruises.
71	Limonia acidissima L. [Rutaceae]	Kaintha	Tree	Sikharchandi	<b>Bark:</b> vitiated condition of pitta. <b>Leaf:</b> cough, gastropathy, anorexia, diarrhoea, vomiting, hiccough, bronchitis, cardiac debility and vitiated condition of vata. <b>Unripe fruit:</b> diarrhoea, dysentery, vomiting, hyperdipsia, hiccough, stomatitis, gingivitis, tumors, cough, asthma, consumption, opthalmia, otalgia, cephalalgia, leucorrhoea, wounds and ulcers, anorexia, dyspepsia, cardiac debility, strangury and vitiated condition of vata and pitta. <b>Gum:</b> diarrhoea, dysentery, gastropathy, haemorrhoids and diabetes.
72	Mangifera indica L. <b>[Anacardiaceae]</b>	Amba	Tree	Khandagiri- Udayagiri	<b>Root and bark:</b> vitiated conditions of pitta, wounds, ulcers, metrorrhagia, colonorrhagia, pneumorrhagia, leucorrhoea, syphilis, vomiting, uteritis, diarrhoea, dysentery, diphtheria and rheumatism. <b>Leaf:</b> vitiated conditions of kapha and pitta hiccough, hyperdipsia, burning sensation, haemorrhages, haemoptysis, haemorrhoids, wounds, dysentery, diarrhoea, ulcers, pharyngopath and stomatopathy
73	Mentha arvensis L. [Lamiaceae]	Podina	Herb	Sikharchandi	<b>Whole plant:</b> coryza, diaphoretic fever, headache, rhinitis, cough, sore throats, arthralgia, neuralgia, colic, vomiting, dyspepsia, diarrhoea and prurigo.
74	Merremia tridentata subsp. hastata (Hallier f.) Ooststr. <b>[Convolvulaceae]</b>	Pani-lai	Climber	Khandagiri- Udayagiri, Sikharchandi	<b>Decoction of root:</b> toothache. Whole plant: piles rheumatism and urinary disorders.
75	Michelia champaca L. [Magnoliaceae]	Champa	Tree	Khandagiri- Udayagiri	Root and root bark: abscesses, inflammation, constipation, amenorrhoea and dysmenorrhoea. Stem bark: chronic gastritis, fever, strangury, cough, bronchitis and cardiac debility. Flower: dyspepsia, nausea, vitiated conditions of pitta and vata, burning sensation, haemoptysis, pruritus, skin diseases, leprosy, wounds, ulcers, anorexia, vertigo, flatulence, helminthiasis, opthalmia, gout, cough, cephalalgia,





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					nephropathy, bronchitis, amenorrhoea, malarial fever,
76	Mimosa pudica L. [ <b>Mimosaceae</b> ]	Lajakuli- lata	Herb	Dhauligiri, Khandagiri- Udayagiri, Sikharchandi	Leaf and root: piles, fistula and scorpion sting. Leaf paste: hydrocele. Decoction of the root: urinary infections.
77	Mimusops elengi L. <b>[Sapotaceae]</b>	Baula	Tree	Khandagiri- Udayagiri, Sikharchandi	<b>Tender stem:</b> toothbrushes and are useful in cystorrhoea, urethrorrhoea, diarrhoea and dysentery. <b>Flower:</b> wounds and ulcers; powder of dried flowers is a brain tonic and is useful as a snuff to relieve cephalalgia. <b>Unripe fruit:</b> masticator and will help to fix loose teeth. <b>Seed:</b> suppositories in cases of constipation especially in children. <b>Bark:</b> gargle for odontopathy, ulitis and ulemorrhagia.
78	Morinda pubescens Sm. <b>[Rubiaceae]</b>	Achhu	Tree	Sikharchandi	<b>Root:</b> haemorrhages, dysentery, inflammations, boils and general debility. <b>Leaf:</b> gastropathy, dyspepsia, diarrhoea, ulcerative stomatitis, wounds, gout, inflammation, hernia, sarcocele and fever.
79	Musa paradisiaca L. <b>[Musaceae]</b>	Kadali	Herb	Dhauligiri	<b>Root:</b> venereal disease, helminthiasis, scabies, leprosy, skin diseases and debility. <b>Leaf:</b> scabies, inflammations, opthalmopathy, blisters and burns. <b>Fruit:</b> vitiated conditions of pitta, dipsia, bronchitis, helminthiasis, scabies, pruritus, pharyngodynia, nephropathy, strangury and general debility. <b>Flower:</b> dysentery, diabetes, ascites and dropsy.
80	Naringi crenulata (Roxb.)D.H.Nicolson <b>[Rutaceae]</b>	Benta	Tree	Sikharchandi	Fruit: malignant and pestilent fevers.
81	Nerium oleander L. <b>[Apocynaceae]</b>	Kara-bira	Shrub	Khandagiri- Udayagiri	<b>Root:</b> cardiac asthma, strangury, renal and vesical calculi, chronic stomachalgia, arthralgia, leprosy, pruritus, ulcers. <b>Root bark:</b> ring-worm. <b>Leaf:</b> scabies, haemorrhoids and vitiated condition of vata.
82	Nyctanthes arbor- tristis L. <b>[Oleaceae]</b>	Gangasiuli	Shrub	Khandagiri- Udayagiri	Leaf: vitiated condition of kapha and vata, asthma, obstinate sciatica, cough, strangury, constipation, hepatopathy, haemorrhoids, greyness of hair and baldness. Flower: inflammation, flatulence, opthalmopathy, colic, dyspepsia, splenomegaly, greyness of hair and baldness. Seed: baldness, scurvy and affection of the scalp.
83	Ocimum americanum L. [Lamiaceae]	Ganga- tulasi	Herb	Dhauligiri	Leaf: vitiated condition of vata and kapha, leprosy, anorexia, helminthiasis, dyspepsia, flatulence, dysentery, parasitic and poisonous affections, vomiting, haemoptysis, strangury, migraine fever and malaria. Seed: malaria, migraine, hyperdipsia, emaciation.
84	Ocimum gratissimum L. <b>[Lamiaceae]</b>	Rama tulasi	Shrub	Sikharchandi	Whole plant: sunstroke, headache and influenza
85	Ocimum sanctum L. [Lamiaceae]	Tulasi	Shrub	Sikharchandi	<b>Plant:</b> cardiopathy, leucoderma, asthma, bronchitis, catarrhal fever, otalgia, hepatopathy, vomiting, lumbago, hiccough, opthalmia, gastropathy in children, genitor-urinary disorders, ringworm, verminosis and skin diseases.
86	Oxalis corniculata L.	Ambiliti	Herb	Khandagiri-	Plant: scurvy, burns, wounds, convulsions in children and for





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	[Oxalidaceae]			Udayagiri	healing fractured bones. Ground leaf: dizziness, body pains,
					diarrhoea, dysentery, internal bleeding and remedy for thrush.
87	Paederia foetida L. [Rubiaceae]	Pasaruni	Climber	Sikharchandi	<b>Leaf:</b> bacillary dysentery; its decoction is used in treating urinary lithiasis, dysuria, rheumatism, dyspepsia, gastritis and enteritis.
88	Pavetta tomentosa Roxb.ex Sm. <b>[Rubiaceae]</b>	Kukur- chhelia	Shrub	Sikharchandi	<b>Root:</b> visceral obstructions, urinary diseases, jaundice and dropsical affections. <b>Decoction of leaf:</b> lotion for ulcerated nose and for haemorrhoids.
89	Pergularia daemia (Forssk.) Chiov <b>[Asclepiadaceae]</b>	Uturudi	Climber	Dhauligiri	<b>Plant:</b> urethororrhoea, strangury, metropathy, cough, inflammations, vitiated conditions of vata and kapha, asthma, amenorrhoea, dysmenorrhoea, intermittent fevers and leucoderma. <b>Leaf:</b> vitiated conditions of kapha, helminthiasis, haemorrhoids and leprosy. <b>Fruit:</b> vitiated conditions of kapha and dyspepsia.
90	Peristrophe paniculata (Forssk.) Brummitt <b>[Acanthaceae]</b>	-	Herb	Sikharchandi	<b>Root:</b> filiariasis, skin diseases, worm infestation, wounds, indigestion and intermittent fever.
91	Phyllanthus emblica L. [Euphorbiaceae]	Aenla/ Amala	Tree	Sikharchandi	<b>Bark:</b> gonorrhea, jaundice, diarrhoea and myalgia. <b>Leaf:</b> conjunctivitis, inflammation, dyspepsia, diarrhoea and dysentery. <b>Fruit:</b> diabetes, cough, asthma, bronchitis, colic, flatulence, cephalalgia, opthalmopathy, dyspepsia, hyperacidity, peptic ulcer, erysipelas, skin diseases, leprosy, haematenesis, inflammations, anaemia, emaciation, hepatopathy, jaundice, strangury, diarrhoea, dysentery, haemorrhages, leucorrhoea, menorrhagia, cardiac disorders, intermittent fevers and greyness of hair.
92	Phyllanthus reticulatus Poir. <b>[Euphorbiaceae]</b>	Jajanga	Shrub	Dhauligiri, Khandagiri- Udayagiri, Sikharchandi	Whole plant: vitiated conditions of pitta, burning sensation, sores, strangury, gastropathy, opthalmodynia, diarrhoea, skin eruption and obesity. Leaf: bleeding gums, smallpox, asthma and syphilis.
93	Phyllanthus urinaria L. <b>[Euphorbiaceae]</b>	Badi-aenla	Herb	Dhauligiri, Khandagiri- Udayagiri, Sikharchandi	Whole plant: sore throat, boils, impetigo, infantile cheek, eczema, tongue thrush, arthralgia, snake and centipede bites, post-partum haematometra, fever, opthalmia and hepatobiliary diseases.
94	Phyllanthus virgatus G.Forst. <b>[Euphorbiaceae]</b>	Bhuin- aenla	Herb	Khandagiri- Udayagiri	Whole plant: In Ayurveda, used in eye diseases, hiccough, thirst, polyuria, anaemia, jaundice, leprosy, urinary disorders; in Siddha, used in menorrhagia, vomiting, diseases of head, skin diseases.
95	Plumbago zeylanica L. [Plumbaginaceae]	Chita-paru	Herb	Sikharchandi	<b>Root:</b> diarrhoea, dyspepsia, piles, anasarca; made into a paste with vinegar, milk/salt and water applied externally in leprosy and other skin diseases.
96	Plumeria rubra L. [Apocynaceae]	Katha- champa	Tree	Dhauligiri	<b>Flower:</b> cough, constipation, dysentery, acute enteritis and hemophilia. <b>Bark:</b> dropsical and venereal affections. <b>Latex:</b> ulcers, herpes and scabies.
97	Psidium guajava L. [Myrtaceae]	Pijuli	Tree	Khandagiri- Udayagiri	Leaf juice: diarrhoea, coughs, stomachache and dysentery. Leaf: toothaches. Fruit: constipation.
98	<i>Quisqualis indica</i> L. [Combretaceae]	Madhu- malati	Climber	Khandagiri- Udayagiri	<b>Seed:</b> macerated in oil, used for application in parasitic skin troubles; ascariasis, ringworm disease and malnutrition.





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99	Rauvolfia tetraphylla L. <b>[Apocynaceae]</b>	Patala- garuda	Shrub	Sikharchandi	Plant extract: mixed with castor oil, applied to skin ailments.		
100	Ricinus communis L. [Euphorbiaceae]	Jadda	Shrub	Khandagiri- Udayagiri, Sikharchandi	<b>Seed and oil:</b> warts, tumors, indurations of the abdominal organs, lacteal tumors, indurations of the mammary gland, corns and moles. <b>Leaf:</b> applied to the head for headache and as a poultice for boils.		
101	Rosa gallica L. <b>[Rosaceae]</b>	Golapa	Shrub	Khandagiri- Udayagiri	<b>Root:</b> intestinal ulcers, rickets, heamorrhages and diarrhoea. <b>Leaf:</b> wound, ophthalmic, hepatopathy and hemorrhoid. <b>Oil:</b> aromatherapy; mildly sedative, anti-depressant and anti-inflammatory remedy.		
102	Saccharum spontaneum L. <b>[Poaceae]</b>	Kasatandi	Grass	Dhauligiri	<b>Plant:</b> vitiated conditions of pitta and vata, burning sensation, strangury, renal and vesical calculi, dyspepsia, haemorrhoids, menorrhagia, dysentery, agalactia, phthisis and general debility.		
103	Scoparia dulcis L. [Scrophulariaceae]	Chira-rita	Herb	Khandagiri- Udayagiri	<b>Whole plant:</b> coryza, hyperthermia, sore throat, cough, erythema, measles, boils, impetigo and menorrhagia.		
104	Semecarpus anacardium L.f. <b>[Anacardiaceae]</b>	Bhalia	Tree	Sikharchandi	<b>Fruit:</b> beriberi, cancer, vitiated conditions of kapha and vata, sciatica, neuritis, cough, asthma, colic, dyspepsia, constipation, flatulence, haemorrhoids, helminthiasis, hepatopathy, splenopathy, leprosy, leucoderma, scaly skin eruption, inflammation, cardiac diseases, fever, diabetes , dysmenorrhoea, amenorrhoea, tumors , ulcers and general debility.		
105	Sida acuta Burm.f. [Malvaceae]	Bajra-muli	Herb	Dhauligiri, Khandagiri- Udayagiri, Sikharchandi	<b>Root:</b> nervous and urinary disorders and bowel complain also used as an electuary for expelling worms. <b>Leaf:</b> boiled oil, applied to testicular swellings and elephantiasis.		
106	Sida cordifolia L. [Malvaceae]	Bisiripi	Herb	Dhauligiri, Khandagiri- Udayagiri, Sikharchandi	<b>Whole plant:</b> fever, feats, leucorrhoea, micturition, gonorrhea, colic, nervous disorders, general debility and heart irregularity. <b>Root juice:</b> healing of wound.		
107	Smilax zeylanica L. [Smilacaceae]	Muturi	Climber	Sikharchandi	<b>Root:</b> venereal diseases, skin troubles, sores, swellings and abscess. <b>Whole plant:</b> In Ayurveda, is useful against skin diseases, pitta, insanity, diarrhoea, colic, vata, syphilis, gonorrhea, fever, arthritis, leucorrhoea, impotency and general weakness.		
108	Streblus asper Lour. <b>[Moraceae]</b>	Sahada	Tree	Khandagiri- Udayagiri, Sikharchandi	<b>Root:</b> vitiated conditions of kapha, ulcers, sinusitis, inflammations, elephantiasis, boils, haemorrhages, haemoptysis, cough, bronchitis, convulsions, fever, diarrhoea, dysentery, syphilis and haemorrhoids. <b>Bark:</b> foul ulcers, diarrhoea, dysentery, fever and inflammations. <b>Leaf:</b> sore heels, chapped hands, adenitis neuralgia, haemorrhages.		
109	Strychnos nux-vomica L. [Loganiaceae]	Kochila	Tree	Khandagiri- Udayagiri, Sikharchandi	Leaf: applied as poultice in the treatment of chronic wounds and ulcers; leaf decoction: paralytic complaints. Pulp of the ripe fruit: paralytic affections of paws and foot. Seed: anaemia, asthma, bronchitis, constipation, skin diseases, diabetes, insomnia, paralysis cardiopalmus, weakness of limbs, intermittent and malarial fevers.		
110	<i>Syzygium cumini</i> (L.) Skeels	Jammun	Tree	Dhauligiri, Sikharchandi	Leaf: strengthening of teeth and gums. Tender shoot: vomiting. Fruit and seed: diabetes, diarrhoea, pharyngitis,		





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	[Myrtaceae]				splenopathy, urethrorrhea and ringworm.
111	Tagetes patula L. [Asteraceae]	Gendu	Herb	Khandagiri- Udayagiri	<b>Whole plant:</b> used internally in the treatment of indigestion, colic, severe constipation, coughs and dysentery. Externally, it is used to treat sore eyes and rheumatism.
112	<i>Tecoma stans</i> (L.) Juss. ex Kunth. <b>[Bignoniaceae]</b>	-	Shrub	Khandagiri- Udayagiri	<b>Root:</b> remedy for snake bite and rat-bites and for scorpion sting.
113	Tectona grandis L.f. <b>[Verbenaceae]</b>	Sagwan	Tree	Dhauligiri	<b>Root:</b> anuria. <b>Bark:</b> bronchitis, hyperacidity, vitiated conditions of pitta, dysentery, burning sensation, diabetes, leprosy and skin diseases. <b>Leaf:</b> leprosy, inflammation, skin diseases, ulcers, haemorrhages, haemoptysis and vitiated conditions of pitta. <b>Fruit:</b> strangury, vesical calculi, pruritus and stomatitis. <b>Flower:</b> vitiated conditions of pitta, kapha, dipsia, leprosy, skin diseases, diabetes and strangury. <b>Seed:</b> vitiated conditions of vata, strangury, skin diseases and pruritus. <b>Wood:</b> vitiated conditions of pitta and kapha, skin diseases, leprosy, menorrhagia, haemorrhoids and dysentery.
114	<i>Tinospora cordifolia</i> (Thunb.) Miers <b>[Menispermaceae]</b>	Guluchi	Climber	Sikharchandi	Whole plant: vitiated conditions of vata, burning sensation, gout, hyperdipsia, helminthiasis, dyspepsia, flatulence, stomachalgia, cough, intermittent fevers, chronic fevers, inflammations, vomiting, cardiac and general debility, skin diseases, seminal weakness, leprosy, asthma, erysipelas, anaemia, jaundice, uropathy and splenopathy.
115	Toddalia asiatica (L.) Lam. <b>[Rutaceae]</b>	Tunda- poda	Climber	Sikharchandi	<b>Root:</b> vitiated conditions of vata and kapha, paralysis, malarial and intermittent fevers, colic, dyspepsia, flatulence, diarrhoea, cough, bronchitis, nausea, wound, filthy ulcers, epilepsy, gonorrhea and general debility. <b>Unripe fruits and leaves:</b> vitiated condition of vata. <b>Flower:</b> external application in wasp-stings.
116	<i>Tribulus terrestris</i> L. <b>[Zygophyllaceae]</b>	Gokhra	Herb	Khandagiri- Udayagiri	<b>Root and fruit:</b> strangury, dysuria, anorexia, vitiated conditions of vata and pitta, renal and vesical calculi, dyspepsia, helminthiasis, cough, asthma, anaemia, inflammations, cardiopathy, haemoptysis, scabies, opthalmia and general weakness. <b>Leaf:</b> gonorrhea, inflammation, menorrhagia, strangury, leprosy, skin diseases, verminosis and general weakness. <b>Seed:</b> epistaxis, haemorrhages.
117	Tridax procumbens L. [Asteraceae]	Bisalya- karani	Herb	Dhauligiri, Khandagiri- Udayagiri, Sikharchandi	<b>Leaf:</b> bronchial catarrh, dysentery and diarrhoea; leaf juice check heamorrhages or wounds
118	<i>Vetiveria zizanioides</i> (L.)Nash <b>[Poaceae]</b>	Bena	Grass	Dhauligiri, Khandagiri- Udayagiri	<b>Root:</b> vitiated condition of pitta and vata, ulcers, hyperdipsia, skin diseases, nausea, colic, obstinate vomiting, dyspepsia, anaemia, cough, asthma, haemorrhages, haemoptysis, hiccough, strangury, bilious fever, gout, sprains, cephalalgia, hysteria, spermatorrhoea, insomnia, diarrhoea, amentia, cardiac debility, amenorrhoea, erysipelas, dysmenorrhoea, helminthiasis and general debility.





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119	Wedelia chinensis (Osbeck)Merr. <b>[Asteraceae]</b>	Bhrungaraj	Herb	Dhauligiri	Whole plant: vitiated condition of kapha and vata, colic, dyspepsia, seminal weakness, inflammation, fever, elephantiasis, cephalgia, ulcers, wounds, helminthiasis, anaemia, baldness, greyness of hair.
120	Ziziphus mauritiana Lam. [Rhamnaceae]	Bara koli	Shrub	Khandagiri- Udayagiri, Sikharchandi	<b>Bark:</b> dysentery, diarrhoea, boils and gingivitis. <b>Leaf:</b> stomatitis, urorrhea, wounds, syphilitic ulcer, asthma, typhoid fever, diarrhoea and obesity. <b>Fruit:</b> vitiated condition of pitta, vomiting, flatulence, hyperdipsia, constipation, dyspepsia, nausea, leprosy, skin diseases, pruritus, wounds and ulcers, haemorrhages and general debility. <b>Seed:</b> dipsia, encephalopathy, opthalmopathy, cough etc.



Fig.1. Location map of Bhubaneswar present in Khurda district of Odisha, India.



Fig.2. Habit-wise distribution of medicinal plants (in %) in the sacred groves of Bhubaneswar





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Fig.3. Family-wise distribution of genera and species of medicinal plants in the sacred groves of Bhubaneswar



Fig.4. Genus-wise distribution of medicinal plants in the sacred groves of Bhubaneswar



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**RESEARCH ARTICLE** 

# Influence of $\gamma$ - Irradiation on Properties of PAN (Poly Acrylonitrile) **Fibers**

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## ABSTRACT

Polyacrylonitrile samples are prepared by treating fenton reagent with acrylonitrile and irradiated at room temperature with Co<sup>60</sup>  $\gamma$ -rays with different doses of 1M rad to 20M rad and annealed upto 120hrs at 80°C.It is found that after irradiation the molecular mass decreased initially at lower doses but increased at 20M rad . Gel fraction determination indicated that gamma irradiation led to the predominant crosslinking of PAN fibers, with G values (the number of event per 100eV energy absorbed) of G(X) = 0.28 and G(S) = 0.16 for chain crosslinking and scission but the anneling of radiation damage become effective after 120 hrs due to increase in gel fraction and internal chemical reactions. This attributes to the fact that the residual radicals as well as broken fragments crosslinks with each other after irradiation thereby increase in the intrinsic viscosity and molecular mass of PAN. Radiation crosslinking has potential application in the production of PAN-based carbon fibers.

**Keywords**: PAN,  $\gamma$  - Irradiation, annealing, G-values, cross-linking, intrinsic viscosity.

## **INTRODUCTION**

Polyacrylonitrile (PAN) fibers are one of the most important precursors for the production of high-performance carbon fibers [1,2]. The radiation technique has two advantages over the conventional method. One is that the possible crosslinking of PAN fibers results in a better thermalstability and the other is the modified polymer is homogeneous and free from any impurities. It has been previously found that irradiation induces PAN to produce a predominant crosslinking structure [3]. The effect of radiation on PAN via electron beam [4,5,6],  $\gamma$ -ray [7,8,9], UV [10,11], and X-ray irradiation [12,13] has been investigated. Because the fibers have much higher degrees of crystallization and orientation than the bulk material, the effects of  $\gamma$  irradiation on the structural and thermal proper- ties of PAN fibers should be specially studied in detail to evaluate the potential application of radiation technology in producing carbon fibers. In the present study PAN is subjected to irradiation with  $\gamma$  rays and annealed





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upto 120 hrs at 80°C. The viscosity, molecular mass ,average chain length and tensile strength of PAN is determined at different doses of irradiation and anneling.

## MATERIALS AND METHODS

Fentons reagent consisting of ferrous ammonium sulfate (FAS) and hydrogen peroxide is used in the present study. Acrylonitrile and NaOH are reagent grade chemicals and was used as such. DMF is of reagent grade chemicals and was used as solvent to calculate the Intrinsic viscosity with ubbeholde type suspended level viscometer. Molecular mass of various samples are calculated by Mark-Hauwink-Sakurada equation.

 $[\eta] = KM^{-a}$ 

M= Molecular mass,  $[\eta]$  = Intrinsic viscosity, a= solvent constant, K=Polymer constant. The intrinsic viscosities were obtained by plotting reduced viscosity( $\eta_{red}$ ) vs concentration of polymer solutions with extrapolation to zero concentration with help the of Huggin's equation  $\eta_{sp} = [\eta] + k_1 [\eta]^2 C$  or k2 Krammer's equation  $\ln \eta_{red} = [\eta] - k_2 [\eta]^2 C$ , where  $k_1$  and  $k_2$  constants for a give polymer/solvent/temperature system.

#### Irradiation and anneling

ThePAN fibers are packed into the glass amplules (diameter: 5cm, 30cm in length) and then the amplules are sealed off after evacuation upto  $10^{-2}$  Pa. The samples are exposed by 60 Co  $\gamma$ -rays at room temperature with adose rate of 4.3M rad/h. The variation of dose is 1–20M rad by changing exposure time. The irradiated samples were then exposed to air for characteriza- tion and annelation. Anneling of the PAN fibers is carried out using an isothermal heating progress at 80°C in clean air with varying time upto 120 hrs.

#### Measurements

In the gel measurement a dried and weighed PAN fiber sample is placed in a 150-mesh stainless basket and then immersed in DMSO for 24h at 80 °C. Then, the basket is extracted with methanol for 12h to eliminate the solvent swelled in the sample, and the residual component was dried at 80 °C in vacuum for 24h. The G values of crosslinking (G(X)) and scission(G(S)), which represent the number of crosslinking or scission per100eV absorbed, are calculated using the Charlesby–Pinner equation<sup>14</sup>. The tensile strength was measured using an electronic single filament strength tester (LLY-06E) at a constant speed of 20mm/min. The filament gauss length was 20mm. The average of the data for 50 filaments was reported for each sample.

## **RESULTS AND DISCUSSION**

#### **Radiation crosslinking of PAN fibers**

The PAN fibers changed from white to pale yellow after  $\gamma$ -ray irradiation at dose higher than 5Mrad and a gel was formed. The PAN fibers irradiated to 20M rad were compared with the original fibers with respect to the solubility in DMSO, as shown in Fig. 1. It canbe seen that a yellow gel formed for the irradiated sample, while the original fibers dissolved completely in 4h. Shrinkage is clearly observed for the irradiated sample due to the disorientation of the PAN fibers afters welling by the solvent. Predominantly a crosslinking type of polymer is formed upon irradiation [13]. The cross- linking may result from the recombination of the backbone radicals or addition of backbone radicals to the nitrile groups on the adjacent chains as the crosslinking predominantly occurs in the amorphous region and preferentially near the surface [15,16,17].





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#### Anneling behavior of PAN fibers

The PAN fibers irradiated at different doses from 1 to 20 M showed decrease in viscosity, molecular mass as well as average chain length which is clear from fig-3. This may be attributed to the fact that due to increase in radiation dose there is a regular degradation in the structure of the polymer that affects polymer properties. But when Irradiated PAN fibers are annealed at 80°C from 24 h to 120 h there is no appreciable changes in the viscosity, molecular mass and average chain length that cleared from the fig-4.

The gel fraction as a function of absorbed dose over the dose range of 1M rad-20M rad in vacuum. The gel fraction is approximately 14 at a dose of 1 M rad and then increased gradually with increasing radiation dose. A gel fraction of 79 % was achieved at 20 M rad which attribute to the fact that the decrease in molecular mass as well as average chain length, PAN is becoming crosslinked.

#### Radiation effects on mechanical properties of PAN fibers

The tensile strength of the fibers decreased slightly at low doses and then remained almost unchanged at higher doses, as shown in Fig. 5. A little decrease in tensile strength was caused by the cyclization, and low levels of degradation. However, due to the forma tion of a crosslinked structure in the amorphous region the decrease in strength was very limited even at a dose of 20 M rad. The mechanism for the radiation induced crosslinking is proposed and presented in Scheme 1. The backbone radicals induced by  $\gamma$ -ray irradiation may recombine to form crosslinking structure or add to the nitrile groups of the adjacent chains to crosslink [3] and form new macromolecula rradicals. The radicals located at N=N may initiate cyclization at room temperature. The crosslinked and partially cyclized structure in PAN fibers may be responsible for the reduction of the onset temperature of cyclization and the alleviation of the exothermic process.

## CONCLUSIONS

Irradiation results in the crosslinking of PAN fibers at a relative low dose, and the crosslinked fibers retained the highly oriented structure and there is a slight decrease in the tensile strength. However, the exothermic behavior of the cyclization reactions of radiation crosslinked PAN fibers are significantly moderated and the effect could be regulated by varying the absorbed doses. It is speculated that the crosslinking resulted mainly from the addition of backbone radicals to nitrile groups. The crosslinked PAN chains in the amorphous region are expected to keep the orientation of the pre anneling PAN fibers. Our results indicate that the radiation technology has potential applications in the production of carbon fibers used for industrial purpose.

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**RESEARCH ARTICLE** 

Analysis of Influence of *Syzigium cumuni* Seed Powder on Histoarchitecture and Ultrastructure of Male Reprodutive Organ (Epididymis) of Hyperglycemic Swiss Albino Mice

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## ABSTRACT

The main objective of this study was to analyse the therapeutic influence of Syzigium cumuni seed powder on histoarchitecture and ultrastructure of reproductive organ (epididymis) of hyperglycaemic Swiss Albino Mice.Drug Alloxan Monohydrate was injected in swiss albino male mice to persuade hyperglycemic condition. This leads to deficiency in insulin secretion. Fixed dose of Syzigium cumuni seed powder along with food were fed for three weeks. Histoarchitecture and SEM of epididymis of control, diabetic and Syzigium cumuni fed mice tissue were monitered at a regular intermission. Syzigium *cumuni* seed powder refurbishes the histoarchitecture of pancreatic  $\beta$  cells and sparks the secretion of pancreatic insulin. Syzigium cumuni seed powder treatment intensify the number of spermatogenic cell in mice of Group-III when compared to that of hyperglycemic miceof Group-II. The epididymis configuration was reinstate and Leydig cells were rejuvenated in Syzigium cumuni seed powder treated diabetic group after 21 days. Ultra structure of accessory reproductive organ (epididymis) of treated group Animal (Group-III) after 21 day exposure and recovery period has been observed. In the surface electron micrograph of control section stages of spermatogenesis were clearly observed as in control animals. Spermatozoa were in groups, attached to the inner portion of the lumen of the seminiferous tubules. In the present analysis, ultra micrograph of epididymis treated with alloxan monohydrate persuaded diabetes group of animals after 21 day indicated substantive damages in normal ultra histological architecture. Syzigium cumuni seed powder treatment increased the number of spermatogenic cell in mice of Group-III when compared to that of hyperglycemic animals Group II, it was found to be intensified with the exposure duration.

**Keywords:** Histoarchitecture, Hyperglycemic, Ultrastructure, Spermatogenesis, *Syzigium cumuni*, Epididymis.





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## **INTRODUCTION**

Diabetes is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use insulin it produces. Insulin is a hormone that regulates blood sugar, Hyperglycemia, or raised blood sugar, is a very common effect of uncontrolled diabetes and over period leads to serious damage to many of body's system, particulary the nerves and blood vessels. Diabetes is of various types e.g.Type 1 diabetes, Type 2 diabetes and Gestational diabetes, impaired glucose tolerance (IGT) and impaired fasting glycemia (IFG).Mainly Type1 and Type2 diabetes are commonly known.Type1 diabetes previously known as insulin dependent is characterized by lack of insulin production, Type2 diabetes formely known non insulin dependent or adult onset, is characterized by ineffective use of insulin. According to WHO report published on their website on 1st June 2018, Non Communicable Diseases have become a great issue of global concern with about 41 million deaths per year and 1.6 million deaths occurring as a result of diabetes alone. In addition over 85 % of deaths occur in low and middle income countries. Thus the aim is to reduce premature deaths from Non Communicable Diseases globally by 1/3<sup>rd</sup> by 2030[https//www.WHO.int/ncds/governance] The main objective of this analysis deals with the investigation on the influence of diabetes on histological and ultra structural change occurring in reproductive organ (epididymis) of swiss albino male mice, Mus musculus and their probable restoration utilizing Syzigium cumuni seed powder in conjuction with the food supplementation for 21 days. Since a long period, Indian herbal drugs have played an important source of medicines for the prevention and treatment of diseases including diabetes mellitus.

#### Syzigium cumuni

Locally known as jamun or black plum or Indian black berry .This belongs to family myrtaceae (Lemmens, 1995; Mabberley, 1997). Syzygium cumini (Myrtaceae) is a worldwide medicinal plant traditionally used in herbal medicines due to its vaunted properties against cardiometabolic disorders, which include: antihyperglycemic, hypolipemiant, antiinflammatory, cardioprotective, and antioxidant activities. These properties have been attributed to the presence of bioactive compounds such as phenols, flavonoids, and tannins in different parts of the plant, albeit the knowledge on their mechanisms of action is scarce. This mini-review highlights the cardiometabolic properties of Syzigium cumuni by correlating its already identified phytochemicals with their described mechanisms of action. Data herein compiled show that some compounds target multiple metabolic pathways; thereby, becoming potential pharmacological tools. Moreover, the lack of clinical trials on Syzigium cumuni usage makes it a fruitful field of interest for both scientific community and pharmaceutical industry Myrtaceae family comprises about 121 genera with 3800-5800 species of shrubs and trees distributed mainly in tropical and subtropical areas of the world (Stefanello et al., 2011). The genus Syzygium, a leading member of this family, embrace 1100 species with deserving attention to Syzigium cumuni (L.) Skeels (syn.: Eugenia jambolana, Syzygium jambolanum), which has been used in the treatment of numerous diseases, especially diabetes (Ayyanar and Subash-Babu, 2012). Pharmacological studies have expanded the biological activities of Syzigium cumuni, which include antihyperglycemic, antiinflammatory, antibacterial, cardioprotective, and antioxidant (Kumar et al., 2008a; Rekha et al., 2008; Sharma et al., 2008b, 2011; Mastan et al., 2009; Arun et al., 2011; Tanwar et al., 2011) Alloxan which is chemically called 5,5-dihydroxyl pyrimidine-2,4,6-trione is an organic compound, a urea derivative, a carcinogen and cytotoxic glucose analog. Alloxan is the most common diabetogenic agents often used to analyse the antidiabetic potential of both pure compounds and plant extracts in studies involving diabetes.

## MATERIALS AND METHODS

## PLANT MATERIALS

Fresh *Syzigium cumuni* seeds were collected from trees grown in PG Department of Botany campus, TMBU Bhagalpur, Bihar, India. Taxonomic identification was authenticated by the PG DEPT of Botany, TMBU, Bhagalpur. The seeds were air dried, prepared coarse powder with the help of mortar and pestle. It waskept in airtight jartill utilization.





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#### EXPERIMENTAL SWISS ALBINO MICE

Swiss albino mice of weight about 30±5 gram were obtained from CDRI Lucknow. Mice were maintained at the Animal house of PG Department of Zoology, T.M. Bhagalpur University under standard conditions and fed with standard diet. Food and water were provided *ad libitum*. Rice husk was utilized as bedding material and replaced daily. Animal handling was performed as per good laboratory practice (Work Manual, CDRI). The mice of 12 weeks of age were acclimatized in the laboratory condition for one week before the experiment (Zarrow et al [9], 1964 andAhmad et al. [8], 2008).

#### DRUGS AND CHEMICALS

The drug Alloxan-monohydrate was procured from Loba Chemicals, Mumbai, Maharashtra. All chemicals used in the entire experiments were of analytical grade. Alloxan is most prominent chemical compound used in diabetogenic research. In research it is used for induction of Type 1 diabetes. Alloxan is a urea derivative which causes selective necrosis of the  $\beta$ - cells of pancreatic islets. It has been widely used to induce experimental diabetes in animals such as rabbits, rats, mice and dogs by varying the dose of alloxan. The experimental animals were kept on fast before induction of hyperglycemic condition. Diabetes was induced intraperitoneally by injectingalloxan-monohydrate.Total dose of Alloxan monohydrate (450mg/kg/bw) was administered in three injections at interval of 48 h (150mg/kg/bw) each time.

## **EXPERIMENTAL DESIGN**

The experimental mice were divided into three groups of 10 animals each.

Group-I (Control)

Group-II (Diabetic control)

Group-III (Diabetic fed with *Sygizium cumini seed powder*). The total experimental protocol was maintained for 21 days (3 weeks) after induction of diabetes as per method suggested by Zarrowetal [9], 1964. Experiments were performed on the frequency of 7, 14 and 21 days for all the test animals.

#### HISTOLOGICAL PROCESS

Atthe end of the experiment, animals were sacrificed and their organs were removed and fixed in Bouin's solution, and after overnight fixing, organ samples were then washed through a graded ethanol series, then dehydrated by passing the tissue through increasing percentage of alcohol, then cleared in xylene and embedded in paraffin and sectioning was done and stained with Haematoxylin Eosin and then mounted with DPX for histological assessment under light microscope (Pears [5], 1985). Selected sections of testis of control and experimental groups are examined under low and high magnification respectively. (Fawcet and Bloom [2], 1972 and Pears [5], 1985).

## MICRO ANATOMICALTECHNIQUE FOR SEM

Control and treated Swiss Albino Mice (*Mus musculus*) were sacrificed under chloroform anesthesia and the testes were removed immediately after dissection. After those testes were transversely cut and exposed the tissues were rinsed in Phosphate buffer 5-10 minute along with tween solution for removal of mucous from the tissue. After rinsing in buffer, the tissues were fixed in 2.5% gluteraldehyde for 24 hr at 4°C.After fixation, the tissues were removed, rinsed in buffer and post-fixed in 1% OsO4 for 2 hr and again rinsed in 0.1 M Phosphate Buffer and dehydrated in graded acetones, followed by amyl acetate. Then tissues were dried by critical point method with liquid carbon monoxide. The tissues were cemented to metal Stub and coated with gold to a thickness of approximately 20mm and were examined under SEM.





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## RESULT

Histology of accessory reproductive organ (epididymis) of different test groups animals (Group-I, Group-II and Group-III) after 21 day exposure and recovery periods have been observed. In the present study, control HE stained 5µ section of Epididymis (Group-I) after 21days showed normal histological architecture. The epithelium of epididymis is comprised of several cell types including principal cell, basal cell, apical cell, halo cell, clear cell and narrow cell each of which vary in number and size along the epididymal duct were seen in control mice (Group-I) In the present study, HE stained 5µ section of Epididymis of alloxan monohydrate induced hyperglycemic mice group (Group-II) after 21 days showed severe damages in normal histological architecture. The epithelium of epididymis is comprised of several cell types including principal cell, basal cell, apical cell, halo cell, clear cell and narrow cell each of which vary in number and size along the epididymal duct, cellular infiltration of acute inflammatory cells were seen in diabetic mice (Group-II). Syzigium cumuni seed powder treatment increased the number of spermatogenic cell in mice of Group-III when compared to that of diabetic animals Group-II. The luminal configuration was restored and epididymal cells were rejuvenated in Syzigium cumuni seed powdertreated diabetic group after 21 days. Ultra structure of epididymis among different test groups animals (Group-I, Group-II and group-III) after 21 days exposure and recovery periods have been observed. Ultra structure of accessory reproductive organ (Epididymis) of control mice (Group-I) after 21 day exposure have been observed. Ultra structure of accessory reproductive organ (Epididymis) of chemically induced hyperglycemic mice (Group-II) after 21 days exposure and recovery periods after treatment with Syzigium cumuni seed powder have been observed.

The surface electron micrograph showed cilia on the epithelial cells lining the lumen of the ductuliefferents of the caput epididymis were dense, giving it a normal appearance, other cellular component were seen to be normal. In the epithelial lining, the contour of the cells was clear and appeared to be normal. In the caput epididymis of control animals after 21 days there were normal matured motile spermatozoa. In the chemically induced diabetic group (Group-II), in animals treated with alloxan monohydrate showed cilia on the epithelial cells lining the lumen of the ductuliefferents of the caput epididymis were less dense or absent in some regions, giving it a bald appearance compared with material from control animals. At certain regions of the epithelial lining, the contour of the cells was not clear and appeared to be peeled off. In the caput epididymis of animals treated for 21 days there were fewer spermatozoa than in control animals. *Syzigium cumuni* seed powder treatment increased the number of spermatogenic cell in mice of Group- III when compared to that of diabetic animals Group II. The epididymal configuration was retained and epithelium of epididymis were almost rejuvenated in *Syzigium cumuni* seed powder treated group after days 21. Some abnormal epididymal cells are also present in few slides of days 21. The spermatogenic cells are seen to be recovering after treatment with *Syzigium cumuni* seed powder.

## DISCUSSION

The present study analyse that significant variations in the histological and ultra structural patterns in the epididymis.Similar variations accompanied by the accumulation of immature cells within the tubular lumen were also observed under the influence of Alloxan monohydrate persuaded hyperglycemic mice. More conspicuous degenerative differences in testicular tissues and an increase in sperm head abnormalities were observed in H&E stained section of Alloxan monohydrate induced hyperglycemic mice. (O'Neill et al., [10] 2010) The release of immature germ cells within the tubular lumen in alloxan monohydrate persuaded mice reported degenerative changes in the internal milieu of testes. The cytological changes observed in the acrosomal cap may hamper the potentiality of these cells to mature into functional sperm. The restoration of morphological features of the seminiferous tubules was observed when the mice fed with *Syzigium cumuni* seed powderat fixed dose (200mg kg<sup>-1</sup>bw<sup>-1</sup>) for three weeks in hyperglycemic mice recorded visible changes in the histoarchitecture of hyperglycemic mice towards normal. The hyperglycemia affects the spermatogenic cycle finally the morphology of spermatozoa was





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changed and retained in the epididymis. Diabetes effects include apparent deleterious consequences, such as lower sperm motility and count and an increase in detached sperm head that could help in the fertilization. Similar effects on testis were also reported when exposed to other toxic chemicals and ameliorated by some other herbs (endosulfan, phosphamidon and mannose - Khan and Sinha [11]1996; Chromium- Akunna et al [1] 2012). However, these effects were again retained after a short recovery period, suggesting that the changes caused by toxicants are mostly reversible (Ghosh and Surawanshi, [13] 2001). More puzzling and of potential interest is the finding that the percentage of normal healthy sperm is increased following exposure and that this effect does not seem to be readily reversible. It may suggest that diabetes interferes with sperm capacitating, therefore rendering the cells more resistant to undergo the acrosome reaction (Arikawe et al., [1] 2006). If this is indeed the case, the present results suggest that this effect may be long lasting and may potentially affect fertility at a longer time despite otherwise normal sperm parameters. Studies in mice models suggest mechanisms including oxidative stress, DNA damage to sperm, altered hormonal profiles, and abnormal progression through spermatogenesis (Desjardins,[4] 1978)

## CONCLUSION

The present study enlights *Syzigium cumuni* seed powder has a great potential in the prevention and treatment of diabetes and improvement noticed in histoarchitecture of epididymis. Their morphoanatomical alteration caused by alloxan monohydrate persuaded hyperglycemia was successfully restorated. The epididymal variations of sperm were minimised by oral administration of *Syzigium cumuni* seed powder at fixed dose (200mg kg<sup>-1</sup>bw<sup>-1</sup>) for three weeks in different groups of mice (Group-III) used in this study indicating its protective potential against histopathological alteration. It can be suggested that this *Syzigium cumuni* seed powder at fixed dose (200mg kg<sup>-1</sup>bw<sup>-1</sup>) could be very important in minimising the defects associated with Hyperglycemia.

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#### ETHICAL APPROVAL

Animal ethics committee approval has been taken to carry out this analysis.

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## HISTOARCHITECTURE OF EPIDIDYMIS



Fig. 1. Epididymal autopsy of control mice<br/>(GROUP I)Fig. 2. Epididymal autopsy of Diabetic mice<br/>(GROUP II)



Fig. 3. Epididymis autopsy of treated mice with Syzigium cumuni seed powder (GROUPIII )





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## SURFACE ELECTRON MICROSCOPY OF EPIDIDYMIS



Fig. 3. SEM micrographof Epididymis of Diabetic mice treated with Syzigium cumuni (GROUPIII)





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**RESEARCH ARTICLE** 

# Identification of Novel Drug-Like Compounds from *Cassytha filiformis* (Linn) as Antidiabetic Agents: A Molecular Docking Study

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ABSTRACT

The purpose of this study was to investigate the diabetic effect of phytocompounds of *Cassytha filiformis* through *in silico* molecular modelling studies. Molecular docking was carried out against human pancreatic alpha-amylase, human dipeptidyl peptidase IV, human PPAR-gamma and Glucagon receptor using Glide module. ADMET properties was calculated using quikprop module. Phytocompounds showed better binding score against human PPAR-gamma protein. Compound 1,25-dihydroxycholecalciferol was identified as a potent lead molecule in the management of diabetes mellitus.

Keywords:In silico docking, Diabetes Mellitus, Cassytha filiformis (Linn), ADMET

## INTRODUCTION

In 21<sup>st</sup> century, Diabetes mellitus is a major health problem world-wide. Globally about 200 millionpeople are suffering from diabetes and in middle income countries about 80% of the deaths occur every year due to diabetes. 90% of cases are of type 2 diabetes mellitus (T2DM) [1]. To every nation, it has become a pertaining medical issue with an extensive financial weight. In globally, a quicker development is found in the Asian regions. Augmentation in the occurrence of diabetes is caused due to various reasons such as life style, obesity, population, ethnicity and





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genetic predisposition [2]. Though lot of synthetic drugs are available, major disadvantages like incompetent oral consumption of insulin, side effects and toxicity caused due to synthetic agents was observed during the treatment. Therefore, finding a safe and potent agent to treat diabetes appears to be an unreached target [3]. According toWorld Health Organisation (WHO) about 21,000 medicinal plants and a wide variety of plant-derived bioactive compounds around the world that have established their role in treatment of diabetes mellitus [4]. *Cassytha filiformis* (Linn) is a perennial, parasitic, herbaceous plant with no leaves, which belongs to Lauraceae family [5]. This plant is distributed throughout in India and used medicinally in various countries like China, Indochina, Madagascar and South Africa. *Cassytha filiformis* was pharmacologically screened and proved as antiplateletic agent, vesorelaxant, alpha adreno receptor antagonist and anti trypnosomal drug. [6-7]. In continuation to our previous work [8], the aim of the present study is to discover a novel compound present in *Cassytha filiformis* against diabetics and to predict ADME/T property studies used to measure the safety of the compounds as drug.

## MATERIALS AND METHODS

#### Molecular docking and ADME and Toxicity studies

Molecular docking studies of compounds were studies by GLIDE program [9]. 23 ligand molecules were selected from the GCMS analysis of *Cassytha filiformis* based on their structural and pharmacological profile. The X-ray crystal structures of human pancreatic alpha-amylase (PDB: 1HNY), human dipeptidyl peptidase IV (PDB: 2P8S), human PPAR-gamma (PDB: 2XKW), Glucagon receptor (PDB: 4ERS) retrieved from the Research Collaboratory for Structural Bioinformatics (RCSB) Protein Data Bank was used in this study. "Extra precision" (XP) mode of GLIDE program was implemented in performing docking calculations. GLIDE score (G score) function was used to predict the best docked structure. ADME/T properties of the test compounds was analysed using Quikprop module of Schrodinger 2016 (https://www.schrodinger.com/qikprop).

## **RESULTS AND DISCUSSION**

#### Molecular docking and ADME

G-score is the scoring function of GLIDE docking program. The most forthright method of comparing the accuracy of a docking technique is to determine how carefully the lowermost energy pose (binding conformation) expected with the aid of the object scoring characteristic. In the present study, by removing the inhibitor compound, Extra Precision GLIDE docking procedure was performed and validated. The docking result of these ligands is given in table 1. From the minimized complex interaction energy was calculated. Among the four docked diabetic targets, the selected ligand molecules should potent interaction towards PPAR-gamma protein and moderate interaction against human pancreatic alpha-amylase, human dipeptidyl peptidase IV and Glucagon receptor. The docking score was found -3.17 Kcal/mol to -8.648 Kcal/mol for the test compounds against PPAR-gamma protein. All the test molecules bound to protein by hydrophobic and hydrophilic interaction. Interestingly, compound 1,25-Dihydroxycholecalciferol showed a potent binding interaction against all the docked proteins with the binding score of -8.162 Kcal/mol, -7.929 Kcal/mol, -8.648 Kcal/mol, -7.774 Kcal/mol against human pancreatic alpha-amylase, human dipeptidyl peptidase IV, human PPAR-gamma and Glucagon receptor respectively. Interaction images of 1,25-dihydroxycholecalciferol with the target proteins have shown in figure 1-4. From the *in-silico* results, it shows that the selected test compounds are potent and selective in action towards human PPAR-gamma protein, which could be the possible mechanism of action. This proves that whole extract of Cassytha filiformis, especially compound Lucenin could be a potential drug for anti-diabetic drug development.





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#### Ligand based ADME/Toxicity prediction

QuikProp module of Schrodinger was used to predict the drug-like activity of the ligand molecule, shown in Table 2. The selected properties are known to influence metabolism, cell permeation, and bioavailability. All the predicted properties of the test compound were in the range for 60 to 100% of known oral drugs expect Tricyclo [3.3.1.1(3,7)]decane-2,6-diol, 2,6-bis(aminomethyl) and also satisfy the Lipinski's rule of five to be considered as drug like potential.

## CONCLUSION

The Protein and ligand play an important role in structural based drug design. In the present work, some selected phytoconstituents of *Cassytha filiformis (Linn)* was screened for their *in silico* anti-diabetic property against human pancreatic alpha-amylase, human dipeptidyl peptidase IV, human PPAR-gamma and Glucagon receptor. From the study it was found that, *Cassytha filiformis (Linn)* could be great source of new PPAR-gamma inhibitor. Compound 1,25-Dihydroxycholecalciferol was found to be potent molecule in molecular docking analysis. Further, evaluation of *Cassytha filiformis (Linn)* and Lucenin by *in vitro* and *in vivo* can prove their efficacy in the diabetic treatment.

#### CONFLICT OF INTEREST STATEMENT

The authors declare that there is no conflict of interest.

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## Table 1: Docking score of selected phytoconstituents of Cassytha filiformis (Linn) against diabetic targets

C N.	Comment 1	Docking score				
5.IN0	Compound	1HNY	2P8S	2XKW	4ERS	
1	(E,1'RS,2'RS,3'SR)-4-(2',3'-epoxy-2',6',6'- trimethylcyclohexyl)-3-methyl-3-buten-2-one.	-4.962	-2.895	-5.665	-3.088	
2	1-(Hydroxymethyl)-2,5,5,8a-Tetramethyldecahydro-2- Naphthalenol	-4.321	-2.228	-5.331	-3.246	
3	1,1'-Biphenyl, 3,4-Diethyl	-4.147	-3.27	-6.668	-3.618	
4	1,25-Dihydroxycholecalciferol	-8.162	-7.929	-8.648	-7.774	
5	1,4-Methanoazulen-3-ol, decahydro-1,5,5,8a-tetramethyl	-3.793	-2.202	-3.163	-0.143	
6	16-Nitrobicyclo [10.4.0]hexadecan-1-ol-13-one	-4.808	-3.703	-6.203	-4.298	
7	1-Oxaspiro[4.4]non-8-ene-4,7-dione, 9-hydroxy-2- isopropyl-8-isovaleryl-6-(3-methyl-2-butenyl)-	-4.581	-6.589	-5.737	-3.159	
8	3-buten-2-one, 4-(5,5-dimethyl-1-oxaspiro [2.5]oct-4-yl)	-4.824	-3.116	-4.321	-2.122	
9	3-Phenyl-2,3-dihydro-1H-isoindol-1-one	-3.691	-3.65	-7.531	-2.026	
10	5,7,9(11)-Androstatriene, 3-hydroxy-17-oxo	-5.353	-4.059	-4.236	-3.34	
11	5-Hydroxy-6-methyl-12,13-dioxa-tricyclo[7.3.1.0(1,6)] tridecane-10-carboxylic acid, methyl ester	-5.23	-4.377	-4.357	-4.403	
12	Acetamide, N-(6-acetylaminobenzothiazol-2-yl)-2- (adamantan-1-yl)-	-4.213	-3.975	-4.414	-4.753	
13	Benzene, 1,2,3,4-tetramethyl	-2.6	-2.931	-4.856	-1.988	
14	Betamethasone acetate	-6.731	-3.971	-4.941	-6.559	
15	Cyclobutane, 1,3-bis[2-(2-isopropyl-3,3-dimethyloxiran-2-yl)ethenyl]-2,4-diacetyl	-5.24	-4.363	-6.951	-4.426	
16	Ethanone, 1-[3-(2-hydroxyethyl)-2, 2-dimethylcyclobutyl]-, semicarbazone	-5.413	-5	-5.128	-4.012	
17	Ethyl 6-amino-5-cyano-4-(5-cyano-2,4-dimethyl-1H-pyrrol- 3-yl)-2-methyl-4H-pyran-3-carboxylate	-1.891	-4.471	-5.561	-3.714	
18	Lup-20(29)-en-28-oic acid, 3-hydroxy-, methyl ester,	-4.183	-3.614	-3.17	-3.513	
19	Morpholine, 3-(4,5-dihydroxy) phenyl	-4.775	-5.683	-5.761	-4.556	
20	Propionic acid, (3,6,7,8-tetrahydro-3,7-methano-2,4,6- trimethyl-2H-oxocin-7-yl) methyl ester	-5.346	-3.292	-5.652	-3.877	
21	Retinal	-3.6	-4.413	-7.522	-3.725	
22	Serotonin	-6.022	-4.502	-4.264	-3.527	
23	Tricyclo[3.3.1.1(3,7)]decane-2,6-diol, 2,6-bis(aminomethyl)	-4.936	-1.988	-4.866	-3.163	





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#### Table 2: ADMET properties of selected phytoconstituents of Cassytha filiformis (Linn)

Title	mol MW	don orH B	accp tHB	QPlo gPo/ w	QPlog BB	Percent Human Oral Absorpt ion	Rule ofFive
Acceptable Range	(130.0 - 725.0)	(0-6)	(2- 20)	(-2.0 - 6.5)	(-3.0 - 1.2)	(>80% is high)	(maxim um is 4)
(E,1'RS,2'RS,3'SR)-4-(2',3'-epoxy-2',6',6'- trimethylcyclohexyl)-3-methyl-3-buten-2-one.	222.32	0	4	2.318	0.082	100	0
1-(Hydroxymethyl)-2,5,5,8a- Tetramethyldecahydro-2-Naphthalenol	240.38	2	2	2.869	-0.126	100	0
1,1'-Biphenyl, 3,4-Diethyl	210.31	0	0	6.027	0.641	100	1
1,25-Dihydroxycholecalciferol	222.37	1	2	3.294	0.185	100	0
1,4-Methanoazulen-3-ol, decahydro-1,5,5,8a- tetramethyl	416.64	3	4	5.526	-1.432	96	1
16-Nitrobicyclo [10.4.0] hexadecan-1-ol-13-one	362.46	0	7	3.462	-0.969	100	0
1-Oxaspiro[4.4]non-8-ene-4,7-dione, 9-hydroxy-2- isopropyl-8-isovaleryl-6-(3-methyl-2-butenyl)-	208.3	0	4	2.101	0.044	100	0
3-buten-2-one, 4-(5,5-dimethyl-1-oxaspiro [2.5]oct- 4-yl)	209.24	1	3	2.615	-0.09	100	0
3-Phenyl-2,3-dihydro-1H-isoindol-1-one	284.39	1	4	3.157	-0.181	100	0
5,7,9(11)-Androstatriene, 3-hydroxy-17-oxo	270.32	1	5	1.957	-0.285	95	0
5-Hydroxy-6-methyl-12,13-dioxa- tricyclo[7.3.1.0(1,6)] tridecane-10-carboxylic acid, methyl ester	297.39	1	5	2.329	-0.69	88	0
Acetamide, N-(6-acetylaminobenzothiazol-2-yl)-2- (adamantan-1-yl)-	383.50	2	7	3.609	-0.741	100	0
Benzene, 1,2,3,4-tetramethyl	134.22	0	0	3.475	0.754	100	0
Betamethasone acetate	434.50	2	8	2.574	-1.507	81	0
Cyclobutane, 1,3-bis[2-(2-isopropyl-3,3- dimethyloxiran-2-yl)ethenyl]-2,4-diacetyl	416.6	0	8	4.404	-0.545	100	0
Ethanone, 1-[3-(2-hydroxyethyl)-2, 2- dimethylcyclobutyl]-, semicarbazone	227.30	4	3	0.522	-1.593	61	0
Ethyl 6-amino-5-cyano-4-(5-cyano-2,4-dimethyl- 1H-pyrrol-3-yl)-2-methyl-4H-pyran-3-carboxylate	326.35	3	6	1.426	-1.753	68	0
Lup-20(29)-en-28-oic acid, 3-hydroxy-, methyl ester,	470.73	1	4	6.699	-0.152	100	1
Morpholine, 3-(4,5-dihydroxy) phenyl	195.21	3	5	0.031	-0.105	67	0
Propionic acid, (3,6,7,8-tetrahydro-3,7-methano- 2,4,6-trimethyl-2H-oxocin-7-yl) methyl ester	252.35	0	4	3.142	-0.066	100	0
Retinal	284.44	0	2	5.189	-0.782	100	1
Serotonin	176.21	4	2	0.212	-0.503	63	0
Tricyclo[3.3.1.1(3,7)]decane-2,6-diol, 2,6- bis(aminomethyl)	226.31	6	4	-0.729	-0.241	32	1





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**RESEARCH ARTICLE** 

# Novel Method to Synthesis Indazole and Hydrazone Derivatives with **Significant Antibacterial Property**

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## ABSTRACT

Indazole derivatives exhibit a versatile biological activity and have attained position in the field of medicinal chemistry. To synthesise indazole derivatives by a novel method and analyse the structure by IR, NMR and MASS spectra and evaluate its antibacterial action. The substituted groups of aldehyde and ketone are reacted with hydrazine in presence of DMF to give an indazole derivative and that upon the action of methyl iodide, KOH and acetone gives the methylated indazole & hydrazine derivatives. The structure was evaluated by spectral studies and its antibacterial action through agar well diffusion method. Indazole containing derivatives were synthesized from aldehydes and ketones gives hydrazones through this novel method and it possess significant antimicrobial action against *E.coli*, compare with the standard drug streptomycin.

Keywords: Indazole, Hydrazones, Synthesis, Antibacterial, Novel method, IR, NMR, LCMS

## **INTRODUCTION**

Indazole, is a heterocyclic aromatic compound, also called isoindazole which is rare in nature and have a wide range of biological and pharmaceutical applications. Heterocyclic compounds are cyclic organic compound containing at least one atom other than carbon in a ring formation such as N, O and S. In case of Indazole, it belongs to azole family containing two nitrogen as hetero atoms in 1, 2 positions. Indazole was first defined by scientist Emil Fishes as a"Pyrazole ring formed with Benzene ring". Due to its interesting chemical and biological properties, these compounds are extensively studied [1]. Indazole nucleus is present in naturally occurring alkaloids and biologically



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active molecules. Nigellidine is a natural product containing an indazole nucleus, isolated from plant *Nigella sativa* and used in the treatment of various diseases. And it is found that indazole ring system is also present in many other compounds such as herbicides, dyes and sweeteners [2].

#### Structure



**General properties** Chemical formula: C7H6N2 Melting point: 147 to 149 °C Boiling point: 270 °C Molar mass: 118.14g/mol

#### Normenclature

The 1 substituted indazole were named as isoindazoles in early literature. But recently it is termed as 1H indazole or 2H indazole.



#### Synthesis of indazole

First reported synthesis of indazole from naturally occurring indazole compound (ortho Hydrazino cinnamic acid).



1. Ortho Hydrazine Cinnamic acid

2. Indazole [1]

#### Tutomerism of indazole







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#### Indazole derivatives

The indazole and its derivatives have a great pharmacological importance because it provides the basic structure for large number of compounds which are found to have potential therapeutic values. Different indazole derivatives have been found to possess various activities like anticancer, anti-inflammatory activity, anti-microbial, anti-depressant, analgesic, anti-pyretic, dopamine antagonistic, antihypertensive, antitumor, anti-emetic and anti-HIV activities and action against disorders involving protein kinases (aside from cancer) and neuro-degeneration [3]. In resent research and development in medicinal chemistry Indazole produces compounds with contraceptive activities for men. The compounds with defined mechanism of action can afford new molecules with biological and therapeutic properties.

#### Synthesis of indazole derivatives

Many reactions lead to the synthesis of indazole derivatives. Most suitable compounds used for the synthesis of indazole derivatives are o-disubstituted benzene derivatives in which these two sustituents can react with each other to form a pyrazole ring. Based on the point where the ring closure occurs, the ring closures are classified into three groups;



Nitrogen containing heterocyclic compounds are very important as is comprises the world's largest selling drug [4]. Many useful drugs have emerged due investigation in this feild. Indazole ring system is not a common found in nature. A large number of synthetically prepared indazole devivative compounds has shown various pharmacological properties, therefore various efforts have been made in the last few decades in order to synthesize a different new and novel heterocyclic indazole compounds & its derivatives and were evaluated for various activity. An important area now in the field of drug development and discovery deals with the various heterocyclic ring structures and its various derivatives and therefore more effective studies are done in this field like indazole derivatives.

#### **Antibacterial studies**

A few harmful microbes, for example less than 1% of bacteria, can invade our body (the host) and make us ill. Bacteria may contribute to many non–infectious chronic diseases such as some forms of cancer and coronary heart disease. Microbes that cause disease are called pathogens. When a bacteria enters in our body it induces mutation. Nowadays humans are highly susceptible to this bacterial infection. Many drugs are commercially available as antibacterial agent but this bacteria gain resistance against many of these agents [5]. Streptomycin comes under aminoglycoside family of antibiotic and it is known as a protein synthesis inhibitor. Streptomycin prevents bacterial protein synthesis at initiation [6]. Streptomycin is an antibiotic used to treat a number of bacterial infections. Streptomyces first isolated on October 19, 1943 by Albert Schatz. It is produced by soil *actinomycete Streptomycesgriseus*. It acts by inhibiting initiation and elongation process during protein synthesis. It is a pseudo trisaccharide having a monosubstitutedaminocyclitol to which a disaccharide is attached. In contrast to penicillin, streptomycin inhibited Gram positive and Gram negative bacteria [7].



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## MATERIALS AND METHODS

Table 1:	Chemicals	and	strain	of	bacteria	used in	proi	iect
				~	~ ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			

SL.NO	CHEMICALS	COMPANY
1	2 Chlorobenzaldehyde	Nice
2	Acetophenone	Nice
3	N,N-Dimethyl Formamide	Nice
4	Hydrazine Hydrate	Nice
5	Ethyl Acetate	Nice
6	Hexane	Nice
7	Sodium Chloride	Nice
8	Magnesium Sulphate	Nice
9	Acetone	Nice
10	Potassium Hydroxide	Nice
11	Methyl Iodide	Nice
12	Sodium Sulphate	Nice
13	Methanol	Nice
14	Dimethyl Sulfoxide	Nice
15	Agar	Nice
16	Streptomycin	Chemdyes Co.

#### Scheme

Step 1: The substituted aromatic aldehyde and ketone are reacted with hydrazine hydrate in presence of DMF to give an indazole derivative and recrystallization is carried using methanol. Step 2: The synthesized indazole derivatives upon the action of methyl iodide, KOH and acetone undergo methylation to give methylated indazole derivative and recrystallization is done.



R<sup>1</sup>=H, R, Ar etc. X=H, F, Cl, Br, I, Etc [1].

**TLC** The completion of reaction is determined by Thin Layer Chromatography. The Rf value is also calculated by the formula, Rf value = distance traveled by Sample ÷ distance traveled by solvent front. The test samples are dissolved in suitable solvent samples. Here the solvent used is n-hexane.

#### Antimicrobial study

A drug is considered to have anti bacterial activity when it inhibits the growth of bacteria, when it kills the bacteria. In vitro tests are used for screening new agents. In order to access the biological significance and ability of the sample, the antibacterial activity was determined by agar well diffusion method. The antibacterial activity present in the sample allows diffusing out in the medium and interacting in a plane freshly seeded with test organism. The resulting zone of inhibition will be uniformly circular as there will be a confluent lawn of growth. The diameter of zone of inhibition can be measured in millimeter.







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## PROCEDURE

## Step 1: Synthesis of indazole derivative

To a stirred solution of aldehyde or ketone (1.0mmol) in DMF (5ml) at 23°C was added to hydrazine hydrate (3.0mmol for ketone, 2.0mmol for aldehyde). The solution was stirred at 23°C for 2hrs, at which time TLC (20% ethyl acetate in hexane) indicated complete conception of the starting carbonyl compound. The crude mixture was added to water, washed with water and brine, dried over magnesium sulphate, filtered and concentrated under vacuum to give pure indazole products.

#### Step 2: Synthesis of methylated indazole derivative

To a solution of indazole derivatives obtained in step 1 (0.15g, 0.66 mmol) is dissolved in acetone. The solution is cooled to 0°C and KOH (0.05g, 1.0 mmol)was added. After 15 min, at 0°C, methyl iodide (0.04 ml) was added drop wise and stirred for 2 hrs. The reaction mixture was evaporated; the resulting mass was dissolved in ethyl acetate and washed with water and brine, dried over sodium sulphate. The solvent was removed under vacuum to give crude compound N-methy-3-aryl/alkyl indazole derivatives.

## Step 3: TLC

The Silica gel g (stationary phase) is prepared and applied onto the plate uniformly and then allowed to dry and stabilize. The Hexane (mobile phase) is poured into the TLC chamber and waited for at least 10 mins for complete saturation of TLC .With a pencil, a thin mark is made at the bottom of the plate to apply the sample spots. Samples solutions are applied on the spots marked on the line in equal distances. The plate prepared with sample spotting is placed in the TLC chamber. After proper development of TLC plate, remove the plates and allow them to dry. The sample spots are observed under UV light

#### Step 4: Evaluation of antimicrobial activity

Preparation agar medium: Agar - 10g Nutrient Broth - 6.8g Water - 500ml

500ml of nutrient broth was prepared by dissolving 6.8g of commercially available nutrient broth and 10g of agar in 500 ml distilled water and boiled to dissolve the medium completely. The medium was dispersed as desired and sterilised by autoclaving at 15lbs pressure (121°C) for 15 minutes. Evaluation of antimicrobial action: Petri plates containing 20ml nutrient agar medium were seeded with bacterial culture of *E.coli*. Wells of approximately 8 mm was bored using a cork borer and mixtures of concentrations of synthesised compound such as  $500\mu g/ml$ ,  $1000\mu g/ml$ and  $1500\mu g/ml$  were added. The plates were then incubated at  $37^{\circ}$  C for 24 hours. The antibacterial activity was assayed by measuring the diameter of the inhibition zone formed around the well.

## RESULT

SI NO.	Compound no.	Physical nature	Melting point	% yield
1.	1N1a	Yellow Needle shaped crystals	146°C -148°C	65.6 %
2	1N2a	Yellow crystals	136°C-138°C	61%
3.	1N1b	Off White crystals	164°C-166°C	89.6%
4.	1N2b	Off White crystals	146°C-147°C	83.2%

#### Table 2: Physical data of formed products





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## Spectral features for compound 1N1a



1-H Indazole Molecular Formula: C7H6N2 Molecular Weight: 118.13534

## IR spectrum



Figure 1: IR spectrum of compound 1N1a

## Table 3: Interpretation of IR spectrum of compound 1N1a

Functional group	Peak position	Reference value
Aromatic C-H str	3068 cm <sup>-1</sup>	900-690 cm <sup>-1</sup>
N-H str	3396cm <sup>-1</sup>	3500-3100 cm-1
C-N	2368 cm <sup>-1</sup>	1640-1550 cm <sup>-1</sup>

## Spectral features for compound1N2a

CH<sub>3</sub>

1 Methyl Indazole Molecular Formula: CsHsN2 Molecular Weight:132.16172g Rf value: 0.5161





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### IR spectrum



Figure 2: IR spectrum of compound 1N2a

#### Table 4: Interpretation of IR spectrum of compound 1N2a

Functional group	Peak position	Reference value
C-H bend	868 cm <sup>-1</sup>	900-690 cm <sup>-1</sup>
N-H str	3647cm <sup>-1</sup>	3500-3100 cm-1
N-H Bend	1586 cm <sup>-1</sup>	1640-1550 cm <sup>-1</sup>
C-N str	1314 cm <sup>-1</sup>	1350 -1000 cm <sup>-1</sup>

#### NMR

Proton NMR: Chemical shift range in ppm



Figure 3: Proton NMR of compound 1N2a

## Table 5: Interpretation of Proton NMR of compound 1N2a

Type of proton	Chemical shift range in ppm	Reference value
Aromatic proton	7.34	6.5-8.0
Aromatic proton adjacent to Nitrogen	8.22	8.0-9.0





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## C13NMR



Figure 4: C13 NMR of compound 1N2a

#### Table 6: Interpretation of C13 NMR of compound 1N2a

Type of Carbon	Chemical shift range in ppm	Reference value
Aromatic hydrogen	1270-135.8ppm	110-175ppm
C=N	159.01 ppm	150-170ppm

#### Mass spectrum



Figure 5: Mass spectrum of Compound 1N2a

The mass spectrum showed a peak at 132.3 ie.( M+1) which is in agreement with a molecular formula C8H8N2

#### Spectral features for compound 1N1b







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Benzil-dihydrazone Molecular Formula:C14H10N2O Molecular Weight: 238.28636g

## IR Spectrum:



Figure 6: IR spectrum of compound 1N1b

## Table 7. Interpretation of IR spectrum of compound 1N1b

Functional group	Peak position	Reference value
N-H str	3286cm <sup>-1</sup>	3500-3100 cm-1
N-H bend	1539 cm <sup>-1</sup>	1640-1550 cm-1
C-H str	2970 cm <sup>-1</sup>	3000-2850 cm-1
Aromatic C-H bend	841 cm <sup>-1</sup>	900-690 cm-1

## Spectral features for compound 1N2b



3,3-dimethyl-benzil-dihydrazone Molecular formula:C15H12N2O Molecular Weight:266.33912g Rf value: 0.1846




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# Table 8: Interpretation of IR spectrum of compound 1N2b

Functional group	Peak position	Reference value
N-H str	3286cm <sup>-1</sup>	3500-3100 cm-1
N-H bend	1539 cm <sup>-1</sup>	1640-1550 cm-1
C-N str	1378 cm <sup>-1</sup>	1350-1000 cm-1
C-H str	2970 cm <sup>-1</sup>	3000-2850 cm-1
Aromatic C-H str	3050 cm <sup>-1</sup>	3200-3000 cm <sup>-1</sup>
Aromatic C-H bend	841 cm <sup>-1</sup>	900-690 cm-1

#### NMR spectrum

Proton NMR Chemical shift range in ppm



Figure 8: Proton NMR of compound 1N2b

Table 9: Interpretation of Proton NMR of compound 1N2b

Type of proton	Chemical shift range in ppm	Reference value
Aromatic proton	7.26-7.94	6.5-8.0
Aliphatic proton	2.4	1-3





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# C13 NMR



Figure 9: C13 NMR of compound 1N2b

#### Table 10: Interpretation of C13 NMR of compound 1N2b

Type of Carbon	Chemical shift range in ppm	Reference value
Aromatic hydrogen	127.4-135.7ppm	110-175ppm
Substituted benzene	139.3-141.3 ppm	130-150ppm

#### Mass spectrum



The mass spectrum showed a peak at 266.5 ie.( M+1) which is in agreement with a molecular formula C16H18N4.

# **RESULT OF ANTIBACTERIAL STUDY**

Table 11: Result of antibacterial study

Compounds	Sl.No.	Concentrations	Diameter of Zone Of Inhibition (mm)
(Standard)	1.	500µg/ml	23
Streptomycin	2.	1000 µg/ml	22
	3.	1500 µg/ml	20
1N2a	1.	500 µg/ml	22
	2.	1000 µg/ml	14
	3.	1500 µg/ml	10
1N2b	1.	500 µg/ml	10
	2.	1000 µg/ml	9
	3.	1500 µg/ml	8





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# DISCUSSION

Substituted aromatic aldehyde or ketones has undergone nucleophilic addition with hydrazine hydrate using dimethyl formamide as solvent to get an Indazole nucleus.Indazole nucleus was methylated on reaction with methyl iodide in presence of potassium hydroxide at 0°C to get an indazole derivative by using electrophilic aromatic substitution. "Aryl hydrazones are prepared from benzaldehyde substituted by fluorine at C2 and nitro group at C5,and they carried out deprotonation and nucleophilic aromatic substitution".<sup>[2]</sup>Preliminary examinations confirmed the formation of indazole nuleus from the above literature. The same procedure was carried out by using a diketoneand the spectral interpretation of the compound was carried out by using IR, MASS and NMR studies showing the formation of an aromatic compound instead of indazole. This indicates the separate reactive behaviour of aldehyde and ketone in this novel method. Aldehydes undergo nucleophilic addition faster than ketones. The ketones are less reactive due to steric hindrance of bulky alkyl and aromatic groups. In the product IN2a the aldehyde used is 2- chlorobenzaldehyde. Here chlorine is a good leaving group and this will promote nucleophilic addition and ring closure to form the indazole nucleus. This clearly indicates that ortho substituted aromatic aldehyde is more preferred for the production of indazole derivatives. The ortho substituent should be a good leaving group like halogens. In IN2b the starting carbonyl compound was benzil which is a diketone. Due to the presence of two carbonyl group in the benzil and also the absence of leaving group in ortho position it is difficult for ring closure and expected product. Here benzil forms corresponding hydrazone on reaction with hydrazine hydrate. The product contains C=N attached to phenyl ring. This substitution deactivates the aromatic nucleus and on methylation in step 2 the methyl group is substituted in meta position of the two aromatic rings. Hydrazones generally forms a mixture of geometrical isomers which may be showing different actions. So further studies are required to separate the isomers and to evaluate its biological activities. From the above studies, we can conclude the more reactivity of aldehyde derivatives than ketone derivatives in this novel synthetic protocol.



#### Scheme for reaction of aldehyde

#### Antimicrobial evaluation

According to the results, its clear that the methylated indazole derivatives show antimicrobial activity similar to the standard drug streptomycin. But hyrazone derivatives show little activity against gram negative bacteria. According to literatures hydrazone derivative compounds are more active against gram positive bacteria than Gram negative







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bacteria [8]. Hydrazones generally forms a mixture of geometrical isomers which may be showing different actions. So further studies are required to separate the isomers and to evaluate its biological activities.

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**RESEARCH ARTICLE** 

# Comparative Analysis of Biochemical Composition of Fresh and Cooked Exoskeleton of *Portunus pelagicus* (Linnaeus 1957)

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# ABSTRACT

Blue swimmer crab *Portunus pelagicus* is a predominantly available and economically valuable species found along the southeast coast of India. During processing of the crabs for export, the exoskeleton will be discarded which also contains all the biochemical constituents. In this report, we have a detailed comparative study on the biochemical composition of both fresh and cooked exoskeleton. The exoskeleton of fresh crabs recorded highest constituents when compared with cooked crabs. Among the biochemical constituents, protein was found more in fresh male (10.41%) while lipids in fresh berried crabs (7.20%). Ash and carbohydrates were more in fresh female (3.1% and 2.06% respectively), while moisture was more in male (36.1%). There were significant differences among male, female and berried crabs in the biochemical composition of fresh and cooked meat and also between fresh and cooked exoskeleton. Hence, it may be concluded that in terms of nutritional value, male and female crabs may be considered more suitable than the berried for consumers.

Keywords: biochemical, protein, carbohydrates, lipid, moisture, ash, exoskeleton

# INTRODUCTION

Crabs have exceptional and scrumptious taste as compared to fish and molluscs and rank third after shrimps and lobsters for their revered delicacy and the value of fishery they support in the south east coast of India. The use of marine resources for human consumption has improved rapidly worldwide and export of processed sea food bags good revenue for the country. Crabs have a tough exoskeleton covering the entire body which gives mechanical strength and protection to the animal. While processing the crab for export, only the meat is taken and the shells





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were thrown out as wastes. Thus, seafood processing industry in India is contributing tones and tones of waste material along the coastal environment. These shell wastes being organic in nature contain very high BOD (Biochemical Oxygen Demand) [1]. In general, shell wastes contain 30-40% protein, 30-50% calcium carbonate and calcium phosphate, and 20-30% chitin [2]. The possible solution to this problem tends to be the rapid recycling of shell wastes produced by crustaceans and the extraction of commercially viable substances that can be further used in other applications. Blue swimming crab, Portunus pelagicus (Linnaeus, 1957) is an important coastal species found around the world, which have high demand and high value in the local and world markets. It forms an important large commercial species of the Indo-Pacific region. They are usually found in large numbers in shallow bays with sandy bottom. The blue swimming P. pelagicus is distributed from the eastern Mediterranean to east Africa in the Indian Ocean and to Japan and Tahiti in the Western and South Pacific Ocean [3]. It also occurs in estuarine waters throughout the Indo-West Pacific from Africa to India, Southeast Asia and Australia [4]. In India, the species is available all along the coast, prominently in the southeast and the south-west regions and breeds round the year [5]. It is distributed throughout the coastal waters of the tropical regions of the western Indian Ocean and the Eastern Pacific [6]. From India, P. pelagicus crab was exported as whole frozen crab or as canned meat. It is collected and exported in large scale particularly in Mimisal, Tamil Nadu. Literature information is very mearge on the proximate composition of meat or exoskeleton wastes of P. pelagicus of Mimisal coast. Hence, the present study aims to analyze the comparative study of proximate composition of fresh and cooked meat of *P. pelagicus* of Mimisal coast.

#### MATERIALS AND METHODS

#### Specimen collection

Live (male, female and berried) crabs were collected from Mimisal landing centre (9.9202 E and long 79.1528 N) in the month of December, 2014. They were washed to remove the sand particles and weighed in the collection point. Fresh crabs male, female and berried (each 20) were categorized and weighed separately. Exoskeleton (carapace) was removed carefully from each animal using forceps. Apart from this, another set of crabs were categorized as males and females (including berried) crabs (each 20) and were boiled in large containers in the sea food processing units for 20 min and 25 min respectively. Then they were taken out and cooled to room temperature and were again weighed. Exoskeleton (carapace) was removed carefully from each animal using forceps. The separated carapaces were collected in ziplock covers, labelled and brought to the college laboratory. Thus in the present study, two groups namely fresh and coked exoskeleton were used. The carapaces were dried, ground to fine powder and used for further biochemical analyses.

#### **Analytical methods**

Total protein, total carbohydrates, total lipid and moisture content were estimated following standard methods [7,8,9,10] respectively. Total ash was estimated by incinerating the pre-weighed samples in the muffle furnace at 560°C for a period of 5-8 hours [10].

$$Protein (\%) = \frac{OD \ of \ the \ Sample}{OD \ of \ the \ Standard} \times \frac{Concentration \ of \ the \ Standard}{Volume \ of \ the \ Sample} \times 100 = mg\%$$

$$Carbohydrates = \frac{OD \ of \ the \ Sample}{OD \ of \ the \ Standard} \times \frac{Concentration \ of \ the \ Sample}{Volume \ of \ the \ Sample} \times 100 = mg\%$$

$$Lipids (\%) = \frac{OD \ of \ the \ Sample}{OD \ of \ the \ Standard} \times \frac{Concentration \ of \ the \ Standard}{Volume \ of \ the \ Sample} \times 100 = mg\%$$

$$Lipids (\%) = \frac{OD \ of \ the \ Sample}{OD \ of \ the \ Standard}} \times \frac{Concentration \ of \ the \ Standard}{Volume \ of \ the \ Sample} \times 100 = mg\%$$

$$Moisture (\%) = \frac{Wet \ Weight - Dry \ Weight}{Wet \ Weight} \ X \ 100$$



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 $Ash (\%) = \frac{Wet Weight - Dry Weight}{Wet Weight} X \ 100$ 

#### **Statistical Analysis**

The data were subjected to analysis of variance (one way ANOVA) and significant differences (if P < 0.05) between the means were compared with Turkey's post hoc test using PAST 3.09 version.

# RESULTS

The results revealed significant variations in the biochemical constituents of the exoskeleton of male, female and berried fresh and cooked *P. pelagicus*. The biochemical constituents of exoskeleton viz proteins, carbohydrates and lipids of fresh (Table 1), cooked groups (Table 2) and between groups (Table 3) were significantly different among male, female and berried crabs. The moisture content was also significantly different among male, female and berried crabs of fresh, cooked groups and between groups (Table 1, 2 and 3). Ash content was significantly different among male, female and berried crabs of fresh group (Table 1), and was not significant among male, female and berried crabs of cooked group (Table 2). Between the fresh and cooked groups, ash content was significant between males and not significant between female and berried crabs (Table 3).

# DISCUSSION

Proper use of crustacean wastes facilitates the recovery of value added by-products with future applications in the food and medicine market [11]. From the organic content rich crab shell wastes,  $\alpha$ -chitin, proteins, carotenoid pigments and inorganic calcium carbonate can be extracted [12]. Comparative analysis of fresh and cooked exoskeleton showed higher macronutrients, moisture, and ash content in fresh exoskeleton than in cooked exoskeleton. Only few works have been carried out regarding the proximate composition of exoskeleton (carapace) of crustaceans. The proximate analysis of carapace of Procambarus clarkii and Erugosquilla massavensis as studied by [13] and have showed high amount of proteins, amino acids, fatty acids and minerals in marine mantis shrimp E. massavensis than in freshwater crawfish P. clarkia. Protein content of shell wastes of male and female P. pelagicus found in Rea Sea showed that protein content was more in males than in females [14]. According to [15] protein and fat content were higher in flesh than in carapace, while carbohydrates, ash and fibre were predominant in carapace. Likewise, the snow crab (Chionoecetes opilio) shells also showed high protein, amino acids, fat acids and ash content [16]. Comparative analysis of exoskeletons of the American lobster Homarus americanus and edible crab Cancer pagurus were analysed [17] which showed that the exoskeleton of the lobster was less mineralized than crab exoskeleton. Heavy metal accumulation between hepatopancreas tissue, muscle tissue and exoskeleton of P. pelagicus was studied by [18] and showed that bioaccumulation in the exoskeleton was less than other categories. Chemical characterization of Cancer pagurus, Maja squinado, Necora puber and Carcinus maenas shells showed no significant difference in the ash content [12]. Hence, the thrown out shell wastes from the shrimp and crab processing units can be used as animal feed additive or as organic fertilizers for crop cultivation.

# CONCLUSION

The present study revealed that the exoskeleton of male and female crabs contain higher macronutrients and ash content than the berried crabs. The exoskeleton of this species showed high proximate components and thus can be powdered and used as animal feeds or as fertilizers besides extracting chitin, chitosan and carotenoids. Thus, thrown away *P. pelagicus* shell wastes are potential sources of substantial quality added by-products which can be used in the health care and food industries.



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# **CONFLICTS OF INTEREST**

The authors declare that they have no conflicts of interest.

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Table 1 Proximate anal	vsis of fresh exoskeletor	n of Portunus pela	gicus from male,	female and berried crabs
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Proximate analysis	Groups	Exoskeleton	F Value Significant Level P<0.05
	Male	10.41	
Protein (mg %)	Female	8.24	F = 490.9
	Berried	6.35	
	Male	2.06	
Carbohydrates (mg %)	Female	2.66	F = 220.2
	Berried	2.52	
	Male	4.08	
Lipid (mg %)	Female	5.16	F = 2511
	Berried	7.20	
	Male	36.1	
Moisture (%)	Female	34.8	F = 1363
	Berried	27.7	
	Male	2.0	
Ash (%)	Female	3.1	F = 7.825
	Berried	2.7	

Df Value: Between Groups – 2; Within Groups – 1

Table 2 Proximate ana	lysis of cooked exoskele	ton of Portunus pelagi	<i>icus</i> from male, female	and berried crabs.
	5	1 0	,	

Proximate analysis	Groups	Exoskeleton	F Value Significant Level <i>P&lt;0.05</i>
	Male	9.18	
Protein (mg %)	Female	7.41	F = 307.8
	Berried	5.76	
	Male	1.17	
Carbohydrates (mg %)	Female	1.81	F = 298.8
	Berried	1.47	
	Male	2.59	
Lipid (mg %)	Female	3.18	F = 3487
	Berried	6.06	
	Male	28.5	
Moisture (%)	Female	21.5	F = 945.3
	Berried	18.7	
	Male	1.4	
Ash (%)	Female	2.5	Not significant
	Berried	1.9	

Df Value: Between Groups – 2; Within Groups – 1





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 Table 3. Comparison of proximate composition between fresh and cooked exoskeleton of *Portunus* pelagicus from male, female and berried crabs

Proximate analysis	Groups	F Value Significant Level <i>P</i> <0.05
	Male	189.5
Protein (mg %)	Female	49.18
	Berried	12.01
	Male	1383
Carbohydrates (mg %)	Female	848.7
	Berried	1122
	Male	1350
Lipid (mg %)	Female	1567
	Berried	707.6
	Male	2221
Moisture (%)	Female	3208
	Berried	1809
	Male	6.255
Ash (%)	Female	Not significant
	Berried	Not significant

Df Value: Between Groups – 2; Within Groups – 1



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**RESEARCH ARTICLE** 

# Stirling's Numbers and Harmonic Numbers

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# ABSTRACT

Among various classes of interesting numbers that exist in mathematics, Stirling's numbers play an important role in several counting problems. In this paper, we will discuss Stirling's numbers of first kind and connect them to factorial function. Several properties of Stirling's numbers of first kind were also discussed which will provide a scope for future research in similar counting problems.

**Keywords**: Stirling's Numbers of First Kind, Permutations, Disjoint Cycle Factorizations, Symmetric Group, Recurrence Relation, Harmonic Numbers.

# INTRODUCTION

In mathematics especially in Combinatorics, a branch of mathematics which discuss all sorts of counting problems, we have two types of Stirling's numbers namely Stirlings numbers of first kind and second kind. These numbers were named after Scottish mathematician James Stirling who introduced them in 18<sup>th</sup> Century. In this paper we shall discuss some of the interesting properties of Stirling's numbers of first kind and connect these numbers to various mathematical concepts.

### Definitions

2.1 Let  $S = \{x_1, x_2, ..., x_m\}$  be a set with *m* elements. A function  $f : S \to S$  which is one – one and onto (bijective) is called a permutation.

2.2 Let  $S = \{x_1, x_2, ..., x_m\}$ . The set of all permutations that exist between *S* to *S* is called Symmetric Group with *m* symbols. It is denoted by  $S_m$ .





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Since the number of one-one functions from a set with m elements (domain) to n elements (co-domain) is

$${}^{n}P_{m} = \frac{n!}{(n-m)!}$$
, the number of bijections from *S* to *S* is  ${}^{m}P_{m} = \frac{m!}{(m-m)!} = m!$ .

Thus,  $|S_m| = m!$ . So we have totally m! permutations that can exist from a set containing *m* elements to itself.

#### 2.3 Definition

The number of permutations in  $S_m$  whose disjoint cycle factorizations consists of exactly n cycles is defined to be the Stirling's Number of the First Kind denoted by s(m,n). In s(m,n) we note that  $1 \le n \le m$ .

In the following theorem we determine s(m, n) when n = 1, m.

#### **Theorem 1**

s(m,1) = (m-1)! (3.1) s(m,m) = 1 (3.2)

#### Proof

(a) By definition of s(m,n) we notice that s(m,1) is the number of permutations in  $S_m$  whose disjoint cycle factorizations consists of single cycle. Let  $p = (x_1, x_2, ..., x_m) \in S_m$  be a permutation with *m* cycle. Then there will be *m* choices for  $x_1$ , m - 1 choices for  $x_2$ , and so on until there is only one choice for  $x_m$  to fill the *m* cycle. Hence, there will be *m*! choices to get the *m* cycle. But among these, due to the cyclic property of the permutations, the following *m* permutations are such that  $(x_1, x_2, ..., x_m) = (x_2, x_3, ..., x_m, x_1) = \cdots = (x_m, x_1, ..., x_{m-2}, x_{m-1})$ .

Hence  $s(m,1) = \frac{m!}{m} = (m-1)!$  proving (3.1)

(b) The only partition of *m* having *m* parts is the permutation in  $S_m$  where each element is mapped on to itself. (This in fact, will be the identity element of the Symmetric Group  $S_m$ ). Thus, s(m,m) = 1 proving (3.2) This completes the proof.

#### Theorem 2

If  $1 < n \le m$  then s(m+1, n) = s(m, n-1) + ms(m, n) (3.3)

#### Proof

Let *U* be the set of all permutations in  $S_{m+1}$  whose disjoint cycle factorizations consist of *n* cycles. Then by definition 2.3, we have |U| = s(m+1,n). Let *p* be a partition of  $\{1, 2, 3, ..., m, m+1\}$  in  $S_{m+1}$ . Let us define two sets by  $U_1 = \{p \in U \mid p(m+1) = m+1\}, U_2 = U - U_1 = \{p \in U \mid p(m+1) \neq m+1\}$ . We then see that  $U_1$  is the set of all partitions in which m + 1 is a fixed point of *p* but it is not in  $U_2$ . Also, we see that  $|U| = |U_1| + |U_2|$ . We now notice that  $p \in U_1$  if and only if m + 1 is a fixed point of *p* if and only if (m+1) is a cycle of *p*. Deleting this 1-





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cycle from *p* leaves a permutation  $p' \in S_m$ . Since *p* is a unique permutation in  $S_{m+1}$  that can be obtained by attaching the m-cycle p' and 1-cycle (m+1), the correspondence  $p \to p'$  is a one-one correspondence between  $U_1$  and the permutations is  $S_m$  whose disjoint cycle factorizations consist of n-1 cycles. Hence,  $|U_1| = s(m, n-1)$ . Similarly if a permutation  $p \to U_2$ , then m+1 must lie in a cycle of *p* of length more than 1. That is, p(m+1) = i for some  $i \neq m+1$ . Deleting m+1 from this cycle produces a partition p'' in  $S_m$  with *n* cycles in its disjoint cycle factorization. Conversely for any  $\theta \in S_m$ , by inserting m+1 just before *i* in the disjoint cycle factorization of  $\theta$ , there is a  $p \in U_2 \subset S_{m+1}$  such that  $p'' = \theta$ . Since there are *m* possible choices for *i*, there must be exactly m permutations  $p \in U_2$  such that  $p'' = \theta$ . Hence,  $|U_2| = ms(m,n)$ . Since,  $|U| = |U_1| + |U_2|$  we get s(m+1,n) = s(m,n-1) + ms(m,n). This completes the proof. Using equation (3.3) of theorem 2, we can construct a table of numbers portraying Stirling's numbers of first kind for first seven values of *m*, *n* as shown in Figure 1. From these tabular values we see that s(m,1) = (m-1)! and s(m,m) = 1 verifying the results (3.1) and (3.2) obtained in theorem 1. If we sum the numbers in each row we get 1, 2, 6, 24, 120, 720, 5040, ... which are precisely m! for m = 1 to 7. We now prove this fact formally through the following theorem.

#### Theorem 3

The sum of row m entries of Stiring's numbers of first kind is m!.

That is, 
$$\sum_{n=1}^{m} s(m,n) = m!$$
 (4.1)

#### Proof

By definition 2.3, the number of permutations in  $S_m$  whose disjoint cycle factorizations consists of exactly 1 cycle is s(m, 1). Similarly the number of permutations in  $S_m$  whose disjoint cycle factorizations consist of exactly 2 cycles is s(m, 2). At the most we can get can get *m*-cycle in  $S_m$ . The number of permutations in  $S_m$  whose disjoint cycle factorizations consist of exactly *m* cycles is s(m, m). Thus, the total number of permutations in  $S_m$  whose disjoint cycle factorizations consist of exactly *n* cycles ( $1 \le n \le m$ ) is the total number of permutations that can exist from a set containing *m* elements to itself which (by definition 2.2) is  $|S_m| = m!$ . But, the total number of permutations in  $S_m$  whose disjoint cycle factorizations consist of exactly *n* cycles  $(1 \le n \le m)$  is the total number of permutations that can exist from a set containing *m* elements to itself which (by definition 2.2) is  $|S_m| = m!$ . But, the total number of permutations in  $S_m$  whose disjoint cycle factorizations consist of exactly *n* cycles  $(1 \le n \le m)$  (by definition 2.3) is also given by the sum  $s(m,1) + s(m,2) + s(m,3) + \cdots + s(m,m) = \sum_{n=1}^m s(m,n)$ .

Thus,  $s(m,1) + s(m,2) + s(m,3) + \dots + s(m,m) = \sum_{n=1}^{m} s(m,n) = m!$ . This completes the proof. We now prove a theorem connecting Stirling's numbers of first kind of particular type with the Harmonic Numbers.

#### Definition

The sum of reciprocals of natural numbers is called Harmonic Numbers. In particular, the *n*th Harmonic number is defined by  $H_n = 1 + \frac{1}{2} + \frac{1}{3} + \dots + \frac{1}{n} = \sum_{k=1}^{n} \frac{1}{k}$ 





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#### Theorem 4

If *n* is a positive integer, then 
$$H_n = \sum_{k=1}^n \frac{1}{k} = \frac{s(n+1,2)}{n!}$$
 (5.1)

#### Proof

We prove this result by Mathematical Induction on *n*.

When n = 1,  $H_1 = 1$  and  $\frac{s(2,2)}{1!} = 1$ . Thus the result is true if n = 1.

By Induction Hypothesis, assume that the result is true up to n = r. We now try to prove the result for n = r + 1.

For 
$$n = r + 1$$
 we have  $H_{r+1} = \sum_{k=1}^{r+1} \frac{1}{k} = \sum_{k=1}^{r} \frac{1}{k} + \frac{1}{r+1}$ . By Induction Hypothesis,  $\sum_{k=1}^{r} \frac{1}{k} = \frac{s(r+1,2)}{r!}$ .  
Hence  $H_{r+1} = \sum_{k=1}^{r+1} \frac{1}{k} = \frac{s(r+1,2)}{r!} + \frac{1}{r+1} = \frac{(r+1)s(r+1,2)+r!}{(r+1)!}$   
From (3.1), we get  $s(r+1,1) = r!$ . Using this and (3.3), we get

$$H_{r+1} = \sum_{k=1}^{r+1} \frac{1}{k} = \frac{(r+1)s(r+1,2) + s(r+1,1)}{(r+1)!} = \frac{s(r+2,2)}{(r+1)!}$$

Thus the result is true for n = r + 1 also. Hence by Induction Principle, the result is true for any natural number n. This completes the proof.

# CONCLUSION

Through the Symmetric Group  $S_m$  on m elements, we get permutations of disjoint cycle factorizations with lengths 1 to m. In this paper, we saw that the Stirling's numbers of first kind provides us with the complete information of how many permutations in  $S_m$  that exist whose disjoint cycle factorizations have length n where  $1 \le n \le m$ . The answer for this turns out to be s(m, n). In theorem we proved that the number of permutations in  $S_m$  that have disjoint cycle factorizations of length 1 and length m are precisely (m-1)! and 1 respectively. In theorem 2, we derived a nice recurrence relation for generating Stirling's numbers of first kind. Theorems 1 and 2 helped us to form the tabular values of first seven rows of Stirling's numbers of first kind. This table provides us lots of information, in particular, about the structure of the symmetric group  $S_m$ . In theorem 3 we proved an important connection between Stirling's numbers of first kind and factorials. In fact, the for each m, the sum of Stirling's numbers of first kind turns out to be m!. In Theorem 4, we proved the connection between Harmonic numbers and Stirling's numbers of first kind. This result helps us to generalize the concept of Stirling's numbers of first kind to get related to much higher concepts in Analytic Number Theory and Combinatorics.

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**RESEARCH ARTICLE** 

# Pulse Shape Discrimination (PSD) Method for the Identification of the Neutron and Gamma using Scintillator

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# ABSTRACT

Neutron detection is one of the important topics since neutrons are closely related with reactors and also they are health hazards. For the detection of neutron people are working hard to synthesize new etection material. Out of many varieties of detection material one of the good material is the scintillators. The big volume Organic/inorganic scintillators are used to detect neutrons. The main problem is the detectors are sensitive to gamma and neutron at the same tie. So one need to filter neutron from gamma. Here an important method has been described to separate these two.

Keyword: PSD, neutron, Scintillator, VME

# INTRODUCTION

In the present days peoples are trying to get a clean energy source. The Fusion reactions seems thesolution and many scientist working on fusion project. The fusion reaction direct drive inertialconfinement fusion experiments at the Laboratory for Laser Energetics (LLE) release large amounts ofstored nuclear energy. Most of it is given off as energetic neutrons. The study of neutrons aredemanding subject. The demand for reliable nuclear data, in particular for neutron cross section from 5to 14 MeV, [1] is still interesting to study. More over there is a need for calibrated neutron detectors to be used for reliablecross section measurements. In addition to the above the neutron imaging is another important fieldwhich is evolving which needs more efficient neutron detectors. A Two-body reactions are used to produce a mono energetic neutrons. Therefore in addition with the existing neutron source the accelerator based source is also important source of neutron.in addition with other reaction like 7Li(p, n)7Be and many others. The reaction has considered and employed for the determination of the efficiency of the neutron detector for a wide range of neutron energies. Inmost of the cases a contamination will possible with intrinsic neutron background.





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# PROCESS AND RESULTS

The neutron detector has been tested by using the gamma ray source as the detector [2] also sensitive toboth neutron and the gamma ray. A typical data acquisition system with theVME based data acquisition system has been used, we have used the V1720 digitizer. We have developed the algorithm based on the Pulse shape discrimination method (PSD) [3,4] Ito distinguish between the neutronand the gamma ray detected by the neutron detector. In addition with the PSD method the sameprogram will also able to analyse the TOF method for the discrimination. To test our PSD analysis program we used the algorithm developed by our group by taking someold data and we found that the n and gamma has been separated out very clearly. Which has beenshown in the Fig 1. From the Fig 1 one can see that in both the method (charge comparison andthe TOF) the neutrons and the gamma has been well separated out. we have used the RF source as the deuteron source in our case is gas. To fix the tuningparameter of the RF source, first we have extracted the proton beam by using hydrogen gas in theRF plasma tube and we have extracted the p-beam successfully then transported to the chambernewly installed chamber in the PRIN line with 90% transmission efficiency. The same proton beamhas been used for the elastic scattering angular distribution measurement. After fixing the parameterfor Proton we just replaced the hydrogen gas with deuteron and transported the beam. The RF source has been used to get also pulse beam which will be used for the time of flight (TOF) measurement.

# CONCLUSION

A program has been developed for the measurement and identification of the neutron and gamma. The scintillators are sensitive to both neutron and gamma .As the detector is sensitive to both so an algotherim has been developed based on pulse shape discriminazation method has been used to identify the neutron and gamma. A test case has also used for the trilbaisb and found working very nice. The hole thing has been designed for a PRIN project. But it can be used for any other situation where the n,gamma identification will required.

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Fig 1 (Left) The Pulse shape discrimination method and (Right) TOF analysis of the previous datausing the newly developed algorithm. Neutron and the gamma are very well separated from both the figure.





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**RESEARCH ARTICLE** 

# The Impact of Natural Disasters on Simplified Procedures and Open Problems

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# ABSTRACT

A natural hazard is a geophysical, atmospheric or hydrological event (e.g., earthquake, landslide, tsunami, windstorm, flood or drought) that has the potential to cause damage or loss, while a natural disaster is the incidence of an extreme dangerous event that impacts on communities causing damage, trouble and casualties, and leaving the affected communities unable to function normally without outside assistance (Twig, 2007). The definition of Natural Disaster Impact (NDI) can change according to both the aim of the study and the scientist assessing it. It can be defined as constituting the direct, indirect and intangible losses caused on environment and society by a natural disaster (Swiss Re, 1998). Direct losses include physical effects such as destruction and changes that reduce the functionality of an individual or structure. Damages to people death, buildings, their contents, and vehicles are included, as are cleanup and disposal costs. Indirect losses affect society by disrupting or damaging utility services and local businesses. Loss of revenue; increase in cost; expenses connected to the provision of assistance, lodging, and drinking water and costs associated with the need to drive longer distances because of blocked roads are included. Intangible losses include psychological impairments caused by both direct and intangible losses that individuals personally suffer during the disaster.

Keywords: physiological effects on people, Damaging Hydro-geological Events

# INTRODUCTION

The Natural Disaster Impact Assessment (NDIA) is crucial in helping individuals to estimate replacement costs and to conduct cost benefit analyses in allotting resources to prevent and mitigate the consequences of damage (UNEP-



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ECLAC, 2000). A general NDIA procedure has not yet been developed several approaches are available in literature and their applicability depends on the accessibility of damage data. Possible end users of NDIA include the following (Lindell & Prater, 2003):

- 1. Governments, with an interest in estimating direct losses to report to taxpayers and to identify segments of the community that have been (or might be) disproportionately affected.
- 2. Community leaders, who may need to use loss data after a disaster strikes to determine if external assistance is necessary and, if so, how much.
- 3. Planners, who can develop damage predictions to assess the effects of alternative hazard adjustments. Knowing both the expected losses and the extent to which those losses could be reduced makes it possible to implement cost effective alleviation strategies.
- 4. Insurers, who need data on the maximum losses in their portfolios to guarantee their solvency or even to undertake additional measures to alleviate the risk that they would face in case of a disaster (i.e., the use of catastrophe bonds which are risk linked securities that transfer a specified set of risks from a sponsor to investors) (Noy & Nualsri, 2011). Data availability and reliability, especially for old events, represent constraints in the NDIA context because of several issues of very different type:

**Data availability**, for current events, depends on the time at which data gathering started. It is impossible to decide a priori when data have to be gathered: it primarily depends on the type of phenomenon causing the disaster and its magnitude, and secondly on the scope of the assessment (for example, the assessment should not be delayed as there is an urgent need to elicit support from the international community) (ECLAC, 2003).

**Long-term losses** must sometimes be determined over a period of years. Slow landslides, for example, can cause damage over long periods. Intangible damage like disaster-related stress also requires years to be detected (Bland et al., 1996).

**In most countries**, there are no agencies responsible for gathering damage data. Damage caused by severest events can be mined from international databases, while data on less severe events can be obtained by means of specific historical studies.

**Data on property damage** can depreciate the value of property, thus they would not be available or not completely reliable (Highland, 2003).

For some type of disasters as landslides or floods, the costs of damages to structures such as roads are often merged with maintenance costs and are therefore not labeled as damage. In addition, when heavy rains trigger both landslides and floods (Petrucci & Polemio, 2009), it is difficult to separate landslide damage from flood damage.

**Developing countries** have an incentive to exaggerate damage to receive higher amounts of international assistance; thus, in these cases, data may not be entirely reliable (Toya & Skidmore, 2007). It is starts with a panoramic of the different approaches reported in the literature to assess the impact of natural disasters, and then presents some simplified approaches to perform a relative and comparative assessment of the impact caused by phenomena as landslides and floods triggered by heavy rainfall during events defined as Damaging Hydro Geological Events. Finally, some indices to assess the relative impact of landslides are presented.

#### A review of impact assessment literature

To identify recent literature concerning NDIA, a search was made using Google Scholar, a technical search engine that search across articles, theses, books and abstracts, from academic publishers, professional societies, online





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repositories, Universities, international organizations and other web sites (Petrucci & Llasat, in press). According to their focus, the selected articles were sorted in three groups described in the next sub-sections.

#### Short-medium-term

It is effects directly involving people and goods affected by a disaster The articles included in this group employ the simplest approach: the impact is expressed by the list of damaged elements and neither monetary figures nor other assessment are performed (Ngecu & Ichang'i, 1999; Whitworth et al., 2006; Bilgehan & Kilic, 2008). Frequently used impact indicators include numbers of victims and damage to buildings, roads and agriculture. In these studies, damage data are obtained by state agencies or even collected by directly asking people involved in the disaster. Both the number of victims and the percentage of people affected are used to compare the impact of a disaster on various communities (Msilimba, 2010) or that of disasters that have occurred in different time and places. Some of these articles focus on damage to people, analysing the circumstances leading to loss of life and assessing them in relation to vulnerability factors (e.g., age, race, and gender) (Jonkman et al., 2009).

#### Medium- and long-term

It is socio-economic effects In these articles, after individuating the affected population and the pre-disaster situation, the researchers isolated effects on social sectors (the population, housing, health and education), service infrastructure (drinking water and sewage, communications, electricity and power), and production sectors (agriculture, industry and trade) in order to measure the disaster's impact on the macroeconomic indicators during a period of one to two years after the disaster (ECLAC, 1991). Natural disasters are seen as a function of a specific natural process and economic activity (Raschky, 2008).

- a) the indicators used to detect the impact on national economies include a) long-term recovery businesses (Webb et al., 2002);
- b) changes in flow variables such as annual agricultural output (Patwardhan & Sharma, 2005);
- c) variations in fiscal pressure (Noy & Nualsri, 2011); and d) effects on the labour market (Belasen & Polachek, 2007; Zissimopoulos & Karoly, 2010). The value of human life can be tentatively assessed using two approaches that assign different values to people in different income groups or in countries at different stages of development (AusAID, 2005):
- 1. The human capital approach involves calculating the average expected future income that the deceased would have generated assuming that he/she had achieved normal life expectancy.
- 2. In the Willingness To Pay (WTP) approach, surveys assess how much an individual is willing to pay to reduce the risk of death. Even environmental damage can be assessed using the WTP approach, either by asking people to state a WTP amount or by inferring this amount based on costs incurred for environmental services (Dosi, 2001).

Economically, disasters can act as a barrier to development, increasing poverty and having a small but significant negative effect on economic growth (Raschky, 2008). This effect can return a society to the level of human development it had achieved two years prior to the disaster (Rodriguez-Oreggia et al., 2010). Indirect societal effects such as decreases in productivity in people affected by disaster can influence economic growth (Popp, 2006). Human capital can be directly affected by these disasters through death or injury and indirectly affected when damage to schools decreases human capital accumulation (in poor countries, decreasing school attendance rates caused by reductions in family expenses can occur). Even demographic effects such as migration have been detected (Smith & McCarty, 1996). Nevertheless, natural disaster can also produce positive effects. Disasters can create Schumpeterian creative destruction (Cuaresma et al., 2004), especially if there are injections of funds for assistance and/or reconstruction. They can represent an opportunity to update capital stock and improve an economy, thereby producing a long-term positive effect on the growth of the Gross Domestic Product (GDP) (Skidmore & Toya, 2002).





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Activities in the construction sector may reactivate the economy, and the demand for construction materials may generate windfall profits (ECLAC, 1991). Outside the disaster area, income increases can accrue for owners of commodities whose price is inflated by disaster-induced shortages (CACND, 1999). For instance, in the case of drought, when agricultural production decreases, farmers in affected areas experience the negative effects of the disaster, and the price of agricultural products increases. Then, farmers outside affected area, who are experiencing normal production, will reap the benefits of these higher prices (Wilhite et al., 2007). Even ways of thinking and acting can be modified by major disasters, resulting in personal and community growth (Birkmann et al., 2008). Disasters are more costly for developing countries: as economies develop, there are fewer disaster-related deaths and damages/GDP (Toya & Skidmore, 2007). Nevertheless, increasing wealth causes relatively higher losses in highincome nations (Raskly, 2008). Increases in income increase the private demand for safety; higher income enables individuals (and countries) to employ additional, costly precautionary measures. Nevertheless, in countries that experience a concentration of assets that is larger than the counter-measures put in place, the income-vulnerability relationship can be inverted, especially in the case of disasters related to behavioural choices such as floods and landslides. Disasters in South, Southeast, and East Asia are more costly than those occurring in the Middle East and Latin America. These results might be tied to the higher population density of Asian countries. Small island developing states are severely impacted by such events (Meheux et al., 2007): the number of victims and affected individuals and the degree of damage are twice as large on average as in any other region (Noy, 2009). Normalization procedures are used to assess what the magnitude of economic losses over time would be if a past disaster took place today. It seems that societal change and economic development are the principal factors responsible for the increasing losses from natural disasters to date (Pielke et al., 2008; Barredo, 2009; 2010). For weather-related disasters, Bouwer (2011) pointed out no trends in losses corrected for increases in population and capital at risk that could be attributed to anthropogenic climate change.

#### Short-to-long-term physical and physiological effects on people

It is focus on natural disasters and their effects on people's health from either a physical or a psychological point of view. Pre and post disaster conditions were compared in these studies to detect the onset of diseases and/or the worsening of pre-existing illness, and to assess if and when disaster related symptoms appear/disappear. The data collection processes mainly involved standardized questionnaires used to collect self-reported information on symptoms quantified using numerical scores (Catapano et al., 2001; Cao et al., 2003) that could measure the disaster's impact. The risk of developing physical and/or psychiatric disorders is related to the extent of the losses suffered (Cao et al., 2003), and it is greater in families that have lost a family member in a disaster (Lindell & Prater, 2003), have experienced evacuation, or have worse finances (Bland et al., 1996). This probability can also be increased by a lack of information on the probability that the event will re-occur (Catapano et al., 2001). Two sub-sets of articles were isolated that focused on psychological and physical effects, respectively.

#### **Psychological effects**

It is Conservation Resource Model, people try to protect resources such as objects (housing, possessions, etc.), social roles (employment, marriages, etc.), energy (time and monetary investments), and personal characteristics (e.g., self-confidence). The threatened or actual loss of these resources as caused by a natural disaster leads to psychological distress (O'Neill et al., 1999). Frequently observed conditions such minor emotional disorders seldom come to the attention of psychiatrists but may negatively affect social relationships and work performance. Commonly detected symptoms are fatigue (Lutgendorf et al., 1995), tics, and cognitive experiences such as confusion, impaired concentration, and attention deficit disorder. Emotional signs such as anxiety, depression, and grief, as well as behavioural effects on suicide rates were detected: earthquake victims (people who had lost family members residing with them, were injured, or experienced property loss) were 1.46 times more likely than non-victims to commit suicide (Chou et al., 2003). All these effects can be mild and transitory or can lead to Post Traumatic Stress Disorder (PTSD). The mental states of victims can include three stages (Sadeghi & Ahmadi, 2008): a) an immediate reaction





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involving distressing symptoms accompanying adaptive stress; b) the post-immediate phase, which includes symptoms of maladaptive stress (confusion, agitation, and occasionally neurotic or psychotic reactions); and c) the long-term sequel phase, which involves a return to normal health or the onset of PTSD, which can sometimes yield a chronic phase that involves personality changes. These surveys make it possible to monitor the most fragile segments of the population, including people with pre-existing mental illness, racial and ethnic minorities, and children, in which symptoms may differ depending on age (Lazarus et al., 2002; Overstreet et al., 2011). Gender differences arise as well: for instance, after an earthquake, women report greater emotional distress and mental health problems than do men (Norris et al., 2002), but the occurrence of addiction disorders among women is much lower (Montazeri et al., 2005).

#### **Physical effects**

Physical effects encompass symptoms affecting people who have not been directly involved in a disaster. The deterioration of hygiene, housing, and basic services can induce the outbreak of diseases such as leptospirosis (Aus AID, 2005) or increase the risk of morbidity and mortality caused by communicable diseases (Waring & Brown, 2005). In developing countries, for instance, contagious and non-contagious diseases are reported during the first weeks after floods. Moreover, in some environments, even the incidence of snake bites can increase (Shajaat Ali, 2007). Disaster-related stress can have several secondary impacts on human health, such as effects on the human immune system (Solomon et al., 1997), diabetes (Ramachandran et al., 2006; Fonseca et al., 2009), and gastro duodenal ulcers (Suzuki et al., 1997). Also increases in serum leptin levels have been detected in subjects with PTSD, which explains the hyper vigilance of people who have faced danger and uncertainty (Liao et al., 2004). In addition, after major earthquakes, the number of patients with Acute Myocardial Infarction (AMI) has been reported to increase 3.5-fold, and the part of women with AMI seems significantly greater than in the years preceding the disaster (Suzuki et al., 1997).

#### The impact of Damaging Hydro-geological Events (DHEs)

It is focuses on climate related damaging phenomena as landslides, floods, urban flooding, and storm surges which occur during periods of bad weather conditions, lasting from one to a few days, and characterized by intense rainfall and sometimes strong winds. These periods can be defined as Damaging Hydro-geological Events (DHEs) (Petrucci & Polemio 2003, 2009), and their impact can be assessed as the sum of the damage caused by all the damaging phenomena triggered through a selected DHE.

#### Data collection

Data on damage caused by DHEs which occur currently can be obtained from different agencies (civil protection, public works offices, etc.) or even by on-site surveys (interviews with people involved or local administrators). On the contrary, dealing with events that occurred in the past, for which no direct surveys can be performed, historical data have to be found. The availability of historical data changes from one country to another and over time, and it is related to event severity. Actually, information concerning older events is less plentiful than information pertaining to newer events and the greatest amount of data usually exists for the most severe events, whereas less severe cases are rarely mentioned. Historical data can be gathered mainly from non-technical sources (books, newspapers, etc.), and then phenomena are described by non-specialist observers, which often focus on the effects (damage) more than on their causes (landslides, floods and so on). In Italy, for example, there is no public authority that systematically collects data on damage caused by DHEs. These data can eventually be found in several offices, but none of these offices focus exclusively on collecting them. Moreover, each office stores documents in its archive by using organization criteria that are designed according to the needs of the office itself and not planned for public use. In addition, the archives of some type of offices, as i.e. fire brigades and hospitals, which can contain data on damage to both people and properties, cannot be accessed because of laws ensuring the privacy of citizens. Other requests for both aid and damage reimbursement are usually sent to civil protection offices, but we mustn't presume that these requests are systematically collected, and, this usually happens only for recently occurred phenomena; it is more





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difficult to find documents concerning damage that occurred several decades ago. Several authors gathered data from press archives (Cuesta et al. 1999, Devoli et al. 2007). Daily newspapers ensure continuity in information flow and, by-passing problems related to privacy, report detailed descriptions of human injuries, supply the age, sex, and names of the people involved and details of the causes of death or prognosis of injuries. However, this information source presents some disadvantages that must be clearly understood.

- 1. The language of newspapers is not technical, so the articles must be carefully analyzed to correctly classify the described phenomena. It is necessary to understand the reporter's perspective and familiarity with phenomena: adjectives to describe the size of a landslide, for example, must be assessed with caution because they are strongly affected by previous experience of the reporter with landslides.
- 2. Local newspapers are more detailed than national ones: until some decades ago, news coming from regions far from the editorial unit was only related to severe events, and thus, only the local newspaper allows a complete screening of both major and minor events occurred in a selected time frame.
- 3. Articles tend to focus on damage, so details on phenomena can be scarce and must be inferred. Similarly, quantitative data on triggers (i.e., rain or wind intensity) are not provided, because newspaper articles focus more on the effects and less on their causes.
- 4. The articles must be checked in order to avoid duplication: often, newspapers report a damaging phenomenon in several editions (at least until major damage has been repaired). Also the number of victims must be carefully checked: newspapers may provide changing figures until the end of rescue operations.

Despite these disadvantages, especially in countries where there are no public authorities collecting these data, newspapers can be used as proxy data to establish a catalogue of damaging situations that can provide an indicator of the social impact of DHEs. In Italy, a systematic collection of data mined from newspapers was organized in an on-line database named AVI (http://sici.irpi.cnr.it/), and the use of newspaper data or, more recently, of internet-sourced news is a common practice to gather data (Kirschbaum et al., 2009).

#### Approaches to the assessment of damage caused by

DHEs the record of damage caused by DHEs in a selected region during a certain study period can be obtained by means of the systematic analysis of daily newspapers. Then, the damage caused by these DHEs can be assessed by various criteria, and the events can be classified according to their damage severity. In this way, data can be used for different types of analyses, as for example: a) the study of triggering rainfall thresholds, b) the comparisons between the severity of DHEs occurred in a selected area through the time, to understand if climatic change can modify their impact, and c) the comparisons between the severity of DHEs occurred in the same places but in different periods, to verify if and how the development of urbanized sectors can affect their impact. The approaches to assess the impact of DHEs can be more or less complex; nevertheless, their applicability depends firstly on data availability and secondly on the scale of the study. The simplest damage classification, which can be applied at both local and regional scale, can be performed establishing a priori three damage levels (Petrucci & Versace, 2000):

#### Level 1: high damage. At least one of the following circumstances occurs

- 1. breaking of bridges
- 2. damage to main roads and railway lines
- 3. serious blocking of roads and railways lines
- 4. damage to major life-lines
- 5. collapse of buildings
- 6. flooding of vast areas of land with great damage to agriculture
- 7. occurrence of victims and casualties





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# Level 2: medium damage. The circumstances of Level 1 do not occur but at least one of the following does:

- 1. some building rendered unusable
- 2. landslides and/or flooding that affect road and railways though with limited effects and brief duration damage to secondary life-lines
- 3. flooding of limited areas of land with serious damage to agriculture

#### Level 3: low damage. The circumstances of Levels 1 and 2 do not occur and just one of the following happens:

- 1. damage to agriculture OR
- 2. flooding of inhabited areas OR
- 3. damage to life-lines

To perform an in depth analysis, further steps can be done, by defining some descriptive indices that can be used to summarize the effects of a DHE.

#### Index of Damaged Area (IDA)

This index represents the relative size of the area affected by floods or landslides during a DHE, and it is assessed in reference to small administrative units of the disaster region. In Italy, for example, we relate this index to the municipalities of a selected region. The IDA is obtained by summing the area of municipalities hit during the DHE (S) and dividing the obtained value by the area of the regional surface (R). IDA (Index of Damaged Area) =  $S / R \times 100$  (1) S is greater than the area truly affected, but this simplification is necessary to by-pass the impossibility of precisely delimiting areas actually hit, because of the low technical level which can characterize historical data. IDA represents the percentage of a region's area affected during each DHE; based on IDA, the DHEs that affected a region can be classified as: Local DHE = IDA<2.5% Wide DHE = IDA: 2.5÷10% Regional DHE = IDA>10%.

#### Local Damage Index (LDI) and Local Damage Index Density (LDId)

It is the Local Damage Index is the sum of damage Di caused in a municipality by the i phenomena that occurred there, and it is based on the concept that damage is the product of the value of damaged element and the level of loss that it suffered (Varnes & IAEG, 1984): LDI=  $\Sigma$ Di (2) Where: Di (Damage) = Vi x Li (3) Vi is the value of the damaged element, ranging from 1 to 10 in an arbitrary scale (Figure 3), and Li is the level of loss suffered, a measure of the percentage of loss affecting the element during the event, that can be High=L1 (1), Medium=L2 (0.5), or Low=L3 (0.25) (Petrucci et al. 2003). By dividing the LDI by the municipal area, we can obtain an index that represents the density of damage in each of the hit municipalities: LDId (Local Damage Index Density) =LDI/Municipality area (4) Obtained values can be sorted into a number of classes. For each event, a regional map of municipalities classified according to the LDId can summarise the regional pattern of damage, thus allowing use of a geographical analysis of the pattern of damage density pattern which can be used, i.e., to identify more intensely affected regional sectors. Moreover, by comparing LDI to the return period of rainfall which triggered the damaging phenomena, the proneness of an area to be damaged by DHEs can be classified as (Petrucci & Pasqua, 2008): - High, if rainfall of low return periods causes severe damage. - Medium, if return period of rainfall and induced damage show equal levels of exceptionality. - Low, if rainfall having a high return period induces damage of low level.

#### The Impact of Mass Movement's Mass Movements

It is defined as the movements of masses of soil, rock, debris, or mud, usually occur because of the pull of gravity, and are a source of great concern because they can impact numerous victims and cause severe damage. Although many types of mass movements are included in the general term "landslide," the more restrictive use of the term refers only to mass movements where there is a distinct zone of weakness that separates the slide material from more stable underlying material (USGS, 2009). Only a low percentage (12%) of the articles analyzed to perform the review presented in the paragraph 2 concern landslides. This low attention to landslides impact depends on two factors: a) if





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compared to earthquakes or hurricanes, landslides could be classified as minor disasters; b) landslides can be secondary consequence of major disasters such as earthquakes. Nonetheless, both the assessment of damage after landslides occurrence, and the appraisal of damage that could be caused by future landslides have practical usefulness. Immediately after an event that triggered several landslides, a rapid relative damage assessment allows for the sorting of phenomena according to their relative impact, upon this assessment priorities for structural remediation can be set and the costs and benefits derived from the implementation of different defensive measures can be assessed. On the other hand, pre-event assessment of the potential impacts of future mass movements can provide information to planners, who must evaluate the consequences of alternative hazard mitigation measures. If the landslide inventory of an area has been conducted, a "consequence analysis" can identify potential outcomes arising from the activation of each mapped landslide. In addition, estimating the potential damage from each landslide can enable preparedness and improve the capacity of governmental agencies to cope with the emergency phases.

#### Identification and direct damage sections

For each landslide, a SAF must be completed to obtain numerical indices representing its impact. The first part of the SAF is the identification section (A), which accounts for:

- 1. location of the landslide (province, municipality, place name, coordinates) and map of the landslide area (if not available in analysed documents, we can roughly trace it on a topographic map with the available information);
- 2. time of activation (year-month-day/s);
- 3. document(s) from which data have been obtained (original title or type of document if no title is available);
- 4. reliability of the document(s) from which data have been collected (ranging from low to high, according to the type of document and the skill of the author). The part of the SAF assessing direct damage is made up of 6 sections (B to G) and it is divided into two parts: the elements (on the left side of the chart) and the levels of loss (on the right) (Figure 4). Each element is characterised by its value, set on an arbitrary scale (red numbers). The levels of loss (black numbers), are set as: L4: complete loss; L3: high loss; L2: medium loss; or L1: low loss. Depending on the section, these levels have different meanings, but they always reflect the aforementioned levels of loss. In the working version of the SAF, the yellow cells are empty: by typing the letter x in a cell describing an element and another one in the cell of the suffered level of loss, formulas implemented in hidden columns multiply these two values to obtain dl, which is the contribution to damage of the line l. All the dl values are used to assess both direct and total damage indices.

#### The elements used for direct damage assessment are organized in the following sections

**Section B: Buildings.** Buildings are classified as public or private. For public buildings, according to the social function, the strategic coordination role in emergency management and the number of people who can be inside during night and day, a unique value was set (city hall =1; barracks =1; hospital =1; school =0.75; church =0.75). For private buildings, two criteria were introduced to identify their value: the number of buildings (1 building; 2-10 buildings; >10 buildings), and whether they are inhabited, temporarily inhabited or uninhabited. The level of loss can be selected from: L4 (collapsed), L3 (unusable due to structural damage), L2 (unusable due to loss of functionality), and L1 (habitable with light damage). In this section, the loss of furnishing inside or outside the buildings is also included and classified according to the number of buildings involved (1 building; 2-10 buildings).

**Section C: Roads**. Roads are classified into five types according to relevance, traffic flow, and possible restoration costs: highway, state road, county road, municipal road and country road. Except for country roads, which are characterised by a simple structure, the damage can affect one or more of the following sub-elements: bridge, tunnel and roadway. Then, except for country roads, the value depends on the damaged sub-element(s). According to the degree and duration of inefficiency, the levels of loss were set as follows: L4: road breakage causing traffic





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interruption for months; L3: road breakage causing traffic interruption for days; L2: temporary interruption without breakage; L1: light damage without traffic interruption.

**Section D: Railways:** According to the relevance and the traffic flow, we divided railways into state and regional railways. The value depends on the damaged subelement(s), and the level of loss can be selected from: L4: railway breakage causing traffic interruption for months; L3: railway breakage causing traffic interruption for days; L2: temporary interruption without breakage; and L1: light damage without traffic interruption.

**Section E: Productive activities:** These are divided into five types: industrial, commercial, handicraft, tourism and farming. The levels of loss were set as: L4: interruption of production and loss of productive system; L3: interruption of production and loss of products; L2: loss of products; and L1: light damage without loss of products.

**Section F: Network services:** This category is divided into five types: gas pipeline, electric line, telephone line, aqueduct, and drainage system. The levels of loss were set according to the duration of the inefficiency and the extent of the suffering area (L4: prolonged service interruption of large areas; L3: temporary service interruption of large areas; L2: local and temporary inefficiencies; and L1: light damage without inefficiencies).

**Section G: People:** Damage to people is described by the occurrence of four conditions: victims; badly hurt; light physical damage; and temporary shock conditions. The levels of loss were set according to the number of people concerned (>60 people; 60-30 people; 60-30 people; 60-30 people; 30-10 people; 30-10 people; 30-10 people; 30-10 people;  $100,000 \in$ ;  $20,000-10,000 \in$ ;

**Indirect damage sections**: The indirect damage analysis process includes two sections, H and ISection H describes actions concerning the dislocation of people, for which the levels of loss are set according to the number of people involved (>60 people; 60-30 people; 30-10 people; 100,000  $\in$ ; 100,000-20,000  $\in$ ; 20,000-10,000  $\in$ ; As for direct damage sections, the numbers are hidden in the operating version of the SAF, because the yellow cells must be filled in. For each action, we have to select only one of the four levels of loss, by typing the letter x into the relative cell: in this way, the hidden value is placed in the correspondent dl cell. All of the dl values are used to assess both indirect and total damage indices.

**Intangible damage section:** The intangible damage, assessed in section L, takes into account the psychological consequences affecting people who live in the damaged area. The levels of loss are set according to the number of people involved (>60 people; 60-30 people; 30-10 people 30-10 people; For each line of the indirect damage sections, by selecting a single level of loss, the appropriate numerical value is inserted in the corresponding cell of d<sub>1</sub>. All of the d<sub>1</sub> values are used to assess both intangible and total damage indices.

# CONCLUSION

The chapter showed a panoramic view of the assessment of the impact of natural disasters as presented in the scholarly literature. The numerous experiences of damage assessment performed in different economic frameworks show that developing countries are more strongly hit than developed ones: as economies develop, there are fewer disaster-related deaths and damages/GDP. Nevertheless, increasing wealth causes relatively higher losses in high-income nations. Increases in income increase the private demand for safety; higher income enables countries to employ additional, costly precautionary measures. Yet, in countries with a concentration of assets that is larger than the counter-measures, the income vulnerability relationship can be inverted, especially in the case of disasters related to behavioral choices such as floods and landslides. Two major constraints obstruct the assessment of the impact of disasters: the first is the lack of shared assessment methodologies. In the different literature sectors, several





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approaches are available, but, as far as academic research are restricted to the detailed discussion of one particular impact, or impacts in a single sector, the result is a somewhat fragmented coverage of impacts. On the other hand, conveying all the different assessments in a single methodological approach is objectively an extremely complicated task which can be handled exclusively by multidisciplinary staffs, having all the skills to cope with a multifaceted task as disasters impact assessment. The second problem is related to data availability. It is impossible to decide a priori the most opportune time to gather data and to undertake impact assessment, as it will depend on the type of phenomenon causing the disaster, its magnitude and scope of the assessment. In addition, continuous data gathering also once the emergency phase has passed ensures detection of long-term effects, as either economic impacts or psychological consequences on people affected. On the contrary, dealing with the impact of phenomena occurred in the past, data gathering becomes very complicated: both the amount of data available and their level of detail can be low and cannot be significantly increased, even by further research. In these cases, simplified approaches can be used to perform relative assessments based on a minimum amount of information. These approaches aim to supply quantitative indices expressing the impact of different disasters in order to make them comparable even if they occurred both at different time and in different areas. Specifically for landslides, a structured approach aiming to collect data and transforming them into relative damage indices is presented. This approach can be used for a) current events for which monetary assessments are not (or not yet) available, and B) past landslides for which monetary assessments of costs are quite impossible to obtain. In both these situations, the approach focuses on the minimum amount of information that can be used to define the impact caused by different landslides in order to perform impact comparisons. It must to be understood when using this approach that one is dealing with relative assessments and their reliability strictly depends on the reliability of the data employed.

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**RESEARCH ARTICLE** 

# Photo-Induced Graft Copolymerization of Methyl Methacrylate onto Psyllium

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### ABSTRACT

Photo-induced graft copolymerization of methylmethacrylate onto psyllium has been carried out using ceric ammoniumnitrate as a photo initiator in an aqueous medium. Thereaction variables including concentrations of initiator, nitric acid, monomer, and amount of the backbone as wellas time and temperature have been varied for establishingthe optimized reaction conditions for grafting. The influence of these reaction conditions on the grafting yields hasbeen discussed. The infrared spectroscopic and scanning electron microscopictechniques have been used for the characterization of graftcopolymers.

Keywords: Photo-induced graft copolymerization, Psyllium, Methyl Methacrylate, IR-spectroscopy, Scanning electron microscopic

# **INTRODUCTION**

Psyllium (Psy) is a natural plant polysaccharide obtained from Plantago ovata and its mucilage is composed of neutral arabinoxylan (arabinose 22.6% and xylose 74.6%). Psy forms mucilage in water, which is composed of arabinoxylan having straight xylose chain with arabinose branches at 2 or 3 position. Psy mucilage is an anionic natural polysaccharide consisting of pentosan and uronic acid obtained from the seeds plantago Psy[1-6]. Graft copolymerization is a well-known technique impart a new property or enhance the existing properties in the parent polymer with minimum degradation of the original properties. Several techniques have been reported for graftcopolymerization such as chemical treatment, microwave reaction, atom transfer radical polymerization, high energy radiation, gamma radiation [7-13]. Due to immense potential of psyllium, in the present studies, it has been chosen as a backbone. In recent years, it iswidely used as a flocculation behavior [14], in the textile industry [15], drug delivery [16], hydrogel [17]. The UV- radiation technique is well known for initiation of graft copolymerization and is among the most promising and practical method because of its simplicity. The graft copolymerization by low





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energy UV-radiation possesses certain advantages like less degradation of the backbone polymer and control over the reaction [18-21]. In present work, the photo-induced grafted with methyl methacrylate in an aqueous medium using ceric ammonium nitrate as a photo-initiator and optimized the reaction conditions. The graft copolymers have been characterized by FT-IR spectroscopyand scanning electron microscopic (SEM) techniques.

#### **EXPERIMENTAL**

#### Materials

Psy was supplied by Gujarat Sat–Isabgol Factory (Unjha, Gujarat, India). Methyl methacrylate (MMA) (Fluka) was washed with 2% NaOH aqueous solution, followed by washing with distilled water, then dried overanhydrous calcium chloride, and finally purified withusual procedure. Ceric ammonium nitrate (CAN; Analar grade, Qualigens, Glaxo India) was used as photo initiator. All other reagents and solvents used were ofreagent grade. Nitrogen gas was purified by passingthrough freshly prepared alkaline pyrogallol solution. The double distilled water was used for the preparation of solutions and in polymerization reactions.

#### Synthesis graft copolymerization

The Photo-induced graft copolymerizationwere carried outin 500 mL glass vessel. A weighed amount ofPsyllium (Psy) (0.2–1.0 g) was dissolved in conductivity water in the photochemical reactor and thesolution was stirred with continuous bubbling of aslow stream of nitrogen gas for an hour at 55°C andthereafter 20 min at room temperature. Freshly prepared CAN solution in nitric acid (Nil–0.5 mol L<sup>-1</sup>) was added to the photochemical reactor and contents were also thenflushed with purified nitrogen gas and freshly distilledMMAwas added and put theiraction vessel in the UV-reactor cabinet. Thus, the solution was irradiated with continuous stirring for different time intervals in the temperaturerange 20–45°C. After completion of the reaction, the crude graft product was isolated bycentrifugation and then purified by washingwith dilute nitric acid and 90% methanol and finallywashed with pure methanol. Thus, the crude copolymer sample of Psy-g-Polymethylmethacrylate(Psy-g-PMMA) obtained was dried under vacuum at 40°C.The grafting yields, namely, percentage of grafting(%G) and percentage of grafting efficiency (%GE) obtained byusing expressions as mentioned earlier[19].

#### CHARACTERIZATIONS

#### **FTIR** analysis

Infrared (IR) spectra of Psy, Psy-g-PMMA, and PMMA were takenin KBr pellet using Nicolet Impact 400 D Fourier transform infrared spectrophotometer.

#### Scanning electron microscopy

Model ESEM TMP b EDAX, Philips make has beenused to obtain the micrographs of Psy, and Psy-g-PMMA graft copolymer samples.

# **RESULTS AND DISCUSSION**

#### Determination of optimum grafting conditions

The reaction variables including concentrations ofinitiator (CAN), nitric acid, monomer (MMA) as time and temperature have been varied forestablishing the optimized reaction conditions forgrafting.

#### Effect of Psyllium concentration

Fig.1 shows the effect of backbone concentration on percentage grafting (%G) and grafting efficiency (%GE) in the case of grafting of MMA. From the results we can say that percentage grafting (%G) and grafting efficiency (%GE) decreases when the concentration of psyllium increases. Due to higher concentration of psyllium in the reaction



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medium viscosity of the reaction medium has been increased and the rate of graft copolymerization may have been hindered. Furthermore, high concentration of psyllium produced more macroradicals, which can interact with each other and terminate the reaction

#### Effect of initiator

It Can be observed from the Fig. 2 that initially both %G and %GE are found to be increased with increase in photoinitiator concentration reached maximum values of %G and %GE at [CAN] =  $3.0 \times 10^{-3}$  mol/L. At this optimum value of the photo-initiator concentration, the value of %G is found to be 270.81%. Beyond this optimum value of the photo-initiator concentration, %G and %GE are found to be decreased. The observed increase in %G within the photo-initiator concentration (CAN) range  $0.5 \times 10^{-3}$ -  $3.00 \times 10^{-3}$  may be due to the fact that within these concentration ranges, the complex formation between the –OH groups as well as carboxylate anion of psyllium and Ce<sup>+4</sup> is facilitated and the photo decomposition of the complex leads to the formation of more active sites. The observed decrease in the grafting yields (%G and %GE) beyond optimum concentration may be attributed to fast termination of the growing grafted chains. Furthermore, homopolymer (PMMA) formation at higher initiator concentration which competes with the grafting reaction for the available monomer (PMMA) could also lead to a decrease in %G as well as %GE.

#### Effect of acid concentration

The photo-grafting of MMA onto psyllium at different nitric acid concentrations are shown inFig. 3. Fig. 3 shows that an optimum concentration of nitricacid at 0.3 mol/L which affords maximum percentage of grafting and grafting efficiency. Thevalues of %G and %GE are found to be decrease beyond the respective optimum concentration of nitric acid. The values of %G and %GE increase in the beginning with increase in nitric acidconcentration may be due to decrease termination rate of the growing polymer chain, or anincrease in the initiation rate. However, beyond the optimum concentration of acid, the decreasein %G and %GE could be attributed to a corresponding reduction in ceric-psyllium complexformation, as well as an increase in termination rates.

#### Effect of monomer concentration

It is evident from Fig.4 that % G and %GE are increases almost linearly with entire range of concentration of monomer studied. This happened due to gel effect. i.e. increase in the viscosity of the medium owing to the solubility of homopolymer in its own monomer which could be more pronounced with increase of monomer concentration. This causes interruption in termination, particularly by coupling of growing polymer chains. Apart, this gel effect also causes swelling of psyllium thus smoothing the diffusion of the monomer to the growing grafted chains and at the active sites on backbone, thereby enhancing grafting and grafting efficiency.

#### Effect of reaction time

In the time effect, it is clear from the Fig. 5 the maximum percentage of grafting (%G = 225.63) obtained at 4 h. After that this optimum time the values of %G and %GE decreases. The observed increase in the grafting yields up to 4 h due to with the increase in the reaction time the number of active sites on the backbone increases as a result of which the extent of initiation and propagation of photo-grafting increases with the reaction time. Beyond the optimized time the value of %G and %GE decreases, may be attributed to the depletion of monomer and initiator concentrations as well as the shortage of the availability of grafting sites.

#### **Effect of temperature**

Fig. 6 represent the grafting yields of temperature effect. From the experimental data we can conclude that the percentage of grafting yields increase up to 303.15 K after that the values of grafting yields decreases. The increases in the grafting yields due to when the temperature increases the photolysis of the reaction increases and its leads to the formation of active sites on to backbone as well as the enhancement in the diffusion rate of monomer from the aqueous phase to monomer. At the temperatures increases the number of hydrogen abstraction and chain transfer



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reaction might be accelerated leading to decrease in %G and %GE as well. The optimized reaction conditions obtained in the photo-induced graft copolymerization of MMA are shown in table:1.

# **EVIDENCE OF GRAFTING**

#### **IR-Spectroscopy**

Fig. 7 shows the IR spectrum of Psy. The presence of a very strong and broad absorption band at-3407 cm<sup>-1</sup> is assigned to -OH stretching. Reasonably sharp absorption band -2928 cm<sup>-1</sup>may beattributed to the -CH stretching. The absorptionband appeared at -1640 cm<sup>-1</sup> is due to hydration ofwater. The -CH<sub>2</sub> bending in Psy is assigned to absorption at -1465 cm<sup>-1</sup> and the frequency at-1345 cm<sup>-1</sup> is attributed to -CH bending. Thebending of -OH is probably distributed at -1325and -1427 cm<sup>-1</sup> frequencies. The IR-spectra of Psy-g-PMMA and PMMA are shows in Fig. 8 and Fig. 9 respectively. InFigure 8 showed absorption bands of Psyand additional strong absorption band at aboutapproximately 1730–1750 cm<sup>-1</sup> assigned to -C=Ostretching of ester group (-COOCH<sub>3</sub>) characteristic of methymethacrylates.

Moreover, in Figure 9, the isolated grafted chains, that is, (PMMA) itshows the characteristic peak of -C=O stretching atabout approximately 1730–1750 cm<sup>-1</sup>. This may beattributed to the fact that hydrolysis of the graft copolymer gives back the grafted chains (PMMA).Thus, the results of Figures 7-9 provide a substantial evidence of grafting MMA onto psyllium.

#### Scanning Electron Microscopy

The scanning electron micrograph of Psy Fig.10 shows fiber-like appearance structure. Upon comparing the morphology of the grafted sample [Fig. 11] with ungrafted material, it is clearly evident that the grafted chains have drastically changed the topology of the Psy. As shown in Figure 11, the lumpy morphology is observed with MMA. The scanning electron micrograph of Psy further reveals the additional surface deposits indicating that grafting has taken place.

# CONCLUSIONS

Photo-induced grafting of MMA has been successfully carriedout onto psyllium using ceric ammonium nitrate as aphoto-initiator and the optimized reaction conditionshave been evaluated. Under the optimized reactionconditions, the maximum values of the grafting yields are %G = 324.24 and %GE = 93.47. The spectroscopic data confirm that the grafting has been take place at hydroxyl group of backbone (Psyllium).

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Table:1 Optimized reaction conditions

Psyllium	0.2 g (dry basis)
[HNO <sub>3</sub> ]	2.0 moL L <sup>-1</sup>
[CAN]	3.0 x 10 <sup>3</sup> moL L <sup>-1</sup>
[MMA]	0.369 moL L <sup>-1</sup>
Temperature	303.15 K
Time	4 h
Volume of water	142.29 mL
Total volume	150.0 mL







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**RESEARCH ARTICLE** 

# Study of Nuclear Potential for the <sup>6</sup>Li+<sup>209</sup> Bi Reaction

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# ABSTRACT

The total potential has been calculated and discussed for <sup>6</sup>Li+<sup>209</sup>Bi. Each term of the potential has been explained and discussed. The graphical representation and the behavior of the potential has been studied. The practical implication of the potential in addition the barrier height and position has also discussed.

Keywords: <sup>6</sup>Li+<sup>209</sup>Bi, barrier, potential, Nuclear.

# INTRODUCTION

Study of Nuclear potential has its own advantage and interest since decades. Starting from the famous Rutherford experiment people are trying to understand the nucleus. It is very difficult to see a bare nucleus. So what normally people observe is the experimental results (like cross section). In order to explain this observed observables or practical results, different theoretical model has been developed time to time. As the time passes and the improvement in the experimental side increase more and more experimental results are possible to get simultaneously. So each time some specific nature of the nucleus is exploring. In order to study these new properties people are developing models and the basis of any model is the interacting potential. The study of potential is very important and still today people are studying this. The main principle on which all the model works is the quantum mechanics and quantum interaction. When one can speak quantum model Quantum tunneling is the important properties which cannot be ignore. In systems with many degrees of freedom is one of the fundamental problems in physics and chemistry (H<sup>°</sup>anggi et al., 1990; Tsukada et al., 1993). In the present paper we have done study on nuclear potential of <sup>6</sup>Li+<sup>209</sup>Bi system.




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# CALCULATION AND RESULT

As mentioned above, study of nuclear potential is very important and atlow energyespecially the quantum tunneling effect is important. Most of the time the experimentalist measure the cross section (fusion cross section). The fusion reactions were analyzed in terms of a simple model, where one starts with a local, one-dimensional real potential barrier formed by the attractive nuclear and repulsive Coulomb interactions and assumes that the absorption into the fusion channel takes place at the region inside the barrier after the quantum tunneling. The shape, location, and the height of this potential were described in terms of few parameters which were varied to fit the measured cross sections. As in all the cases the different potential model has been developed from time to time. There are many potential like proximity potential, wood Saxon potential, Yukawa potential , Gaussian potential etc. are very important and famouse. The general expression for of the potential has been taken as bellow mention equation

$$V_\ell(r) = V_N(r) + V_C(r) + rac{\hbar^2\ell(\ell+1)}{2\mu r^2} = V_0(r) + rac{\hbar^2\ell(\ell+1)}{2\mu r^2}\,,$$

One can see from the above equation that the total potential is not a single quantity but is the manifestation of many term likecoulomb term (Rutherford interaction), The nuclear term which can be (Yukawa, woodsaxon, proximity) most of the time peopleuse the wood Saxonpotential. In addition there is also another term that called as the centrifugal term which is purely quantum mechanical origin and the (ldepended) the angular momentum. For the light ion reaction it is not very important but for heavy ion reaction one cannot ignore it. The behavior of the l depended on the potential has been shown in Fig.1 One cansee from Fig.1 that as the l increase the pocket of the potential, decreases. The behavior of the different potential has been shown in Fig.2 and special for the  $^{6}Li+^{209}Bi$  reaction.

Fig.2 The calculated potentials (total potential) for the  ${}^{6}Li+{}^{209}Bi$  system. There are different curve each one ill represent a different potential. The red one is the famous wood Saxon potential . That is for the nuclear attractive potential. The green one is the Coulomb interaction which is repulsive and long range. The blue is the addition of both. Here the last term i.e. the l dependent term is taken as zero. The S-wave calculation has done. The x axis is the distance and the unit is fm. The y axis is the value of the potential and the unit is MeV. Form the Fig.2 there are two important thing one can notice. The barrier height for the barrier radius (blue curve) . The barrier height ~V\_b is 37 MeV and the barrier radius RB-9 fm . In addition the width of the curve is related with the barrier curvature which is also another important parameter for the experimentalist.

# SUMMARY AND CONCLUSION

A total potential between the target and projectile nuclei for the  $\ell$ -th partial wave has been discussed and the potential calculation has been done using self-written program and found the V<sub>B</sub> and the R<sub>B</sub> for the <sup>6</sup>Li+<sup>209</sup>Bi reaction. The total nuclear potential has been studied using the different parts and the contributions of the potential. The wood Saxon for of the nuclear potential has been considered having V0= -30MeV and the normal coulomb potential has considered. The details calculation has shown discussed. It has also observed that the nuclear potential is short range and attractive and the coulomb potential is long range and repulsive but due to the combination of both at S-wave they form a resultant potential having barrier V<sub>B</sub> (shown in blue color). This is very important in order to perform any experiment as this will provide the required input to the experimentalist for their study.





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Fig.1 The 1 dependent of the total nuclear potential. One can see that for the higher value of 1 the pocket available for the fusion decrees.



Fig.2 The calculated potentials (total potential) for the 6Li+209Bi system.





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**RESEARCH ARTICLE** 

# **Economics of Goat Farming in Tamil Nadu**

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# ABSTRACT

Livestock sector is an important subsector of agriculture and serves as a very important role in the socioeconomic development of the State. The sector contributes significantly to the State's economy, besides being a source of livelihood for rural women either in principal or subsidiary status. This study assesses the economics of goat farming in Tamil Nadu based on the current cost and prices prevailing in Tamil Nadu. The expenditure on recurring, non-recurring, receipts and turn over were calculated. The project is a goat farm having 21 goats (20 does + 1 buck). The goats can be bought at about 6 months of age with an average body weight of 10 kg. The total fixed cost for the above said population is Rs.36,878 and the total variable cost is Rs.2,24,769. The gross income is Rs. 4,47,500 and the net profit is Rs.1,85,853 and the net profit per goat is Rs. 8850. Thus rearing of goats will provide good returns and improve the economic condition of the farmers' especially small and marginal farmers.

Keywords: Economy, Farmers, Livestock, Population, Agriculture.

# INTRODUCTION

Goats are called as 'Poor man's cow' which plays an important role in the rural economy of the landless, small and marginal farmers in Tamil Nadu. It is an enterprise that has been practised by large section of population in rural areas. Goats can survive efficiently on available shrubs and trees in adverse climatic conditions. Goats act as additional source of income for household women. As per the 20<sup>th</sup> livestock census, the total livestock population in India is 535.78 million that is 4.6 per cent higher than the previous census (512.63 million). Among the total livestock, the total goat population is 148.88 million showing an increase of 10.1 per cent over the previous census (135.17 million). About 27.8 per cent of the total livestock population is contributed by the goats. As per the 20th Livestock census, the cattle population in Tamil Nadu rose to 95.19 lakh from 88.14 lakh registered in the 19th Livestock



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census. The population of goats increased to 98.89 lakh from 81.43 lakh during this period. However, the population of sheep declined by 6.36 per cent to 45 lakh from 48 lakh. The State government attributed the reason for this development to rapid urbanisation, which resulted in decline of grazing land. As per the 20th Livestock Census, Tamil Nadu ranked first in poultry, fifth in sheep, seventh in goats and 14th in bovines (cattle and buffalo) population in the country. (Source: 20<sup>th</sup> livestock census, Dept of Animal Husbandry & dairying under the ministry of fisheries). Some of the advantages of rearing goats are their low initial investment compared to other large ruminants. Less housing requirement and less management practices is enough due to their small body size and docile nature.

## **METHODS**

Investment, non recurring expenditure, recurring expenditure, receipts and turn over are the economic considerations in livestock farming. Animal farming is a high investment business. The capital investment comprises of (i) Fixed capital or non recurring and (ii) Working capital or recurring expenditure. Non recurring expenditure: This includes the cost of animals, buildings, equipments, fences, land (if purchased) and other property items. Recurring expenditure: Comprises of variable cost and fixed cost. Variable cost includes the cost of feed including cost of producing fodders, veterinary charges, artificial insemination charges, salary of technical supervisory staff, wages of labour, land rent (if hired), upkeep of buildings, repair of equipment and other dead stock and other miscellaneous expenditure incurred on the day to day running of the farm. Fixed cost includes depreciation on livestock, buildings and equipment and interest on fixed capital. Receipts: The source through which income is received includes sale of main animal products such as milk, meat, wool and egg, sale of culled animals and animals that are in excess of requirement, sale of by products such as manure, hides and skin, and grain and fodder that are in excess of requirements. The mode of receipt of income is based on the type of stock maintained. Turnover or Net profit: It is the total output related to investment. It can also be said as return per unit investment. Turn over from an enterprise varies from farm to farm based on livestock species maintained, production efficiency of the animals maintained, capacity of the farm, proportion of non recurring to recurring expenditure and the management of the farm.

#### Technical details of the project and assumptions

The project is a goat farm having 21 goats (20 does + 1 buck). The goats can be bought at about 6 months of age with an average body weight of 10 kg. Goats can be reared in intensive, semi intensive or extensive system depending on the investment to be made. The average floor space required per goat is 15 sq.ft. The green fodder and tree fodder can be cultivated in their own farm. Tree fodders such as Subabul, Agathi, Kalyana murungai serve as good nutritive source for goats. Concentrate feed can be purchased from nearby feed companies or can be prepared on their own under the expert guidance. The average concentrate and green fodder required per goat is 250 gms and 5 kg per day respectively. The green fodder and concentrate requirement of kid is 2 kg and 100 gms per day respectively. The average gestation period of goats is 150 days with 3 kiddings per year. About 10 kids are allowed for mortality, weak and single kid. One labour can be utilised for maintaining the goat farm. The income is generated through the sale of kids, unwanted gunny bags and manure. The average dung produced by a goat per day varies from 0.3 to 0.7 kg. The detailed cost and returns are discussed in Table 1. The above is a simple economics of goat farming calculated based on the assumptions that based on the current cost and prices prevailing in Tamil Nadu. The turn over or the net profit may vary depending on the season, availability and cost of feed material and the number of kids born for a particular goat. Thus, goat farming provides additional source of income to the household women, poor and landless farmers.

# DISCUSSION

Being small-sized animals, goats can easily be managed by women and children. Feeding, milking and care of goats do not require much equipment and hard work. Capital investment and feeding costs are also quite low. Returns on





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capital of up to 50% and recovery of 70% of retail price are possible in goat farming. The total fixed cost for the above said population is Rs.36,878 and the total variable cost is Rs.2,24,769. The gross income is Rs. 4,47,500 and the net profit is Rs.1,85,853 and the net profit per goat is Rs. 8850. Apart from that livestock sector makes multifarious contributions to overall welfare of the rural population in terms of generating more employment opportunities, especially for the marginal and small farmers and landless labourers, alleviating poverty and stabilizing farm income. Besides, it supplies organic manure to the crop sector; hides, skin, bones, blood and fibres to the industries. In addition, it provides for environmental conservation by utilizing huge amount of crop residues and by-products as feed/fodder and supplying renewable energy sources in terms of dung and draught power. Thus rearing of goats will provide good returns and improve the economic condition of the farmers especially small and marginal farmers.

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I. Fixed Investment (Rs.)	Amount (Rs.)
Cost of Animals	
20 Does @Rs.350/animal (10 kg/animal)	7000
1 Buck @Rs.350/ animal (12 kg/animal)	4200
(a) Animal Cost	11,200
Cost of Shed	
21 x 15 Sq.ft / Goat x Rs.400 / Sq.ft	1,26,000
Other Expenses (Equipments)	5,000
(b) Shed & Equipment cost	1,31,000
I. Total Fixed Investment (a + b)	1,42,200
II. Fixed cost (Rs.)	
Interest of Fixed Investment @ 15 % (1,42,200)	21,330
Insurance on Animal @ 4 % (11,200)	448
Other Misc. Expenses	2,000
Depreciation on Building & Equipment @10 %	13,100
II. Total Fixed Cost	36,878

#### Table.1 Cost of Returns of Goat Farming





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III. Variable Cost (Rs.)	
Concentrate: (0.250 kg x 21 animals x 365 days x	28,744
Rs.15/kg)	
Green Fodder: (5 kg x 21 x 365 x Rs.1 / kg)	38,325
Concentrate: Kids (0.1 kg x 50 kids x 300 days x	22,500
Rs.15/kg)	
Green Fodder : (2 kg x 50 x 300 x Rs.1/ kg)	30,000
Medicines (Adult Rs.200 x 21 : Rs.4,200) + (Kids	9,200
Rs.100 x 50: Rs.5,000)	
Labour Charges 8000 x 1 x 12	96,000
III. Total Variable Cost	2,24,769
IV. Total Expenditure (II + III)	2,61,647
V. Income (Rs.)	
Sale of Kids (50 kids x 25 kg B.Wt x Rs.350 / kg	4,37,500
B.Wt)	
Sale of Gunny Bags (125 bag x Rs.20/bag)	2,500
Manure (5 Ton x Rs.1500/ton)	7,500
(V) Total Income	4,47,500
Net Profit (V – IV)	1,85,853
Net Profit / Goat	<b>Rs. 8850</b>



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**RESEARCH ARTICLE** 

# Core Assessment of Volleyball Sport in Physical Education and its Physiological / Anthropometric Aspects on Players

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# ABSTRACT

The education needs Physical Education (PE) as a significant constraint to check the ability of players. Every sport needs the accurate understanding about strategic decisions based on scientific knowledge, tactics and consequences of sport performance. Such process requires a proper operative organization that controls all the actions by developing an integrated system. Such system monitors the activities of players and provides the collection of appropriate strategies, training to the players, processing of information from other nations and assessment of performances in any sport. Volleyball becomes one of such sport that needs such kind of facilities, as it is a high performance game. It needs a regular implementation and development of programs for their players as the team requires the effective preparation due to fast pace structure of the sports. Such programs consists the content with new operational information suitable for the team. Such tactics not only consist the theoretical approaches towards making best strategies, but also develop the practical trainings for the athletes. This paper represents the scenario of volleyball training with their physical fitness values on athletes. Such values targeted on numerous physiological as well as anthropometric and physiological constraints of volleyball players. It is important to create a specific physiological/anthropological profile for each team disciplines because of certain requirements and functions at each game position.

Keywords: Volleyball, Anthropometric, Physiological, Physical Education, Fitness Effectiveness, Sports

# INTRODUCTION

In modern world, the "Sport" is no longer just a passion or recreation but is taken as a science [1]. Every sport activity has their scientific temper that is assessed with respect to several aspects of theactivity. Such aspects mainly





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include the net outcome of a match in advance, positions suiting players, goals/points scored and level of difficulty according to the opponents. In India, there is a huge craze of Volleyball in people of all ages. It requires the high skill levels and can be played under both indoor as well as outdoor environments. Volleyball is a high-paced sport that needs the high physical fitness as it burns upto 585 calories in 45minutes of game [3]. This sport has many advantages as it build up, tone and enhance the muscle strength, utilizing the lower legs, abdomen, thighs, shoulders, arms and upper body [4]. Furthermore, this sport also improves the reflexes as better eye-hand coordination with balance of the athletes.Volleyball is a team sport and enhances the sportsman spirit, leadership skills, active communication between the players and teamwork. Volleyball consists six positions as the rotational court in context of players such as Left front, Left back, Right front, Right back, Middle front and Middle back [6]. It has also two zones such as defense as well as attack zones. This game is so unpredictable as it transits every moment with the shifting of each player on the basis of their playing positions and the strategy [7]. Initially, there are six players on the court at any given game time consistingone setter (S) and five attackers (A). With the progress of the game, one libero (L) substitutes the attackers. It is necessary to feature different physiological and physical aspects in each player irrespective of the game nature [8]. Therefore, it becomes impossible to fix a certain play position depending on each of the aspect. Such strategies need to develop the novel approaches according to the features of players and their playing positions depending on several other parameters [9].

Players especially as the students (schools or colleges) require the proper lessons of PE to explore the psychological as well as physical developments. Such lessons enhances their emotions as self-esteem and self-confidence, strength cognitive and social capabilities, increases the academic success, attain body-brain integration in balance, teach them how to respect others and own bodies and provide aerobic and anaerobic developments to enhance the capability essential for health (Talbot, 2001) [10]. Volleyball is a sport in which all age groups can participate without any difficulty as it has minimum or no risks of injury. Volleyball need the comprehensive skills consisting scientific, tactical, psychological, technical and physical aspects. Out of them, physical skills of players specifically influence the team tactics with their game intelligence as this sport need the continuous maximum effort. Therefore, athletes require to build up their physical skills as anaerobic/aerobic potentials in context of undertaking the hard and fast movements. Such strengthen also required during the defensive and offensive efficiency of players with long lasting. Volleyball includes the phases of resting and short term loading due to which it is considered as an interval sport. It also features the aerobic and anaerobic loadings consecutively. Hence, this sport needs the high physical skills as well as muscle strength (Abreu et al., 2003) [11].

Literature depicts specifically one of the major issue present in Volleyball as vernacular. The experts do not discuss such issue in detail. The training modules of this sport also never discuss on the role of experience coaches in the sports. This is not the matter of negligence. Therefore, it is required to integrate this concept with the current system of game. Such issue needs the integration of cutting-edge technologies with the sport activity of modems and find out the positions of coaches (with their professional development) in volleyball. Such factor proves their importance in the level of games between national and international players that becomes the topic of fundamental debate in volleyball. It not only provides the methodological and conceptual improvements but also upgrading the difficulty and complex levels of the game. In general, volleyball has specifically needs the efficient tactical as well as technical conducts during the play, not only for each player but also for the whole team. Some of the strategies are as follows:

- Athletic performance depends on the diagnosis of each aspects;
- Adequate selection of qualitative-quantitative weighting as well as quantization parameters;
- Addressing of components during the training process through the set priorities on dynamic-adaptive ranking;
- Development of training conception in their technical staff;
- Specifically address the tactics in official competitions.



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It becomes easy to develop statistical data after collect the throughout information about your opponent. It enhances the performance skills of the whole team and of each player accordingly. Such modules consists the physical aspects, strategic information of the opponents and theoretical/empirical observations that can change the complete game plan and the match in the favor by developing the strategic decisions.

#### MAIN CONSTRAINTS

The main constraint requires in any sport if feature effectiveness that represent the efficiency of any sport item and cannot be replaced by other ones. Volleyball has some of the basic skills are:

- a) Serving
- b) Blocking
- c) Smashing
- d) Under-passing
- e) Passing and so on.

Out of these skills, smashing has some obvious aspects as quick run-up with exerting oneself to jump up, unfolding the abdomen as well as thorax muscle (as recurved bow), and then wingding up as contract abdomen as well as thorax. It requires the condition as not touch the net. It happened with the blocking as jumping up by all one's strength and contract the abdomen and thorax muscle. Such two actions with their operation structures consisting the exercise function at abdomen and thorax muscle along with the vertical body stretching. Such feature not only increase the muscle strength of abdomen as well as thorax with the reduction of deposit fat known as "carnosity" but also gain the development of muscle as well as ossature vertically. Hence, volleyball has the actions of blocking and smashing that validates the fact about enhancing the "body shaping and heightening", leads to promoting the beautifying and features of humans.

There are lot of physical activities and sports that consist the plenty of actions on toning the abdomen and thorax muscle and incite the ossature development vertically. Although, there is no other physical exercise like volleyball that can effectively as well as organically associate the two actions with each other and touch a definite kind of intensity. For example, volleyball needs the consecutively striking of ball over the net with higher height of jump as compared with other net sports such as badminton and tennis. Such striking requires extremely high vertical extension of muscle. In case of basketball, there is also the requirement of vertical extension for recover the backboard. However, it does not require the recurved bow in radian that is essential in case of volleyball. Therefore, basketball has negligible amount of intense impact on abdomen and thorax muscle as volleyball. However, basketball has similar requirement for the arched body as well as jumping height fosubry flop as volleyball. It makes such sports highly difficult in terms of physical activities as compared with the solo sport. Overall, it is not so hard to search the similar features among the all sports in terms of action structures. For instance, volleyball has the action combination such as more efficient smashing in context of body shaping as well as heightening. Furthermore, such sport also carries out the effective playfulness, intensity and extent that in actual target on specific body structure as its shaping and heightening. Researchers validate that "Speed is the second element of heightening, while bouncing is the first". Due to this, blocking as well as smashing actions are integrated with the rapid movement provide the utmost bouncing in volleyball. Therefore, in terms of human body structure, volleyball has the extraordinary features for both in body shaping and heightening.

#### LITERATURE REVIEW

Wilkinson [12] explains the necessarily analytical tool as qualitative skill assessment for physical coaches. They develop a strategy in which such educators determine the discrepancies between the desired response and real response monitored. During the preparation, there is the negligence on the error recognition even if providing instruction. Therefore, some studies illustrate the investigation on alternative method for the assessment on qualitative skills to the students. Such research consists the strategies on efficient evaluation via the development of





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visual-differentiation training programs. It consists the subjects as particular age group students. A multiple baseline design introduces the visual-differentiation training program among three volleyball skills: the overhead serve, the overhead pass, and the forearm pass. Subjects made rapid developments in appropriately examining the volleyball skill after allotting each instructional component. Such strategy as the assessment of qualitative skill is one of the substitute of traditional method currently being utilized during professional groundwork.

Watanabe et al. [13] illustrate the process for computing the sport skills. The findings can be involved during the investigation of quantitative analysis of sports-skill. In this study, researchers targeted on the form of golf-driver swing that is hard to compute and also tough to enhance. Such computation procedure is depending on the kinematic analysis of human-body model. Development of such kind of system is from the 3-D rate gyro sensors that are the position set on the body. These gadgets display the 3-D rotations and translations at the time of golf swing. Such system precisely computes the golf-driver-swing form of golfers as athlete. Golf lesson textbooks include the findings via this approach associated with quantitatively to skill criteria. Also, there is the significance of quantitative information for criteria geared toward a mid-level player as well as a novice golfer. Barzouka et al. [14] investigate the feedback impact with concurrent self-modelling as well as skilled model monitoring on volleyball skill acquisition. Researchers made two experimental groups of fifty-three pupils in the age group of 12 to 15 years as the old formed. While, they used one control group that obeyed the intervention program of twelve practice sessions for retention and data acquisition on the strategies to receive a ball. In the middle or before of each practice session, groups received several feedback types. It has the retention phase in which there is the assessment of every group at the end and before of the intervention program based on reception performance score (outcome) and strategy. Such procedure includes the multivariate assessment as 3 (Group) × 3 (Measurement Period) of variance. It has the strategy of consecutive application in order to examine the differences. The findings of such intervention program validates the enhancement in the performance of all three groups. Augmented feedback types from PE coaches are efficient in skill retention as well as acquisition for the reception in volleyball. The profile of volleyball is just similar to the other sports such as handball and basketball in terms of physiological skills. Sheppard et al. [15] defined the volleyball as a sport classified by frequent as well as short explosive actions e.g. ball play, diving and jumping. Jumping actions can consist the horizontal motion strategies (or without). However, in general consisting the counter movement (blocking, jousts and jump setting).

Numerous research works show the relation with the strategies on maximized the fitness level in volleyball with the help of durable as well as astonishing jumping capability. Experts detected the average amount of jumps made by high-level player i.e. 96.5 jumps during the volleyball match [16]. It supports the results of previous findings. There are some critical volleyball skills as the capability to handle high stretch load and the performance of stretch-shortening cycle. High-level volleyball players needed some good markers as low fat percentage, lean body and great height as their anthropometric profiles. Middle blockers are typically taller as well as heavier than outside hitters and setters. Setters are the players with lowest average standing reach, weight and height. Although, research taking into account the hitters from right side as a definite game position, score to such athletes as the second group in weight and height behind the middle blockers. Numerous work examine the discrimination between developing and high-level volleyball players. Sheppard et al. performed the research on the U-19 team of Brazil and U-21 teams of Brazil as well as Australia with their players [16]. Researchers obtained the equivalent positional and common features to those explained earlier discussed in this paper. All such works illustrate the constant analysis of jump ability as the expression of power highly associated with the squat exercise and its strength output.

# **PROPOSED METHODOLOGY / HYPOTHESIS**

This section shows the methodology to assess the significant aspects of volleyball used in five different nations: Spain, Portugal, Italy, France and Brazil. These results are gathered from certain documents from the federations of each country. Such documents are mostly retrieved from the websites, where the link is available to download the datasets or outcomes on psychological or anthropometric studies of volleyball in such nations. Such federations of volleyball owned the website on Internet just to dedicate the coach education via training modules. Some of the



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countries discriminate themselves by drawing the line between the ones that promoted their coaching actions (i.e., Spain, Portugal) and those that other than offering data on coaching also gave extra support documentation as content for educators (i.e., France, Italy and Brazil, Italy). It is possible to the presence of ambiguity in the terminology used in content assessment because of different languages used in different nations. After completion of data collection, next step is to analyze them on software tool such as SPSS, R, Microsoft excel, Nvivo 10.0 etc. Such assessment also need the comparative analysis between the constraints or the level of education provided to the players based on the curricular content.

#### ATTRIBUTES

One study shows the assessment on the performance level of the students by developing the sample of volleyball players (245 Males and 49 Females) with 294 cluster level (university level players) with the mean age of 21.42±1.14 years. Data acquisition helps in obtaining the written informed consent. Such procedure completed with the consent of each subject in advance. Such athletes further classified as their playing positions namely Liberos (L), Setters (S) and Attackers (A) with a head count of 39 L, 125 S and 130 A. Some of the common constraints are taken as their gender and age (years) as general information. Further assessment required the other constraints as:

- BMI (kg/m sq)
- Body weight (WT) (kg)
- Shoulder diameter (SD) (cm)
- Thigh circumference (TC)(cm)
- Chest circumference (CC) (cm)
- Upper leg length (ULL) (cm)
- Leg length (LL) (cm)
- Upper arm length (UAL) (cm)
- Arm length (AL)(cm)
- Height(HT) (cm)

The most featured parameters considered were the Relative Jump (RJ) as well as Explosive Power (EP). Accurate modelling consists the age and gender of all the players as the primary constraints. Trained sportspeople demonstrated the process prior to the measurements and tests.

# PROCEDURE

#### Data acquisition

Data sheet and consent forms consists the first noted feedback as the general information. These have the binary information as the gender and age in years of the players. There are the acquirement of linear measurements for anthropometric parameters utilizing in computing tape in cm scale. Furthermore, the data needed to be measured on standard weighing scale as WT in Kg. BMI of the body can be measurable by Omron Body Fat Analyzer in kg/msq. Height reached beyond the standing player height known as EP. Though, execution of sergeant jump utilizes the fixed vertical scale and measured in inches. The calculation of RJ can be performed as;  $RJ = 0.393 \left[\frac{EP}{HT}\right]$ 

#### Data Handling

Such process is a crucial part of machine learning algorithms or techniques during the building of model. It has two acquired features as: Continuous Features and Categorical Features. Researchers consider name as the unique features under Categorical Variables, consisting the encoded target. There is the need to operate on in continuous features, prior to transmitting the information in developed model. Further, there is the requirement of fundamental transformation during the monitoring of data as skewed (continuous). Such procedure causes the reduction in the



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influence of low magnitude data points as well as low frequency that could have been equally important. Standardization process can perform the data scaling transformation.

#### Classification

There is the need to perform the multi-dimensional assessment if the class of predicted findings have the function of multiple features. However, it requires a classification algorithm when such features depict the overlapping between different classes. It uses several kernel for accurate feature assessment. The existing studies associated with the Support Vector Machine (SVM) and Extreme Gradient Boosting (XG Boost) to estimate as well as characterize the information respectively. SVM contains hyper parameters and is a classic model that provide the model architecture. Such hyper parameters consist a broad range of values since it is a dynamic model. Hyper-parameters are much different with Model Parameters as they do not automatically regularize themselves according to the data and are required to be found through trial and error. Such procedure can be accomplished with the developed algorithms e.g. Bayesian optimization, grid search etc. XG Boost is the most trending model that formed with Gradient Boosting Machine (GBM) using the learning schemes of Model Parameter. It controls the strategy without over-fitting the data. The complete experimental paradigm of such procedure consisting the analysis is presented in fig. 2.

#### Statistics

The data processing includes the employment of traditional statistical approaches and measures, particularly, in the computation forms of means as well as standard deviations. Mostly, SPSS assesses the information as the statistical package program. It accurately provides the results in form of data analysis with comparative studies between each groups. Some of the test used in SPSS are t-test, ANNOVA test, the Mann-Whitney U test, correlation test etc.

# **RESULT AND DISCUSSION**

Some test performed at the initial level such as handgrip examination on players intended to compute their static strength. The findings illustrate that there is no substantial discrimination between the static strengths of players who got proper volleyball training and those who did not. Another test named as standing broad jump computes the explosive strength of players. It also shows the same conclusion as the previous one and applicable for all gender type. The measurement of functional strength can be done by bent arm hang test showing the power of the muscle endurance in players. It showed the same conclusion as the previous one, but only performed on male players. However, the values of bent arm hang in athletic students (male) were superior than those of sedentary students (male). In addition, female students shows the superiority in results who got volleyball training than sedentary students. Some other tests are available in literature such as sit-ups test to compute body strength in form of muscle endurance of the students. Results demonstrated the higher values of body strength of both male as well as female students who received volleyball training as compared with those did not. Another test named as shuttle test performed to analyze the coordination and speed skills of the students. It showed the higher value of skills in female players who received the volleyball training than those who did not. Although, the results are contradictory in males as it shows no difference in them. Next test is plate-tapping test used to assess the speed motion of upper extremities of the players. The results illustrated no significant difference between speed of motions in upper extremities of both male as well as female players who either received and not the volleyball training.

Next level of test is to judge the elasticity of the players conducted by sit-and-reach test. The results showed the higher value of elasticity in female players who received volleyball training as compared to those who did not. Although, there is no difference in the results of male players. The next parameter is the balance that can be computed by flamingo balance test. The results showed the same thing as the superior values for those who received volleyball training (both male and female) as compared with those who did not.





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# CONCLUSION

This paper performs the comprehensive study on the existing work in volleyball sports. It starts with the physical features of the players, the role of physical education in the curriculum of students, physiological as well as anthropometric parameters, standard procedure to achieve mean and standard deviations, types of tests etc. According to the existing outcomes, volleyball training is the efficient way to enhance the body shaping as well heightening and appropriate for all age group people. It enhance the features of body parts such as eye-mind balance, reflexes, elasticity, coordination and speed skills, functional strength and body- muscle endurance. Volleyball training has low injury risks and required less maintenance (as less equipment needed). It also enhances the good sportsman spirit, leadership skills and teamwork approach in the players.

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Fig.2 Analysis of Volleyball Players-Experimental Paradigm [16]



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**RESEARCH ARTICLE** 

# Study of Fusion Cross Section and Potential for the Nuclei<sup>215</sup>Rn

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# ABSTRACT

The fusion cross section and the driving potential has been studied for the compound nucleus <sup>215</sup>Rn. The same compound nucleus has been formed by the two different reaction mechanism with the same excitation energy. Very interesting result has been found that the fusion cross section is more for <sup>16</sup>O based reaction and also the FWHM is wider in the potential profile for the heavy ion compared to light one case.

Keywords: Cross section, potential, NRV, fusion

# INTRODUCTION

Starting from long time back people are trying to understand the formation of the compound nucleus (CN) and to study their properties. As the formation and the decay are two independent process suggested by the Bhor called Bhor hypothesis of CN.[1,2] There are many reports which indicated that the Bhor hypothesis is depend on two important condition, the excitation energy (Ex) and the matching of angular momentum. The matching of excitation energy can be done using the control over the incident project ile laboratory energy. The matching of Ex is some what can be achieved but the matching of the angular momentum is not easily possible as for different projectile target it is different. It is important to study this entrance channel effect which will form the same compound nucleus with different deformation and excitation energy [3,4,5]. In the present paper we have studied the formation of the <sup>215</sup>Rn compound nucleus formed by the two independent channel <sup>6</sup>Li+<sup>209</sup>Bi and the <sup>16</sup>O+<sup>199</sup>Pt. Both having the same input excitation to the compound nucleus but different entrance channel.





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# CALCULATION AND RESULT

The calculation has been performed using the nuclear reaction video project (NRV)[6]. Here the two different entrance channel has been considered to form the same compound nucleus  ${}^{6}\text{Li}{}^{+209}\text{Bi}$  and  ${}^{16}\text{O}{}^{+199}\text{Pt}$ . The excitation energy has been matched but the angular momentum matching is difficult. Both the two independent channel leads to the formation of the compound nucleus  ${}^{215}\text{Rn}$ . The mass flow for the two system has been shown the in Fig.1. From Fig.1 one can see that the 3D plot of the potential has been done where the other two axis are the elongation R , and the atomic number for the two system forming the same compound nucleus. One can also see that the upper part of the Fig.1 is for the  ${}^{6}\text{Li}{}^{+209}\text{Bi}$  reaction and the lower one is for  ${}^{16}\text{O}{}^{+199}\text{Pt}$  reaction. The spread on the atomic number and the potential energy is more for the heavy projectile systemcompared to the light one in addition there is a third peak also present for the  ${}^{6}\text{Li}{}^{+209}\text{Bi}$  system. This FWHM will affect the formation cross section as the tunneling probability is completely depend on the height and the width of the potential.

The fusion cross section for the two system has also calculated using the same NRV code. The calculated fusion cross section has been shwn in Fig.2. The fusion coross section has been calculated using the quantum tunneling method. One can see from the Fig.2 that the cross section is not same even if the same compound nucleus is forming and the same Excitation energy. Another interesting thing is, the fusion cross section is more for the  $^{16}$ O case compared to  $^{6}$ Li.

# CONCLUSION

A study has been done for the two system forming the same compound nucleus <sup>195</sup>Rn. The same compound has been formed using the two different mode of input. The potential curve has been studied and found that more width in the <sup>16</sup>O case compared to the <sup>6</sup>Li case. Inaddition the fusion cross has found more for <sup>16</sup>O induced reaction. This clearly indicates that the even if the two mode of formation is different the same compound there is an effect of entrance channel.

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**REVIEW ARTICLE** 

# **Open Cast Coal Mines Pit Unique Habitat of Biodiversity: A Review**

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# ABSTRACT

Coal mining activity creates a harmful effect on the environment and the whole eco-system; simultaneously it heavily damages local flora and fauna. Mainly the forest land is topographically altered to a great extent for coal mining activity. It affects the underground water and adjoining land area level silts surrounding water reservoir. Coal mining has a great contribution in economic development of a country but also it has a great adverse impact on the mining workers, local inhabitants' health, behavior and their socio-cultural life. The present review, study of cited information vividly reflects the coal mining in the global perspective, the Indian perspective and the West Bengal perspective.

Keywords: Coal mining, Eco-system, Flora and fauna, Mining workers, Socio-cultural

# INTRODUCTION

Coal is an inflammable brownish black or black sedimentary rock, formed as rock strata called coal seams. It is mostly carbon having variable amounts of other elements, chiefly hydrogen, sulfur, oxygen, and nitrogen. Coal is formed as a result of dead vegetation being decayed and deposited in the hollow of earth for over million years and being heated and pressed in the depth of the earth. Coal forests are, infact, the vast amount of coal originated in former wetlands occupying the Earth's major part of land areaswhen the Carboniferous (Pennsylvanian) and Permian eras prevailed. Coal being the major source of energy, improper management of it may pose threat of scarcity though right now the stock of it is adequate. The two methods followed for the explosion have its own short coming and advantages but it has also affected the environment of the area [1].Coal mining is one of the core industries that contribute to the economic development of a country but also it deteriorates the environment. It is extracted by both opencast and underground mining methods [2]. In the process of mining, huge amount of water is discharged on surface to facilitate the mining operation. TSS, TDS, hardness and heavy metals released from water



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often cause the contamination of the surface and ground water. Sometimes it is acidic in nature and pollutes the water bodies [2].

# HISTORICAL OVERVIEW

#### In Global Perspective

One of the most dramatic ways through which human affected the natural environment is opencast mining [3]. The shape of the open cast mine pits is largely determined by the geological setting (i.e. kind of mined mineral, shape of the deposit, properties of the host rock), and by geo-mechanical safety requirements [4]. The creation of artificial lakes is a common method of reclaiming opencast mine pits[5] Exhausted pits are transformed into pit lakes (i.e. post-mining water bodies) throughdeliberate over flowering by allowing the pits to fill naturally through hydrological processes such as precipitation and groundwater infiltration [4]. Sometimes the bottom and shores of the prepared lake are transformed; in such cases, the bottom is at least partially levelled, and then the shores are profiled to resemble a natural water body [4][6]. In Poland and Germany border area 4 stages of open cast pits development are observed1) In a very shallow water bodywith a sand layer containing fine lignite particles and very poor Diatom and Cladoceran communities but without formation of typical lake sediments 2) Deeper water body acidic in nature with increasing frequencies of phyto and zooplankton3) Intermediate period (rebuilding communities of Diatoms and Cladocera) a deep lake with benthic and planktonic fauna and flora with wide ecological tolerances and 4) A change to environmental conditions with an essential increase in planktonic taxa that prefer more fertile water[7]. To evaluate the level of contamination, total concentration of heavy metals in the soils of mine sewage and surrounding agricultural fields in the northern part of Bangladesh were determined [8].

Abandoned mine pits, known as pit lakes, represent a potential resource or valuable water treasure to mining companies, the environment, and regional communities. If contaminated by acid mine drainage the quality of water in the pit lakes can control the uses of water [8].Nevertheless, various and diverse treatment strategies now exists for remediating the water quality of these significant post-mining landscape characters [9]. Filling up of the pit may prevent the formation of a pit lake, or may be important in determining the final pit lake shape and bathymetry [9] [10]. Fast filling or alternative use of the lake may also reduce the extent of pyrite oxidation and hence acidity production. Some potential remediation technologies such as direct liming of pit water are successful and effective, but may be expensive to maintain following mine closure and lease relinquishment [9].Passive remediation techniques such as acceleration of initial production and sulfate minimization to develop the quality of pit water are being adopted as the substitute by the other approaches. In spite of much possibility, abundant opportunity for research and supervision in there in this multidisciplinary field, prior to the dependence of science on the long-term prediction forecast of the quality of water related to the liability of present well nurtured pit lakes [9] [11].

Land returned to wildlife or at some sites decreased to such an extent that it is unsuitable for any alternate use has been the legacy of mining activities [12]. Progress towards sustainability is made when value is added in terms of the ecological, social and economic wellbeing of the community. In keeping with the principles of sustainable development, the innovative use of flooded open pits and tailings impoundments as commercial, recreational or ornamental fish farms should be considered in some locations, as it could make a significant contribution to the social equity, economic vitality and environmental integrity of mining communities [12] [13]. Here it highlights the growing significance of aquaculture and explores the benefits and barriers to transforming flooded pits and impoundments into aquaculture operations. Among other benefits, aquaculture may provide a much needed source of revenue, employment and in some cases, food to communities impacted by mine closure. Critics of fish farming who are concerned about fish escapes and viral transmissions to wild populations are ready to accept aquaculture in a closed controlled environment. Aquaculture in flooded pits and impoundments are not devoid of complications though it has potential benefits. A site specific design approach is required and that must not ignore the matters right from metals uptake by fish, to the long term practice of the aquatic system as habitation of fish to the general





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contribution of aquaculture to sustainability [14]. Toxic metals such as Zinc, Lead, Copper, Mercury, Arsenic, Bismuth, Cobalt, Antimony, Thallium, Selenium, Silver and Cadmium were released in the surroundings of Donana Park as a consequence of acidic waters and mud (Ph-3), the mine tailings spill accident in Aznalcollar (SW Spain). It is popularly known asDoñana Park related environmental risks [15].

Mining activities have a large local impact on the environment though it apparently affects a small area. Metals are released from mining sites initially through acid mine drainage and erosion of waste stock and tailings deposits. Good agreement between measured and predicted values is shown by the drainage and tailings inputs affected by the copper concentration in a river system which a geochemical model was used to predict in a case study. The fate of released metals is predicted by the available methods of acid mine drainage [16]. For the purpose of large scale commercial mining operations, tools to predict and prevent environmental impact are available. However, mining operations that involve a large number of small-scale activities are difficult to control [16][17]. Mining activities bear both local and regional impacts on terrestrial and aquatic ecosystems. Mines produce large quantities of waste-rock and tailings that must be disposed of on land or into aquatic ecosystems. Heavy metals largely contaminate area of wasteland and sources of acid and metal rich escape from land sited tailing piles or waste rock heaps and cause subsequent pollution of soils, lakes, rivers, and coastal areas [18]. There is complication and the cost is exorbitant in the process of remediation or control of leachates tailings and waste-rock on land and clearance and renovation of waterways affected by mine tailing. Mitigation measures are fruitfully adopted by the new mines that shows long term financial prospect [18] [19].

#### **Indian Perspectives**

Analysis of mine water samples that were collected from the East Bokaro coalfield was done with in view of assessing its suitability for domestic, irrigation, and industrial uses. It was found that the pH of the samples ranged from 6.78 to 8.11 in the pre-monsoon season, 5.89-8.51 during the monsoon season, and 6.95-8.48 in the postmonsoon season. Anion were dominated by HCO3- and SO42-, with minor amounts of Cl-, NO3- and F- In about 44% of the collected samples, the Fe concentration were found to exceed the maximum permissible limit of the BIS drinking water standard. The range of turbidity, TDS, Fe, total hardness (TH), SO<sub>4</sub><sup>2-</sup>, and Mg<sup>2+</sup> also sometimes goes above the admissible limit in drinking water. Even the concentrations of TDS, TH and SO<sub>4</sub><sup>2-</sup> in the mine water does not suit domestic purposes as well as for industrial use; The suitability of agricultural use is restricted by the high values of %Na, SAR, RSC, and Mg-hazard at certain sites [20]. In coal mining town Dhanbad, 10 ponds wereconsidered for study (Figure 1). In summer season, 36 algal species were recorded and studied through Boyd's diversity index process. This is indicated that the studied sites were higher diversity with higher pollution level. Here Algal biodiversity indices can be used in detecting the level of pollution in pond [21]. What is known as Coal void is a surface pit developed after open cast mining which gets filled with rainwater. The result of poor water mixing and strong thermal and dissolved oxygen stratification is less surface area and great depth. For this reason it is different from natural water bodies.Water temperature ranges 7 to 27°C, pH 7.8 to 8.8, Conductivity 538 to 1446 mhos, TDS 468 to 1258 ppm, Dissolved oxygen 3.6 to 12.4ppm, Carbon dioxide 4.4 to 13.2ppm, Alkalinity 109 to 151 ppm, chloride 22 to 31ppm, Hardness 256 to 860ppm, COD 30 to 42ppm, BOD 1.4 to 2.0ppm, Nitrate 1.1 to 1.98ppm, Ammonical nitrogen 0.18 to 0.29ppm, Phosphate 0.7 to 2.0ppm, Organic carbon 2.8 to 5.7ppm and TSS 81 to 999ppm are the parameters as revealed by the physiochemical and bacteriological study. The bacterial load ranged from 0.63x103 to 9.222x103. In case of coal voids which receives organic matter from runoff the range is found to be much greater [22].

What is considered to be the most polluting source of energy is coal, which creates environmental problems at various stages from mining to coal cleaning, from transportation to electricity generation to disposal, by releasing numerous toxic pollutants into the environment [23]. Besides, mining operations have the potential to destroy the flora and fauna and contaminated soil, air and water in the surrounding areas. In Jharia coalfield, Dhanbad of Jharkhand the air quality is deteriorated due to coal mining, land degradation, water pollution and siltation, loss of vegetation and driving out fauna, noise and vibration, reduction in aesthetics and rehabilitation of people [24][25].





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All the components of environment and ecology are affected by the process of mining, resulting in different types of pollution problems like soil, surface and ground water pollution. Acid Mine Drainage (AMD) and mine spoil dumps may contain an elevated amount of Heavy metals[26]. In Moil, Nagpur region, mine waters of Mansar, Kandri, Beldongari and Gumgaon, Manganese mines the physiological effect of heavy metal toxicity is carried out on phytoplanktonlike Chlorella vulgaris, Scenedesmus bijugatus, Oscillatoria amphibian, Lyngbyama juscula. Results obtained showed significant concentrations of heavy metals in mine spoil and mine water. Observed Mn and Fe concentrations were very high (215.2 to 224.3 and 47.9 to 52.5 mg kg-1, respectively in mine spoil followed by Pb, Cr, Cu, Zn, and Cd concentrations. Similarly, mine waters of all sampling sites showed elevated concentrations of manganese (1.645 to 1.745 mg/l), iron (0.950 to 1.124 mg/l) followed by copper (0.029 to 0.032 mg/l) and zinc (0.011 to 0.013 mg/l) while concentrations of cadmium, chromium and lead remained below detecting limit and hence they were selected for toxicity tests. Most of the tested algal species were reported with maximum inhibitory level and TIC to iron and manganese than zinc and copper. Among all algal species Cyanophycean member Oscillatoria amphibia was reported with maximum inhibitory concentration for Mn(2.5 mg/l), Fe (2.4 mg/l), Cu (1.0 mg/l) and Zn (1.7 mg/l) and Lyngbya majuscula with Mn (2.2 mg/l), Fe (2.3 mg/l), Cu (0.9 mg/l) and Zn (1.4 mg/l) whereas Chlorophycean member Chlorella vulgaris was reported with minimum inhibitory concentrations. Tolerance Index Concentration values also revealed more tolerance to iron and manganese and least to copper and zinc. Among Cyanophycean members, Oscillatoria amphibia was reported with more TIC to zinc (0.784 mg/l) while Lyngbyamajuscula with more TIC to iron (1.811 mg/l) followed by manganese (1.574mg/l) and copper (0.665 mg/l). The Chlorophycean member, Scenedes musbijugatus was reported with more TIC to iron (1.543 mg/l) followed by manganese (1.268 mg/l) and copper (0.227 mg/l) whereas Chlorella vulgaris with more TIC to zinc (0.271 mg/l).Overall, all the algal species were affected by heavy metal toxicity and their observed tolerance to the heavy metals especially to higher concentrations of Mn and Fe might be due to adaptation contaminated mine water in the vicinity of mines [27]. After mining of the coal, what remains as the abandoned mines surface pit is known as Coal quarry [28]. A number of such surface pits are available in Jharkhand. These surface pits are filled with rain water and remain fallow. Some coal quarries water is used for irrigation and non-domestic purposes.

This work was to study the Physiochemical and biological parameters of the coal quarries to study the possibilities of fish culture in these surface pits. The analysis of four coal quarries done from 2008 to 2010 revealed that except the low alkalinity and poor concentration of plankton (natural food of fish) Physiochemical parameters are within favorable range of fish culture. The heavy metals were present in sediment, water, plankton and fish muscle. The heavy metals i.e. Iron, Cobalt, Nickel, Copper, Zinc, Manganese, Cadmium, Lead and Mercury are present under beneath sediment water, plankton and fish muscle. Metals like Fe > Zn >Pb>Mn> Cu >Ni > Co > Cd >Hg in sediment and Fe> Zn>Mn> Cu>Pb>Ni> Cd> Co> Hg in water, Zn >Pb>Cu >Ni >Fe. Mn>Pb>Co >Hg in plankton are the way of heavy metals concentration in fish muscle. The continuous exposure of fish increases the concentration of heavy metal in drinking water. Usually the heavy metals in water is below the maximum permissible level of drinking water. The fish analyzed for heavy metals were young wild fish. When the coal quarry was stocked with cultivable varieties there was poor survivability. On the basis of this survey further studied is needed to detect the variety of fish, practice of culture, biological method to decrease the heavy metals and method of harvesting to decide the safest age of fish for consumption [29].

In Singrauli area of the north India a study was carried out to know the water quality at selected sites. Physiochemical parameters like pH, total dissolved solids (TDS), bicarbonate, hardness, calcium, magnesium, sodium, potassium, chloride, sulfate, copper, iron, cobalt, manganese, zinc, and chromium were analyzed in 27 water samples. Locations selected for sampling were based on the preliminary field survey carried out to understand the overall impact of mining and industrialization on the surface and groundwater resources of Singrauli. Base map, drainage map, and land use/land cover of the study area were prepared from Survey of India topographic map 63 L/12 on 1:50000 scale and satellite data of IRS P6 LISS III 4th May 2010. Land use were categorized into 15 categories out of which major area occupied by open forest covers 20.33 %, uncultivated land 20.25 %, cultivated land 12.60 %,



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dense forest 11.00 %, and other categories cover 35.82 %. The results obtained were compared with World Health OrganizationWHO) standards for drinking water quality. Alkaline nature of water, its softness TDS and total alkalinity exceeding the desirable limit potassium exceeding are shown by physiochemical analysis. It shows whether the major ions in water like calcium, and magnesium are within desirable limits and sulfate and whereas sodium and chloride show noticeable higher values. The desirable limit is shown by the values of minor ions like copper and zinc but higher values than the desirable limits which reduce the quality of water are shown by iron, cobalt, and chromium [30] [31].

#### The Perspective of West Bengal

It is cited that the Pit lakes form when surface mines close and open pits filled with water, either through groundwater recharge, surface water diversion or active pumping in Raniganj coalfield (RCF), West Bengal, India promoting sustainable utilization of resources for socioeconomic development of the local stakeholders in due course of time (Figure 1). During 2014–2017 enumeration and characterization was held in 40 OCPs (open cast pits) for determining their nature, position, depth, area and comparative account in Raniganj coalfield. Physicochemical parameters of water and soil was recorded at 27 selected mine OCPs to understand its quality in a consecutive 2-year study. It was observed thata total of 30 species belonging to 21 families of frequent hydrophytes species dominated these OCPs. According to their growth pattern Successional stages of plant species were noticed and grouped. From the OCPs 15 most frequently cultured or naturally occurred fish species under 4 orders, 5 families and 14 genera were collected and identified. Possibility of starting developmental pisciculture in 25 OCPs was the outcome of the analysis of OCPs water quality and questionnaire survey of the local stakeholders. Natural conversion of over 20 to 30 years aged pits into the wetland ecosystem initiated a good amount of aquatic biota, excellent water quality and stabilized embankment. It was traced there were60 species of wetland birds (with terrestrial counterparts in the adjoining floral habitat) belonging to 15 orders and 34 families [32].

It was cited after an investigation from the open cast mining in Bansra and SonepurBazari colliery opencast mining that natural vegetation of an area is replaced with huge quantities of overburden dumps called mine spoils (Figure 2). Natural plant succession on these spoils cause changes in physico-chemical characteristic of soil leading to restoration and conservation of biodiversity. Total 126 angiospermic plant species belonging to 41 families were recorded [33]. In the mining ecosystem the evaluation of environmental contamination regarded assessment of soil quality as one of the key parameters [34]. In Raniganj coalfield area opencast and underground mining sites were selected in for investigating the effect of coal mining on soil quality (Figure 3). Evaluation of the physical, chemical, and biological parameters of the soils and trace metals and PAHs (polycyclic aromatic hydrocarbons) in the soils was carried out. Underground mine (UGM) soil showed significant increase of dehydrogenase (+79 %) and fluorescein (+32 %) activities, whereas opencast mine soil displayed higher peroxidase activity (+57 %). Cd content was higher in UGM but As, Be, Co, Cr, Cu, Mn, Ni, and Pb was significantly higher in OCM soil. Generally, the PAHs contents were higher in UGM soils, probably due to the natural coal burning at these sites. After the conversion of the observed values for the above properties into a unit less score (0-1.00) the scores were integrated into an environmental soil quality index (ESQI). The results of the inclusion of all the soil parameters in the unscreened index (ESQI-1) showed that the quality of the soil was better for UGM (0.539) than the OCM (0.511) soils. Employment of principal component analysis to derive ESQI-2 found total PAHs, loss on ignition, bulk density, Be, Co, Cr, Ni, Pb, and microbial quotient (respiration: microbial biomass ratio) to be the most critical properties. In the soils near UGM (+10.1 %)the ESQI-2 was also higher. By the observationit was revealed that indicators and the ESQI results that soil quality assessment for these coal mining soils largely depends on soil PAHs and potentially toxic trace metals. Further refinement of the proposed ESQI is possible by incorporation of specific parameters related to human exposure risks and exposure pathways [33] [35].

The abandoned opencast coal pit commonly called as Khadan, which is a potential water reserve located at the Raniganj coalfield.Increasing depths in the OCPs water change the water quality and suggest a gradual and significant ecological restoration over time, which can pave the way for a sustainable pisciculture [36] (Figure 4). The





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physical and chemical variables of the OCP water directly depend on the depths and seasons. Depth throughout the year decreases the temperature and alkalinity. In the summer and winter a mixing characteristic is exhibited by the dissolved oxygen concentration, but it decreases the depth in the monsoon and post monsoon season[37]. With depth in the monsoon season the total hardness increased, being maximizing to196.0 mg-1in the winter. With the depth in the winter the biochemical oxygen demand (BOD) and chemical oxygen demand (COD) are on the rise. The increase of silicon concentration with depths is evident and a maximum value of 14.2 mg L-1 in the winter and a minimum value of 1.24 mg L-1 in the post monsoon season is exhibited. Seasonal variations are exhibited by the ammonia-nitrogen, nitrate-nitrogen, potassium, chloride and sulphate concentrations only. Decrease of the concentration of heavy metals (arsenic, chromium, cadmium, manganease) with increased depth is observed. The concentration of fluoride is high in each OCP water layer. The results of this study indicated that limnology variables in thermally stratified lakes may be an important measure for better understanding the gradual process of developing an improved ecological conditions in the OCP and which can facilitate the possibility of pisciculture in the near future[36] [38].

It was also assessed how the individual plants of community responds to the defilement caused by coal mining [39]. Air monitoring, soil physico-chemical and phyto-sociological analyses were carried around Jharia coalfield and Raniganj coalfield, PaschimBardhaman. With increasing pollution load and altered soil quality around coal mining areas the importance value index of sensitive species is minified and those of tolerant species are enhanced. Affluence of the flourishing woody and herbaceous plants decreased with higher pollution load but a large number of species are acclimatized to the stress caused by the coal mining activities (Figure 5). In Jharia coalfield woody plant community was more affected by coal mining than herbaceous community. The structure of herbaceous community was mainly driven by total organic carbon, soil nitrogen, whereas sulphur dioxide in ambient air, soil sulphate and soil phosphorus influenced woody layer community was revealed by thecanonical correspondence analysis. The record of the changes in species diversity at mining areas gave an indication of an increase in the proportion of resistant herbs and grasses showing a tendency towards a definite selection strategy of ecosystem in response to air pollution and altered soil features[39] [40].

The opencast coal extraction method is one of the best and appropriate in the mining industries of India resulting into a void or pit which is eventually filled up by surface runoff and groundwater seepage becoming a pit-lake, the potential water reservoir[41] [42]. In India, coal is a major resource and most important primary source of energy. Therefore, coal mining and its associated activities can imbrue the different sectors of our environment, viz., societal condition, ecology, atmosphere, land and/or water system. The major environmental impacts on the surrounding areas and on human health are well documented by several authors in different times [1][43].Several studies on Raniganj coalfield (RCF) area revealed that it is free from Acid Mine Drainage (AMD)[44][45].Different studies on limnological parameters depicted the high conductivity, total suspended solids (TSS), total dissolved solids (TDS), biochemical oxygen demand (BOD), chemical oxygen demand (COD), sulphates (SO4) etc., in mine water of this area [45] [46] [47]. Few records are available on assessment of water quality and seasonal variations of the Indian coal pit-lakes [47] [48]. The major sources of surface water in the RCF area is Damodar, Ajay and Barakar rivers which are rain fed; and acute shortage of drinking water occurs in summer season mainly due to withdrawing and discharging resulting from underground mining activity. Ongoing opencast mining activity, causing permanent flow of water into the mine also disturbs the aquifers and water table [45].Therefore; it can cause groundwater pollution in this area [44].

Raniganj coal field cited that mining activity also creates tremendous pressure on local flora and fauna particularly where diversion of forest land takes place for mining purposes. The effect of mining on ground water level, silting of surrounding water bodies and land are also great concern [49]. Coal mining contributes largely towards economic development of the nation although it has a great impact upon the human health [50].Socio-cultural aspect of the workers and people residing in and around coal mining areas was also influenced by it. Hence a holistic approach of considering the mining activities, keeping in mind concerns for adjoining habitats and ecosystem is felt inevitable





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[51]. Its necessitatesrecognizing various stock of minerals and various factors ranging from appropriate angle of slope of safe disposal drains, overburden dumps and safe techniques to various silt control structures. "Indian Coal companies' are targeting to reduce environmental impacts through the "Clean coal" strategies. The thermal efficiency of combustion can be increased by the reduced ash contents of the washed coal and it has a direct impact on reducing emission of pollutants. Never the less, extra water needed for coal washing may lead to a pollution free society [50] [52]. In order to evaluate any deterioration in soil properties in Raniganj coalfield mine spoil characteristics of the dump area and the native soil were analyzed critically [53]. The required level of soil nutrient native soil is higher than that of the of soil nutrient of mine soil. It is suggested by the available nutrients (N, P, K), exchangeable elements (Ca, Mg, Na, K) of the native soil that open cast mining changes the soil quality[54]. Other physical properties of the native soil such as bulk density, water holding capacity, moisture content are higher than those of mine soil. The soil texture from silty-loam to sandy soil can be altered by mining method but old mine spoil at Belbad has regenerated from sandy to silty-loam type. The trace metal content in mine spoil and native soil does not have any significant difference [55].

At Alkusha-Gopalpur, Raniganj coalfieldbiological reclamation on a 10-year-old mine spoil was carried out. Till 1997 the effects have been annually calculated in terms of species suitability, spoil chemical quality, and biodiversity of natural succession. Out of 14 Angiospermsconsidered for reclamation, the successful ones are *Acacia auriculoformis*, *Acacia arabica, Albizzia lebbek, Leucenaleuco cephala*, and *Gmelina arborea*. It was found thatimpaired pH, available mass nutrients (N, P, K), organic carbon, exchangeable cations and cation exchange capacity increased whereas trace elements decrease. There is indirect relationship between the survival percentage and trace element intake capacity of the planted saplings [56] [57]. The repository of 46% of Indian coal reserve is the Damodar river basin. Exploitation of coal and related industries in this area have exerted a great impact 0n the environment of the basin. Hydrogeochemical analyses of mines water carried out for all the major coalfields. The analysis revealed that total dissolved solids, sulphate, hardness and iron content are high [45].

#### **Coal mining region**

Coal mining regions are significant resource extraction industries in many parts of the world including India (Table 1). They provide a large amount of the fossil fuel energy in the world economy. These regions have a significant economic activity and often associated with the social, environmental and cultural impact. The Raniganj coalfield was first mined in 1774 and is the oldest coal mine in India in 1973, the various privately-owned coal mines at Raniganj were nationalized and put under the management of E.C.Ltd., PaschimBardhaman (a subsidiary of coal India) in 1975. It consists of 98 mines of 98 mines of which 77 are underground and 21 open-cast; reserves total 16.9 billion tons coal. The Birbhum district has a large coal field, estimated reserves of 5 billion tons of coal. Coal block spread over an area of 9.7 km<sup>2</sup> is to be developed by Bengal Birbhum Coal Company Ltd. Another potential coal reserve is in DewanganjHarinsingha block having an estimated area of 2.6 km<sup>2</sup>, located in Mohammad Bazar CD Block.

#### Impact of open cast coal mines

Open cast coal mining can result in a number of adverse effects on the environment. Complete elimination of existing vegetation, destruction of the genetic soil profile, displacement or destruction of wildlife and habitat, degradation of air quality, alteration of current land uses and to some extent permanent changes of the general topography of the area are the result of it. This often leads to scarred landscape without any scenic value of greater concern, the movement, storage, and redistribution of soil during mining and disruption of the community of soil microorganisms and consequently nutrient cycling process. Depth and difficult accessibility to the remote and distend Pits very often pose anthropological treats.





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# CONCLUSION

Owing to rapid urbanization most of the vacant places are being occupied. We have taken out resource like coal etc. from the open cast collieries and have utilized those resources. And after the closure of the open cast collieries, pits are formed which are helpful in conserving water. In addition to this, a unique biodiversity and biomass is also formed there which is of utmost importance. There are certain points to be taken into consideration while future studies considering the utilitarian perspective.

- I. What unique biodiversity the opencast mines hold in terms of its flora & fauna?
- II. What are the correlating factors that are matching to our existing knowledge set up?
- III. How the existing minerals & heavy metals affect the flora & fauna?
- IV. Is there are bio-monitoring aspect to be ascertained?
- V. Is there any bio-remediating aspect have revealed that could be exploited in utilitarian perspectives?

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# Table 1. Coal distribution in India (Source: Coal Directory in India, Coal Controller's Organization,Kolkata)[58]

Mine	State	Types of Coal
Jhasuguda	Odisha	Bituminous
Talcher	Odisha	Bituminous
Jharia	Jharkhand	Bituminous
Bokaro	Jharkhand	Bituminous
Godda	Jharkhand	Bituminous
Ranganj coalfield	West Bengal	Bituminous
Birbhum coalfield	West Bengal	Bituminous
Korba	Chhattisgarh	Bituminous
Nagpur	Maharashtra	Bituminous
Singareni	Telengana	Lignite
Neyveli	Tamil Nadu	Lignite
Ledo	Assam	Lignite
Bikaner	Rajasthan	Lignite
Nagaur	Rajasthan	Lignite
Bermer	Rajasthan	Lignite
Udhampur	Jammu & Kashmir	Anthracite
Kalakot	Jammu & Kashmir	Anthracite
Rajouri	Jammu & Kashmir	Anthracite







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**RESEARCH ARTICLE** 

# A Study on the Construction of Dynamical Models Regarding the Pace of Eating of a Man

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# ABSTRACT

In the present article we have discussed the formulation of some simple dynamical models regarding the pace of eating of a human being who is sufficiently hungry. Differential equations in this regard have been formed on the basis of very common observations pertaining to one's eating process to satiate hunger. Time dependence of the quantity of food consumed by a man, during eating, has been graphically depicted. The rate of food intake and the maximum amount of food that can be consumed, have been shown to be governed by the constant parameters associated with these models. The differential equations, corresponding to five models discussed here, are very simple and they can be solved easily by integration. Graphical representations of their solutions are consistent with our experiences regarding the pace of eating of a man. The values of the constant parameters, associated with these models, can be determined by experimental observations.

**Keywords:** Pace of eating, maximum food consumption ability, dynamical models, differential equations, mathematical modelling, mathematics education.

# INTRODUCTION

It is possible to construct mathematical models, using our experiences of daily lives, regarding various processes, events or phenomena which are very widely observed. These processes may not always have detailed mathematical theories or explanations of their own. One may outwardly note (maybe in a qualitative manner) the main characteristic features of these processes, using which, differential equations can be formed in a number of ways. The solutions of these differential equations may be compared with the observations regarding the processes. These





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differential equations, in many cases, may be such that analytical solutions do not exist for them. Any differential equation can be numerically solved but it would be a little more difficult to use or analyze the solution, compared with an analytical solution. Therefore, one should look for ways to formulate these differential equations (based on the observed phenomena) in such a manner that one can easily obtain their analytical solutions.

We have constructed simple dynamical models, in the present study, regarding the pace of food intake when a person is eating to satiate hunger. There are actually many factors that affect the speed of eating. In recent times, several studies have been conducted in this regard [1-7]. Our study is not based on any biological theory about the human body. The objective of the study is to obtain simple mathematical expressions that can represent the eating speed in a way which is reasonably consistent with our observations and experiences.

In the present article we have proposed five dynamical models regarding the eating pace of a person who is sufficiently hungry. For each of these models, the differential equation which has been assumed to govern this phenomenon, is based entirely on our observations recorded qualitatively through our common experiences in this regard from daily lives. It has been very widely observed that when we start eating a meal (on being sufficiently hungry), we eat it quite fast at the beginning and the pace of eating is found to be decreasing with time. As time progresses, the stomach gets filled up gradually, and the time-rate of food intake decreases. This simple fact has been expressed in terms of a first order differential equation in every model constructed and discussed here. None of these five differential equations is linear (except for the special case having m=1 for equation no. 1). We have found their analytical solutions and plotted them graphically to offer a pictorial depiction of the time dependence of the process of food intake of a human being. The differential equations that have been formed and solved for the present study are very simple and their solutions have been obtained through integration. For a detailed information on how to form differential equations, based on observations of various types, and their methods of solution, the reader may consult some standard textbooks on mathematical methods [8-12].

# MATHEMATICAL MODELS

In this section we have discussed five models which have been proposed on the basis of five different assumptions regarding the pace of food intake of a person. The differential equations of these models have been formulated on the basis of very common observations and experiences regarding the characteristics of how the pace of eating changes with time.

#### Model-1

Here we have assumed that there exists a maximum quantity of food that one can consume while eating to satiate one's hunger. This maximum quantity has been denoted here by the symbol *Y*. Let y(t) be the amount of food that has been consumed in time *t*, and dy/dt is the rate of food intake at the instant of time *t*. Thus, (Y-y) is the amount of food that can still be consumed at that instant. In this model, the rate of food intake, at any stage of eating, is regarded as proportional to the quantity  $(Y-y)^m$  with m>0. Hence, we may write,

$$\frac{dy}{dt} = \alpha (Y - y)^m \tag{1}$$

The parameter  $\alpha$  is the constant of proportionality and  $\alpha > 0$ .

As *y* becomes closer to *Y*, the rate of food intake becomes smaller, as per equation (1). This is consistent with our perception of eating. Solution of equation (1), for m = 1, under the boundary condition that  $y = y_0$  at  $t = t_0$ , is given by,

$$y = Y - (Y - y_0) Exp[-\alpha(t - t_0)]$$
At  $t \to \infty$ ,  $y \to Y$ 
(2)



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Hence, for all practical purposes, we may take *Y* to be the highest attainable value for y(t) when  $\frac{dy}{dt}$  is proportional to (Y - y). This is consistent with the assumption behind the formulation of the present model.

Solution of equation (1), for  $m \neq 1$ , under the boundary condition that  $y = y_0$  at  $t = t_0$ , is given by,

$$y = Y - \left[-\alpha(1-m)(t-t_0) + (Y-y_0)^{1-m}\right]^{\frac{1}{1-m}}$$
(3)

For m > 1, we have  $y \to Y$  at  $t \to \infty$ , in accordance with equation (3).

#### Model-2

The rate of food consumption, at any point of time during eating, has been assumed, in this model, to be inversely proportional to the  $n^{th}$  power of the quantity (*y*) of food that has already been consumed, considering  $y \neq 0$ . This assumption can be expressed as,

$$\frac{dy}{dt} = \frac{\beta}{y^n} \tag{4}$$

with  $\beta$ , n > 0. Here  $\beta$  is the constant of proportionality. Solution of equation (4), under the boundary condition that  $y = y_0$  at  $t = t_0$ , is given by,

$$y = [y_0^{n+1} + \beta(n+1)(t-t_0)]^{\frac{1}{n+1}}$$
(5)

#### Model-3

Here we have assumed the rate of intake to be proportional to  $e^{-\lambda y}$  with  $\lambda > 0$ . Thus, we write,

$$\frac{dy}{dt} = \gamma \ Exp[-\lambda y] \tag{6}$$

Here  $\gamma$  is the constant of proportionality and  $\gamma > 0$ . Solution of equation (6), under the boundary condition that  $y = y_0$  at  $t = t_0$ , is given by,

$$y = \frac{1}{\lambda} \ln[\gamma \lambda (t - t_0) + e^{\lambda y_0}]$$
<sup>(7)</sup>

#### Model-4

In this model, the rate of food intake, at any instant of time t, has been assumed to be inversely proportional to time (t). Therefore, we can write,

$$\frac{dy}{dt} = \frac{\varepsilon}{t} \tag{8}$$

Here  $\varepsilon$  is the constant of proportionality and  $\varepsilon > 0$ . This model is valid under the restriction of t > 0, to have  $\frac{dy}{dt}$  finite and positive.

Solution of equation (8), under the boundary condition that  $y = y_0$  at  $t = t_0$ , is given by,

$$y = y_0 + \varepsilon \ln \frac{t}{t_0} \tag{9}$$



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#### Model-5

In this model, the rate of food intake, at any time *t*, has been assumed to be proportional to  $e^{-\mu t}$  with  $\mu > 0$ . Hence, we can write,

$$\frac{dy}{dt} = \kappa e^{-\mu t} \tag{10}$$

Here  $\kappa$  is the constant of proportionality and  $\kappa > 0$ . Solution of equation (10), under the boundary condition that  $y = y_0$  at  $t = t_0$ , is given by,

$$y = y_0 - \frac{\kappa}{\mu} [e^{-\mu t} - e^{-\mu t_0}]$$
(11)

At  $t \to \infty$ ,  $y \to y_0 + \frac{\kappa}{\mu} e^{-\mu t_0}$ 

Thus, for all practical purposes, one may say that,  $\left(y_0 + \frac{\kappa}{\mu}e^{-\mu t_0}\right)$  is the maximum value of y(t). This is, therefore, the maximum amount of food that can be consumed by a man.

# RESULTS

Figure 1 shows the time dependence of food consumed (y) by the eater, based on Model-1, for three values of the parameter  $\alpha$ . Figure 2 shows the time variation of food consumed (y), based on Model-1, for three values of the parameter Y. Figure 3 shows the time evolution of food consumed (y), based on Model-1, for three values of the parameter m. In these plots, y is found to be asymptotic to the maximum consumption ability (Y). The time variation of the rate of increase of y depends on the parameters of this model.

For m = 1, we may assume the eating process to stop at  $t = \tau_1$  when we have y = fY with f < 1. Using this assumption, we have obtained the following expression for  $\tau_1$  from equation (2).

$$\tau_1 = t_0 + \ln\left(\frac{\gamma - y_0}{\gamma - fY}\right)^{1/\alpha} \tag{12}$$

For the case of  $m \neq 1$ , the process of eating may be assumed to stop at  $t = \tau_2$  when we have y = hY with h < 1. We have obtained the following expression for  $\tau_2$  from equation (3).

$$\tau_2 = t_0 + \frac{(Y - hY)^{1 - m} - (Y - y_0)^{1 - m}}{\alpha(m - 1)}$$
(13)

Figure 4 shows the time dependence of food consumed (*y*), based on Model-2, for three values of the parameter *n*. For larger values of *n*, we find a slower rise of *y* with time in these plots. Figure 5 shows the time dependence of food consumed, from Model-2, for three values of the parameter  $\beta$ . The larger the value of  $\beta$ , the faster would be the change of *y* with time, as evident from equation (5). No saturation value for *y* is shown by these plots.

Figure 6 shows the time dependence of food consumed, based on Model-3, for three values of the parameter  $\lambda$ . For  $t > t_0$ , y rises faster with time for smaller values of  $\lambda$ . Figure 7 shows the time dependence of food consumed, based on Model-3, for three values of the parameter  $\gamma$ . For  $t > t_0$ , y increases more rapidly with time for larger values of  $\gamma$ . These behaviours are all consistent with equation (7). No saturation for y is observed from these plots.





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Figure 8 shows the time dependence of food consumed, based on Model-4, for three values of the parameter  $\varepsilon$ . Here, y increases faster for larger values of  $\varepsilon$ , as clearly evident from equation (9). These plots do not show any saturation value for y.

Figure 9 shows the time dependence of food consumed, based on Model-5, for three values of the parameter  $\mu$ . Figure 10 shows the time dependence of food consumed, based on Model-5, for three values of the parameter  $\kappa$ . Both figures show the existence of a saturation value for y. Larger values of  $\mu$  lead to smaller saturation values (for a constant  $\kappa$ ) and larger values of  $\kappa$  lead to greater saturation values (for a constant  $\mu$ ). The saturation level for y is  $\left(y_0 + \frac{\kappa}{\mu}e^{-\mu t_0}\right)$ , as evident from equation (11). One may assume that the eating process stops at  $t = \tau_3$  when y becomes a certain fraction (say g) of the saturation value. Hence, we should write,  $y = g\left(y_0 + \frac{\kappa}{\mu}e^{-\mu t_0}\right)$  (with g < 1) at  $t = \tau_3$ . Using this assumption, the following expression for  $\tau_3$  has been obtained from equation (11).

$$\tau_3 = \frac{1}{\mu} \ln \left[ \frac{1}{\left(\frac{\mu}{\kappa} y_0 + e^{-\mu t_0}\right)(1-g)} \right]$$
(14)

To determine the values of  $\tau_1$ ,  $\tau_2$  and  $\tau_3$  using equations (12), (13) and (14) respectively, one has to know the values of all parameters that constitute their expressions. To estimate the values of these constants, extensive experimental studies are required.

# CONCLUSIONS

Among the five models proposed and analyzed in the present study, model-1 and model-5 show a saturation value for the quantity y(t), which denotes the amount of food that is consumed by the eater in time t. According to the other models, this quantity y(t) increases with time with a gradually decreasing slope, indicating a gradual decrease in the rate of food intake. The figures, based on models-1 & 5, are therefore closer to reality than other models. The existence of a saturation level for y(t) was in the assumption for model-1 but, nothing of that sort was assumed in the formulation of model-5. We have assumed  $y \neq 0$  in our formulation of model-2. A better version of this model can be formulated by assuming  $\frac{dy}{dt}$  to be proportional to  $\frac{1}{(\sigma+y)^n}$  where we have  $n, \sigma > 0$ . An improved version of model-4 can be obtained by assuming  $\frac{dy}{dt}$  to be proportional to  $\frac{1}{(v+t)^l}$  with l, v > 0. This change will make this model free from the restriction of t > 0. Several such ideas for modifications of all these models will probably be implemented in a future study on this topic. Proper biological interpretation of the pace of eating, with the help of these models, would be possible if one can establish the connections of the constant parameters to the biological factors or mechanisms that govern the process of eating. The values of the constant parameters associated with these models can be determined by experimental studies carried out on a large number of human beings. The present study can be looked upon as a demonstration of the fact that many such processes, which are widely observed and experienced, can be described in terms of simple mathematical expressions and they can thereby be depicted graphically.

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Figure 1. Plots of cumulative food intake (y) versus time (t), from Model-1, for three values of the parameter  $\alpha$ . Figure 2. Plots of cumulative food intake (y) versus time (t), from Model-1, for three values of the parameter Y.



Figure 3. Plots of cumulative food intake (y) versusFigure 4. Plots of cumulative food intake (y) versustime (t), from Model-1, for three values of the<br/>parameter m.time (t), from Model-2, for three values of the<br/>parameter n.





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**RESEARCH ARTICLE** 

# Siddha and Unani Treatment in Tamil Culture an Study

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## ABSTRACT

Tradition attributes a divine origin to *Siddha* medicine. Both the universe and the human body derive from the same five basic elements: wind, space/ether, fire, water, and earth. They combine to provide each individual with his or her unique configuration of the three basic humours or *doshas* in human beings: wind, bile, and phlegm, called the person's basic nature. A skilled physician uses various methods, including the examination of the patient's pulse and urine, to diagnose an imbalance in the patient's basic nature

Keywords: Siddha Medicine, Herbal And Mineral Treatment, Ayurveda, Yoga and Naturopathy, Unani.

## INTRODUCTION

Three traditional medicinal systems predominate in modern India: Ayurveda, Siddha, and Unani. Ayurveda is found mostly in northern India and in Kerala in the south, Siddha medicine occurs in Tamil Nadu and parts of Kerala, and Unani, which derives from Arabic medicine, is found throughout India, mainly in the urban areas. This essay focuses on Siddha medicine (Tamil: *Citta Vaittiyam*) and its history and practice in South India, with an eye towards the similarities and differences between Siddha medicine and Ayurveda. The Siddha System of Medicine (Traditional Tamil System of medicine), which has been prevalent in the ancient Tamil land, is the foremost of all other medical systems in the world. Its origin goes back to B.C 10,000 to B.C 4,000. As per the textual and archeological evidences which indicate the remote antiquity of the Dravidian civilization of the erstwhile submerged land Kumarikandam, that is the Lemuria continent situated in the Indian ocean, the Siddha System of Medicine is contemporaneous with those of the submerged lands Egyptian, Mesopotamian, Chinese and Grecian medicines. The





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uniqueness of Siddha System is evident by its continuous service to the humanity for more than 5000 years in combating diseases and also in maintaining its physical, mental and moral health while many of its contemporaries had become extinct long ago. The roots of the ancient Siddha System are intertwined with the mythology and culture of the ancient Tamil civilization that existed in the southernmost tip of the Indian peninsula, predating much of recorded history. Mythically, the origin of Siddha is attributed to Lord Siva, who is supposed to have handed it down to his consort Parvathi (Shakthi), who in turn passed on the sacred knowledge to Nandi, from whom it was transmitted to the first of "Siddhars". Siddha is a Tamil word derived from "siddhi" -- attaining perfection in life or heavenly bliss.

The system is said to have emerged in antiquity, from the highly evolved consciousness of the Siddhars. The clarified intellect and heightened intuition of the Siddhars, resulting from their yogic powers, enabled them to explore the world around them and exploit its natural resources for the sake of humanity. Their findings on the characteristics of plants, metals, minerals and animal products and their knowledge of the properties of drugs, its purification, processing, fixing dosage, toxicity, antidote and clinical application, were preserved in the form of verses for the use of the posterity. This unique legacy was bequeathed to select disciples or "chidas" by word of mouth. It is believed that there was a line of 18 siddhars, with Agasthya being the foremost and a large portion of Siddha lore is credited to him. With time, this oral tradition was transcribed on palm leaf manuscripts that now serve as the major repository of the knowledge. The contributors of Siddha system, the Siddhars, of Tamil land, were mystics, yogis, poets, devotees, seers and medical men of various combinations and various statures. They were super human beings who possessed supernatural powers (like Eight types of Siddhis). They were the greatest scientists of ancient times and were the guardians of the world and they existed, and still exist, for the benefit of the public at large. They were men of great practical knowledge and wisdom. They had full awareness of the nature and activities of all the objects in this planet and of all times-past, present and future. They were mainly responsible for the growth and development not only of Tamil medicine that includes alchemy, medicine, yoga, kayakalpa (rejuvenation therapy), philosophy, astronomy, astrology, varma, muppu, thokkanam etc., but also for many other sciences of public utility.

#### **Diagnosis and Treatment**

The unani system of diagnosis of diseases and treatment restoring health, revolves round the concept of temperament or 'Mizaj'. The humours also have specific temperament. Changes in temperament are related to changes in the balance of humours. Any change in temperament brings about a change in the health of the individual. Thus imbalance of the harmony of humours and temperament along with failure of one or more parts of the body to eliminate pathogentic waste causes disease. The Government recognized the merit of Unani system and attempts were made to develop it as a viable system of medicine for National Health care. The Unani drugs are cost effective, safe and widely accepted by the people of India. Therefore, the Tamil Nadu Government have established a Unani Medical College and Unani dispensaries. Siddha medicine, traditional system of healing that originated in South India and is considered to be one of India's oldest systems of medicine. The Siddha system is based on a combination of ancient medicinal practices and spiritual disciplines as well as alchemy and mysticism. It is thought to have developed during the Indus civilization, which flourished between 2500 and 1700 BCE. According to this theory, it came to South India when the Dravidian people (speakers of Dravidian languages), who may have been the original inhabitants of the Indus valley, migrated southward. Siddha medicine appears as part of Tamil culture in the earliest Tamil writings (Tamil is one of the principal Dravidian languages). For example, there are references to it in Tamil shangam literature (1st-4th century CE), including mention in the Tolkappiyam ("Ancient Literature"), a treatise on grammar and poetics, and in Tirukkural ("Sacred Couplets"), a work attributed to the Tamil poet-saint Tiruvalluvar.

#### The Philosophy of Siddha Medicine

Practitioners of Siddha medicine are known as siddhars (or siddhas). According to Tamil tradition, there initially were 18 siddhars; these individuals often are portrayed as having received their knowledge of the Siddha system





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indirectly from the deity Shiva. Siddhars held that the object of their study was to preserve and prolong life. To do so, they believed, required humans to live according to the laws of nature. They led simple lives themselves and were unconcerned with caste, creed, colour, or nationality. They contributed not only to a system of medicine but also to the knowledge of eternity, alchemy, and Yogic living. Some believe that the siddhars travelled widely to other countries to propagate their system of medicine and enrich the sciences. Siddhars possessed ashtama siddhi, the eight great supernatural powers. These powers may have been attained at birth (because of one's previous karma), by chemical means, by the power of words, or through concentration. Meditation on the elements, beginning with the "gross" and ending with the "subtle," enabled the siddhars to gain mastery over the elements. Many of the ancient philosophical tenets of the Siddha system continue to be relevant to modern practitioners. Get exclusive access to content from our 1768 First Edition with your subscription.

#### **The Five Elements**

According to the Siddha system, there are five elements that exist in nature: earth, water, fire, air, and ether, all of which form the original basis of all corporeal things. It is believed that there is an intimate connection between the macrocosm of the external world and the microcosm of the corporeal being. In the human body the element of earth is present in the bone, flesh, nerves, skin, and hair; the element of water is present in bile, blood, semen, glandular secretions, and sweat; the element of fire is present in hunger, thirst, sleep, beauty, and indolence; the element of air is present in contraction, expansion, and motion; and the element of ether is present in the interstices of the stomach, heart, neck, and head.

#### **Humoral Pathology**

Three of the elements—air, fire, and water—are emphasized in Siddha medicine because they are believed to form the three fundamental components that make up the human constitution. These three components – vata, pitta, and kapha (representing air, fire, and water, respectively)-are known as humours, and their inharmonious interaction produces various pathological states. According to the theories of humoral pathology, all diseases are caused by the discordant mixture of vata, pitta, and kapha. Their proportions in the body govern a person's physical and mental disposition. The elements form the connecting link between the microcosm (the human) and the macrocosm (the world). Thus, the external air corresponds to the internal vata, the external heat corresponds to the internal pitta, and the external water corresponds to the internal kapha. Under normal circumstances, according to Siddha theory, vata occupies regions related to the pelvis and the rectum, pitta occupies regions related to the stomach and the viscera, and kapha occupies regions related to breath, the throat, and the head. Siddhars believed vata to be self-originated and identical to divine energy. Imbalance of vata could be the root cause of all disease. Pitta was believed to represent all the characteristics of fire, such as burning, boiling, heating, and similar sensations. It was the name given to the heat contained in the liquid bile, which causes the expulsion of waste matter in the form of urine and feces, and it was believed to give sight to the eyes, beauty to the skin, and cheerfulness to the mind. Kapha was believed to supply moisture to the body and to give stability, adding to the strength of the body by increasing the firmness of the limbs and thereby keeping them in harmony with one another. It was also thought to aid in digestion and sensation, such as by imparting taste to the tongue. The presence and proportion of these humours within the system is indicated by the pulse, which is vital to correct diagnosis.

#### Pranayama

Prana (Sanskrit prāņā) refers to "breath." In Siddha medicine, breathing is considered to be the most important of all functions, providing vitality and freedom from disease. Controlled breathing is the method of charging oneself with vitality and personal magnetism; in Yogic terms this is known as pranayama.

#### Varmam

Varma is an area of practice in Siddha medicine that is concerned with varmam. The varmam are points of intersection of bone, muscle, tendons, nerves, and blood vessels. The ancient siddhars believed that disease emerged





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when these points were adversely affected by an external force. A manipulative technique used in Siddha medicine to restore health at the varmam is known as ilakku murai. There are believed to be 108 varmam, according to Siddha tradition.

#### Herbal and Mineral Treatment

The siddhars did extensive research on plants and devised methods by which plants could be harnessed medicinally. They also described the poisonous nature of some plants and the antidotes for them and classified plants based on the way they affected the body. Unlike Ayurveda, which is another traditional system of Indian medicine, but which gives topmost priority to herbal treatment, Siddha medicine gives importance to the conjunctive use of plants and minerals. For simple ailments, the Siddha practitioner advises the initial use of herbs. If this does not prove effective, the judicious use of plants, minerals, and animal products is advised. According to Siddha theory, preparations made of mercury alone were believed to invest the body with immunity from decay, enabling it to conquer disease. Mercury and sulfur were considered to be supreme curatives. Those minerals, however, are extremely toxic to the human body. Siddha medicine has been used for the management of chronic diseases and degenerative conditions, such as rheumatoid arthritis, autoimmune conditions, collagen disorders, and conditions of the central nervous system. Its effectiveness in those situations has varied.

#### Siddha and Unani Medicine

Siddha science is a traditional treatment system generated from Tamil culture. Palm leaf manuscripts say that the Siddha system was first described by Lord Shiva to his wife Parvati. Parvati explained all this knowledge to her son Lord Muruga. He taught all these knowledge to his disciple sage Agasthya. Agasthya taught 18 Siddhars and they spread this knowledge to human beings. Siddha system of medicine emphasize that medical treatment is oriented not merely to disease, but also has to take into account the patient, environment, age, habits, physical condition. Siddha literature is in Tamil and it is largely practiced in Tamil speaking parts of India and abroad. Unani System of medicine is based on established knowledge and practices relating to promotion of positive health and prevention of diseases. Although Unani system originated in Greece, passed through many countries, Arabs enriched it with their aptitude and experience and the system was brought to India during Medieval period. Unani System emphasise the use of naturally occurring, most herbal medicines, though it uses ingredients of animal and marine origin. Siddha medicine is a traditional medicine originating in Tamil Nadu, India and practised over centuries. The Ministry of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy of the Government of India regulates training in Siddha medicine and other traditional practices grouped collectively as AYUSH. Practitioners are called siddhars (vaithiyars in Tamil), and may have formal training with advanced degrees, such as BSMS (Bachelor in Siddha Medicine and Surgery), MD (Medical Doctor, Siddha) or Doctor of Philosophy (PhD). The Central Council of Indian Medicine, a statutory body established in 1971 under AYUSH, monitors education in areas of rural Indian medicine, including Siddha medicine.

In rural India, siddhars have learned methods traditionally through master-disciple relationships to become local "healers". Siddhars are among an estimated 400,000 traditional healers practicing medicine in India, comprising some 57% of rural medical care. Siddha practitioners believe that five basic elements – earth, water, fire, air, sky – are in food, "humours" of the human body, and herbal, animal or inorganic chemical compounds, such as sulfur and mercury, used as therapies for treating diseases. The Indian Medical Association regards Siddha medicine degrees as "fake" and Siddha therapies as quackery, posing a danger to national health due to absence of training in science-based medicine. Identifying fake medical practitioners without qualifications, the Supreme Court of India stated in 2018 that "unqualified, untrained quacks are posing a great risk to the entire society and playing with the lives of people without having the requisite training and education in the science from approved institutions.



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#### History

Siddha is an ancient Indian traditional treatment system which evolved in South India, and is dated to the times of 3rd millennium BCE Indus Valley Civilization or earlier. According to ancient literature of Siddha, it is said that the system of this medicine originated from Hindu God Shiva who taught it to his consort Parvati. Parvati then passed it on to Nandi and Nandi taught about it to nine Devtas. Most Siddha medical practitioners are traditionally trained, usually in families and by gurus (teachers). When the guru is a martial arts teacher, he is also known as an ashan. Traditionally, it is taught that the siddhars laid the foundation for this system of medication. Siddhars were spiritual adepts who possessed the ashta siddhis. Nandhisar is considered the first siddha and the guru of all siddhars [dubious – discuss].

#### Concept of disease and cause

When the normal equilibrium of the three humors — Vaadham, Pittham and Kapam — is disturbed, disease is caused.[dubious – discuss] The factors assumed to affect this equilibrium are environment, climatic conditions, diet, physical activities, and stress. Under normal conditions, the ratio between Vaadham, Pittham, and Kapam are 4:2:1, respectively. According to the Siddha medicine system, diet and lifestyle play a major role in health and in curing diseases. This concept of the Siddha medicine is termed as pathiyam and apathiyam, which is essentially a rule based system with a list of "do's and don'ts".

#### Herbalism

The herbal agents used by the siddhars could be classified into three groups: thavaram (herbal product), thadhu (inorganic substances) and jangamam (animal products). The thadhu agents are further classified as: uppu (watersoluble inorganic substances that give out vapour when put into fire), pashanam (agents not dissolved in water but emit vapour when fired), uparasam (similar to pashanam but differ in action), loham (not dissolved in water but melt when fired), rasam (substances which are soft), and ghandhagam (substances which are insoluble in water, like sulphur).

#### Siddha today

The Tamil Nadu state runs a 5.5-year course in Siddha medicine (BSMS: Bachelor in Siddha Medicine and Surgery). The Indian Government also gives its focus on Siddha, by starting up medical colleges and research centers like National Institute of Siddha and Central Council for Research in Siddha. Commercially, Siddha medicine is practiced by siddhars referred in Tamil as vaithiyars.

## The principles of treatment in Siddha medicine

According to traditional Siddha thinking, a physician must be knowledgeable in alchemy, astrology, and philosophy; he must be able to apply intuition and imagination; he must not seek fame or fortune from healing; he must not treat a patient before a proper diagnosis has been reached; and he must use only medicines that he has prepared himself. Treatment and pharmaceutics are the two areas where Siddha differs consid- erably from Ayurveda. Like Siddha Yoga, the principle aim of Siddha medicine is to make the body perfect and not vulnerable to decay, so that the maximum term of life can be achieved. Like Ayurveda, Siddha places emphasis on posi- tive health, so that the object of the medicine is disease-prevention. Beyond this fundamental agreement between the two systems, Siddha differs consider- ably from Ayurveda. Siddha has developed expertise in five particular branches of medicine: gen- eral medicine, paediatrics, toxicology, ophthalmology, and rejuvenation, while traditional Ayurveda lists the following eight branches of medicine: general medicine, paediatrics, surgery, treatment of ailments above the neck, toxicol-ogy, treatment of mental disorders due to seizure by evil spirits, rejuvenation- therapy, and potency-therapy. Whereas Ayurveda prescribes a therapeutic regi- men involving the "five purifying actions:" emetics, purgative, enemas, blood- letting and errhines, Siddha employs only purgation.





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## CONCLUSION

Unlike Ayurveda, which has a long and detailed textual tradition in Sanskrit from around the beginning of the Common Era, Siddha medicine's textual history in Tamil is vague and uncertain until about the 13th century C.E., when there is evidence of medical treatises. Most of the knowledge about Siddha medicine comes from modern-day practitioners, who often maintain a histori- cally unverified development of their own tradition and who because of the upsurge of Tamil pride tend to make fantastic claims about the age and impor- tance of Siddha medicine vis-à-vis its closest rival in India, Ayurveda. Based on the evidence thus far marshalled by means of written secondary sources and the reports of fieldworkers in Siddha medicine and informed by my own observations, it would appear that Siddha and Ayurveda share a com- mon theoretic foundation, but differ most strikingly in their respective forms of therapeutics. This would tend to suggest that the original form of Siddha medicine consisted principally in a series of treatments for specific ailments. To these therapeutic measures was added a theoretical component based among others on Ayurveda and perhaps also Unani in the form of diagnosis by means of pulse and urine, which could well have been Ayurveda's source for the same means of diagnosis. The same pattern of medical development, which involves practice followed by theory, may also apply to other forms of Indian medicine, beginning with Ayurveda itself and including the more recent Visha Vaidya tradition of Kerala. The core of Siddha medicine is its alchemy, whose funda- mental principles conform to the alchemical traditions of ancient Greece and China, and of Arabic alchemy. It would, therefore, seem possible that both Siddha and Ayurvedic alchemy might well have derived from one or a combination of these older traditions. Further investigation into each system in relationship to Indian alchemy could reveal important connections between Indian and other systems of alchemy and medicine.

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**RESEARCH ARTICLE** 

# A New Methodology for Software Reliability Based on Statistical Modeling

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## ABSTRACT

Reliability is one of the computable quality features of the software. To assess the reliability the software reliability growth models (SRGMS) are used at different test times based on statistical learning models. In all situations, Tradational time-based SRGMS may not be enough, and such models cannot recognize errors in small and medium sized applications.Numerous traditional reliability measures are used to test software errors during application development and testing. In the software testing and maintenance phase, however, new errors are taken into consideration in real time in order to decide the reliability estimate. In this article, we suggest using the Weibull model as a computational approach to eradicate the problem of software reliability modeling. In the suggested model, a new distribution model is suggested to improve the reliability estimation method. We compute the model developed and stabilize its efficiency with other popular software reliability growth models from the research publication. Our assessment results show that the proposed Model is worthier to S-shaped Yamada, Generalized Poisson, NHPP.

Keywords: Softwarereliability, Software Reliability Growth Models, Testing, Statistical dependencies

## INTRODUCTION

Software-based systems play a important role in this modern world. In the future, the reliance on software systems will increase exponentially. In such circumstances, these software systems should work accurately. The anticipation of a user community of any kind of software system is only one that is nothing more than software that is of very





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high-caliber. The meaning of high-caliber in this context is: "The software should do what it should do, and it should not do what it should not do." According to this high-caliber meaning, both Dos and Don should be concentrated.

To have better knowledge of software quality, the various factors that inspire software quality should be reviewed. The factors influencing software quality are usability, performance, maintainability, reliability, etc. In order to deliver the software of high-calibre, we need to improve the level of quality factors. In this view, software quality can be increased by improving the reliability of the software. The present work inspects the reliability of software under various software quality factors. The reliability of the software can be stated as the chance that it will work successfully in a certain environment for a certain period of time. Early Software Reliability Models (SRGM) represents the reliability growth during the test phase and to estimate future failure time of occurrence many of these Srgms have been proposed as parametric [1–14] and nonparametric [15–18] models. Traditional SRGMs area unit on the idea of the principle that the mean depends on the model follows either exponential growth [1, 3], or s-shaped growth [2, 11] or each [4–8]" [23]. The sole purpose of SRGM is to create a software quality at a very low cost in a fair duration with endeared reliability. In software development process reliability is one of the significant capacities. The reliability of the software is essentially distinct as the probability of a predictable over quantified operation time interval. It would be very significant to know the probability of failure free course of action of a software system for a fixed period of time [10].

To increase the software measure of reliability Several software models are used and it can be classified into two levels namely prediction and estimation models. These two techniques are based on the supervision and assembling of failure data and the determination with statistical hypothesis. At first, using the prediction model, software reliability can be estimated at first in development step and amendments can be done to advance reliability [10]. The other is to estimate the factor values based on measured or assessed data containing random information [10]. Software dependability models are mainly of two kinds: one is with density defect [8] and second one is with improving software reliability [9]. First kind of model observe models so as to make an effort to estimate software reliability based on design parameters and use implementation property such as nested loops number of rows, input / output Estimate the number of software errors present [23]. The second types, software reliability growth models, are used on models that try to estimate the reliability of software based on test data[23]. These models seek to show the relationship between fault detection data and well-known mathematical function such as Exponential and logarithmic functions [23]. The relevancy of these models relies on the level of correlation between the tests In general, to the extent of the software application these models are symbolize on escalating qualitative approach [10]. the reliability of software mainly focused on outcomes like failures and faults ignore the software development process. However, the complexity is decreased and an suitable plan is prepared and new methods are brought in , which are applied in some classes. So we have to select the correct model that suits our required case[10]. In addition, the modeling outcomes can't be acknowledged and applied blindly[10]. In this article, we suggest a reliability model based on software prediction. This article is well thought-out as follows: Section II deals with NHPP (Non homogeneous poission process). In section -3 NASA data set. Section 4 Least square estimation, section 5 the software reliability model based on Weibull distribution is highlighted. Conclusion of article in section VI.

#### Non homogeneous poission process (NHPP)

A non-homogeneous stochastic Poisson process is a process with the parameter  $\lambda$  (t) It demonstrates several random phenomena, including predicting forecasts for a certain value. This process is an addition of this model where  $\lambda$  (t) can be a stochastic process. The Nonhomogeneous poission process model consists of figuring out an average significance task to point towards the projected number of failures







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#### Data set

In this case study, we classify the model on KC2 dataset from NASA and the failures are projected accurately. The failure data acquired is tested for correctness using Specificity, Sensitivity and F-measure. The original dataset of KC2 and its taxonomy process by Gaussian Mixture Model are existing table-1 dataset and the graph.

#### Least square estimation method

Least squares parameter estimation involves the finding out of unknown variables during a specified solution. The function of knowledge is very important. The best technique of method of least squares match could also be a quite common approach for decreasing the total of squares of residuals, a residual being the distinction observed value and therefore the appropriate value provided by a model. The linear technique of statistical procedure drawback pans move into multivariate analysis.during this method, statistical inference to failure data obtained during testing or operation is put into practical use the formula which is given by least square estimation is table 2 Least square estimation

#### Software reliability model based on Weibull distribution and Experimentation

In this method we have created a new statistical method based on weilbul distribution and the formula for the estimate the PDF is presented below.  $f(x) = \sum_{x=0}^{1} \frac{1}{2\pi} e^{-(\frac{x-a}{b})(\mu-\sigma)}$  (1) The values of a,b are estimated using the least square method and the values of  $\mu$  and  $\sigma$  are estimated from the dataset.

## **EXPERIMENTATION**

Two data sets are considered for the experimentation table 3 estimation failures. Each of the error values are given to the model to estimate the probability density functions. Determination of fitness rate. to calculate fitness measure A normalized RMSE (Root Mean Square Error) is selected . it is also known as standard error and standard regression error. A Root mean square error measurementnearer to zero means better fit. The equation responsible for calculating the standardized RMSE is

NRMSE  $=\frac{1}{n}\sqrt{\left[\frac{1}{n}\sum_{i}^{n}(xi-yi)^{2}\right]}(2)$ 

where n: is the no of data points. x: be the i th point of the observed data (original data). y: be the PDF The methodology is tested against productivity based on MSE and metrics such as sensivity and specificity. "We calculate and balance the goodness of fit (GoF) act of the proposed model using NRMSE" [22]. to calculate the square of the distinction among the real and expected values NRMSE is used. The smaller NRMSE indicate the smallest adjustment error and better performance in table 4 NRMSE for test data. Sensitivity, Specificity, and F-measure are used to test the productivity of the model. and the values obtained are tabulated in Table 5

## CONCLUSION

Software reliability is vital in this article we suggested a software reliability growth model based on Weibull distribution. To estimating and monitoring software reliability the model is mainly used, which is viewed as a calculate of software quality.. Equations to find the maximum likelihood estimates of the parameters based on interval domain data are created. The method is tested against two data sets. We come to conclusion that our method of estimation and the control chart are giving a positive recommendation based on MSE and metrics based on sensivity and Specificity. Thismodel is a simple way for validation and for practitioners of software reliability is very suitable. The methodology used in this paper is a lot better than the methodology used by Xie et al [2002]. Therefore, for an early detection of software failures we may come to conclusion that this model is the appropriate choice





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#### Table 1. Data set

Test Time (Weeks)	Estimated Failures
1	75
2	81
3	86
4	90
5	93
6	96
7	98
8	99
9	100
10	100
11	100
12	115
13	120
14	123
15	130
16	135
17	139
18	143
19	150
20	155
21	160
22	163
23	170
24	176
25	179
26	182
27	197
28	210
29	219
30	221

#### **Table 2.Least square estimation**

Dataset #	а	В
1	31.524466	0.029012
2	23.655141	0.026521

#### **Table 3.Estimation Failures**

Test Time	Estimated Failures	PDF
(weeks)		values
1	75	0.02186
2	81	0.02124
3	86	0.03264
4	90	0.03787
5	93	0.04882
6	96	0.05267
7	98	0.05989
8	99	0.06176
9	100	0.06878
10	100	0.06776
11	100	0.07251
12	115	0.07682
13	120	0.07987
14	123	0.07876
15	130	0.08962





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16	135	0.008182
17	139	0.04156
18	143	0.05687
19	150	0.09247
20	155	0.09848
21	160	0.098415
22	163	0.09967
23	170	0.010892
24	176	0.010898
25	179	0.035678
26	182	0.05464
27	197	0.07856
28	210	0.06872
29	219	0.07876
30	221	0.09652

#### Table 4.NRMSE for test data

Root Mean Square Error	MSE		
Normalized Model	RMSE	Normalized RMSE	
Yamada	22.7066	0.5677	
Poisson 23.1365	23.1365	0.5784	
NHPP	23.7988	0.5950	
Raleigh Distribution	24.2316	0.5897	
Proposed method	16.342	0.4123	

#### Table 5.Senstivity, specificity and F-measure

True Postive	False positive	Specificity	Sensitivity	F-measure
0.96	0.21	0.93.7	0.91	0.93
0.80	0.25	0.89	0.87	0.79



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**RESEARCH ARTICLE** 

# Detection and Validation of Effective Combination of Estrus Specific Faecal Volatile Compounds through the Behavioural Expressions of Male Goat (*Capra hircus*)

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## ABSTRACT

At present there is no practical way to detect estrus other than the sexual behaviours performed by bucks under natural conditions (Rajanarayanan and Archunan, 2004). For domestic animals. it is known that bucks can detect reproductive specific odours and differentiate the estrus and nonestrus phase of does. Recently accepted that the estrus specific olfactory signals produced from body fluids ultimately help the male to detect estrus. An individual animal may produce several volatile compounds from a single source but the detection of exact phase of the does influenced by one compound or a mixture of compounds. Since there is no report in the caprinae faecal pheromones, it is mandatory to identify and analyse the bioactivity of individual volatile compounds in the goat faeces. 1-Octadecanol, Octadecanoic acid, N-Pentadecanol, 1-Tetradecanolare the compounds detected only during the estrus phase of the does The volatile compound assay has been done using gas chromatography-mass spectrometry (SHIMADZU QP 2020) method at Bishop Heber college centralized instrumentation facility LAB Tiruchirappalli - 17 all these volatile compound are mixed in different ratio and tested against the male with non estrus does (dummy) show significance in the rate of flehmen and mounting behaviour of the bucks. The volatile compounds are the derivatives of fatty acid released during the specific time to exhibit the reproductive phase of the does which was influenced by the different physiological factors. the endocrine hormones, neural interaction, innate gene regulation together dictates the reproductive





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maturity and the estrus specificity. But the volatile compounds detected through this research may be putative.

Keywords: Estrus, faecal pellets, volitile compounds, fatty acid derivatives, Flehmen behaviour

## INTRODUCTION

The estrous cycle of non-primate mammals consist of episodic phases viz., pro-estrus, estrus and post-estrus (metand di-estrusthe estrus phase is vital in that females attract males, permit mating, ovulate, ova are fertilized and implantation occurs. Incorrect detection of estrus and out-of-estrus phase mating/artificial insemination results in implantation failure (1). This can be overcome by detecting chemical cues in volatile organic compounds (VOCs), which indicate estrus and communicate social status (2). Present study aimed to detect the best combination of the volatile compounds for the attraction of mal buck

## MATERIALS AND METHODS

#### **Test Animals**

Test Animal : Goat (*Capra hircus*)

#### Scientific classification

Kingdom	-	Animalia
Phylum	-	Chordata
Subphylum	-	Vertebrata
Class	-	Mammalia
Order	-	Artiodactyla
Family	-	Bovidae
Subfamily	-	Caprinae
Genus	-	Capra
Species	-	hircus

Sexually mature healthy female and male were selected in this study. All the animals were examined every day during the study period. The length of estrous cycle were observed in female goat. Regularly cycling virgin female (pro-estrus, estrus, metestrus, diestrus) were used in the experiment. The animals were assessed for three consecutive estrous cycles (day 1 to day 21) by authenticated observers (research personnel and farm owners) in consultation with a Veterinarian, and the intervals between estrus phases were noted.

#### Sample collection

Six does and six teaser bucks of *Capra hircus* were used in the present study for samplecollection and behavioural assay in the form at puthambur, pudukottai Dt, Tamil Nadu, India. The stages of the estrous cycle were carefully determined for twoto three consecutive cycles bysymptoms in female such as vaginal swelling, secretions, restlessness Frequent urination and tail waggingand through assessing the morphological changes in the internal reproductive organs. During the fourth estrous cycle, Faecal samples were collected in all the four phases of estrus cycle using sterilized glass vials by free-catch method. The animals were fed with usual diet (green fodder) and water was availablead libitum. The same diet was provided throughout the study. The period within two to three days before estrus was considered as proestrus and that within five to seven days after estrus aspostestrus. All the samples were labelled, transported on ice to the laboratory, and stored at -20 °C until analysis. The ethical approval is not obligatory for this study, because the samples were collected by non-invasive method, without inflicting any



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distress to the goats.Immediately after collection, the samples were stored and frozen at -20 °Cand analysed by gas chromatography-mass spectrometry (GC-MS)

#### Sample analysis

The samples collected from the particular stage as per the experimental protocol were pooled to minimise the effect of individual variation. dichloromethane was used to extract the compoundsfrom the faeces. The faecal pellets were homogenized with dichloromethane. The homogenized mixture pooled sample was dissolved in dichloromethane (1:1 Ratio) used in the GC-MS QP-2020, (Schimadzu, Japan). for volatile analysis. 2  $\mu$ l of extract was injected into the GC-MS on a 30-m capillary column with a film thickness of 0.25  $\mu$ m (30 mm X 0.2 mm i.d. coated with UCON HB 2000) using the following temperature programme, initial oven temperature of 40°C for 4 minutes, increasing to 250°C at a rate of 15°C for 10 minutes. The area under each peak were used for quantitative calculations. The detection accuracy was about 1ng/peak. The relative amount of each component was reported as the percent of the ion current. The GC-MS were under the computer control at 70- eV. Using Helium as reagent gas chemical ionization was performed. Identification of unknown compounds was made byprobability-based matching using the computer library builtwithin the system such as, WILEY Registry<sup>TM</sup> 95, NIST05 and NIST05s

#### Purchase of synthetic compounds

The bound and unbound compounds were procured (synthetic) from Emerk / USA, LOBA, Mumbai.

#### **Bioassay**

The buck bioactivity was carried out in response to synthetic compounds. The synthetic compounds procured were prepared by dilution with different concentrations between 1-5 ppm. The selected concentration of compounds wasapplied manually onto the genital region of non estrus animals (dummy does) were exposed to male goat for studying courtship behaviours like Flehmen and mounting. Six matured bucks and dummy female goats were selected for the present study. The following experiments were carried out in the present investigation:

#### Selection of effective concentration for bioactivity

To select the effective concentration for bioactivity, several concentrations of the estrus specific compounds were exposed to the buck and various behaviours such as, sniffing, licking, repeated Flehmen, mounting and coitus were recorded. Since the solvent, dichloromethane (DCM), has already been used for GC-MS analysis was selected for behavioural study. The compound was kept and choked with cotton and to be presented in a large Petri plate allowing buck to sniff and lick the synthetic compound as well as control. No females were allowed in the study area. In order to reduce the conditioning. The most effective concentration was noted and the tests were conducted at different periods during six months. The buck's behaviour was observed for a minimum period of 30 min at each presentation Flehmen behaviour: Animal sniffs the genital regions of female and raises its neck, extends its chin and inhales with slightly opened mouth, tongue held in a flat position and upper lip curled so that the nostrils become partly closed. Mounting: An animal mounts from behind or from the side with its forelegs and chest on another animal's back.

## RESULTS

Twenty two different volatile compounds were detected through theGC–MSanalysis of faeces obtained in the proestrus, estrus and postestrus periods (Table 1). Of these, 1-Octadecanol, Octadecanoic acid, N-Pentadecanol, 1-Tetradecanolwere unique in the estrus phase (Fig. 2), while the compounds, 2-Decyloxyethanol Pentadecane, Dodecane, Sulfurous acid, 2-Octyldodecan, Hexadecane, 2-Bromotetradecane, 2-Butenoic acid, Propargyl alcohol were found only in proestrus.(Fig. 1)In addition,the compounds, Phenol, 1,2 Ethanediol, Pyrazine, Nicotyrine, 1H-Imidazole2-Tetradecynal, Cyclotridecanepropanal were found exclusivelyin postestrus.(Fig. 3)2- Propenenitrileis present in both proestrus and postestrus and Octanoic acid present in both proestrus and estrusThe flehmen



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behaviour of bulls was significantly (P < 0.001) higher when exposed to the mixture of four synthetic compounds than that of individual compounds and control sample

## DISCUSSION

The assessment of estrus behaviours was proposed as fundamental for efficient reproductive management of cattle (3). Roelofs et al. (2010) (4) opined that in as much as detection of estrus is pivotal, it remains a hurdle and, therefore, progress of knowledge about reproductive physiology offemales is crucial. Over the period, estrus behaviours were reported as reliable for estrus detection in various cattle breeds (5),(6), (7). Estrus detection is a key factor to achieve reproductive success in farm animals (8). Albeit cumbersome, behavioural expressions are primarily used to detect estrus in cattle. Therefore, the behavioural patterns studied in goat, It is prudent that the above behavioural expressions of cattle are endocrine-dependent, since the hormones play crucial roles in regulating diverse physiological and behavioral processes. For instance, estradiol secretion induces estrus behaviors, and determines the duration of estrus in cattle (8) Hormones, in their part, are excreted through body secretions in detectable quantities (9). Therefore, measurement of hormone levels in body secretions is a noninvasive approach of monitoring endocrine regulation in animals (10) the urinary LH and estrogen levels were significantly elevated duringestrus, which obviously indicates that the animals were approaching ovulation. Similar findingswere reported by (11) and (12), in which urinary oestrogenwas suggested to detect ovulation in horse and buffalo, respectively. So, it was reckoned that endocrine status might also influence urinary biochemical composition. Therefore, we proceeded to measure the biochemical components such as lipids, fatty acids, volatiles in Faeces. For instance, the high lipid content of the tiger urinemakes it as a marking fluid. The urinary lipids help in fixing the volatile compounds for longtime and aid in slow release. The urinary lipid concentration of Bengal tiger was 1-2 mg/mL,(13). The findings in the urine of estrus mice also showed a similartrend (14). The high lipid content in may also produce characteristic smell, whichcould help indicate estrus to their conspecifics. With this backdrop of differing lipidconcentration, Interestingly, reported variation in volatile fatty acids during follicular and luteal phases of menstrual cycle.Particularly, the oleic acid in estrus and post-estrus urine has been reported in urineof estrus buffaloes .The variation in urinary lipids and fatty acids led to the presumption that the urinaryvolatiles may also be altered. So, the attempt had been made to analyze the volatile profiles in the faeces, as these volatiles are often reported as pheromones that favor sexual/social communication. Moreover, volatile compounds were also proposed as candidate biomarkers of estrus in manylivestock animals (15). Previously, targeted analysis has been performed toidentify estrus-specific volatile compounds in the urine of mouse (16), dog (17), blackbuck (18), goat(19), mare (20), cow (21), buffalo(22), and elephant (23). Matching thefindings in these studies, we found unique volatiles in each phase. Moreover, the volatiles that we identified in this study were found to be metabolites/pheromones/putative chemosignalmolecules in other animals.

The result was compared with the finding (13) according to which oleic acid present in estrus urine ofbuffalo, and suggested that it promotes mating behavior in bulls. Likewise, oleic acid, togetherwith the other prominent estrus compounds, accelerated the mounting behavior in low-libidomales, and proved to enhance sperm quality parameters (21). Octadecanoicacid identified was reported in the feces of estrus goats(22). The faeces of the goat revealed a mixture of compounds, such as fatty acid, ketone, alkane, alkene, alcohol, etc., butanoic and octanoic acids, were also found during estrus. Black buck (18) reported that vaginal mucus of estrus cows contain priming pheromones that directlyregulate ovarian function and are involved in estrus synchronization. The present results revealed that the 1-Octadecanol, Octadecanoic acid, N-Pentadecanol and 1-Tetradecanolappearedduring estrus phase, but were not found in the other reproductive phases. Among the compounds identified in estrus faeces, 1-Octadecanol and 1-Tetradecanolhas been detected as (19) Estrus specific urinary signal, Similarly, in the present study the gradual increase reproductive behaviour in bucks were observed (FIG 4, FIG 5, FIG 6) and the Mixture of 1-Octadecanol, Octadecanoic acid , N-Pentadecanolrevealed high incidence of precopulatory





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behaviour (FIG). Behavioural investigations demonstrated that the mixture of all these volatile substances serve as an effective attractant bucks. The neural stimulation created by these volatiles may urge the buck to mount on the female

## CONCLUSION

It is therefore possible that the chemical signals produced from faeces and urine probably combinedly activate the buck and initiation the precopulatory behaviours and successful coitus. Further, the present study suggests that the concoction of volatile substances present in faeces act as chemical communicators the quantitative study of the volatile compound may reveal the ratio of the substance serves as a effective communicator for the reproduction of Goat

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S.NO	NAME	MOL. FR	MOL. W	PR ES	ES	PO ES
1	2- Propenenitrile	C3H2C1N	87	$\checkmark$	×	✓
2	Octanoic acid	C9H18O2	158	✓	$\checkmark$	×
3	2-Decyloxyethanol	C12H26O2	202	√	×	×
4	Pentadecane	C15H32	212	$\checkmark$	×	×
5	Dodecane	C12H24F2	206	$\checkmark$	×	×
6	Sulfurous acid	C13H28O3S	264	√	×	×
7	2-Octyldodecan	C20H42O	298	$\checkmark$	×	×
8	Hexadecane	C16H34	226	✓	×	×
9	2-Bromotetradecane	C14H29Br	276	✓	×	×
10	2-Butenoic acid	C25H34O5	414	✓	×	×
11	Propargyl alcohol	C5H3F3O2	152	✓	×	×
12	1-Octadecanol	C18 H38O	270	×	$\checkmark$	×
13	Octadecanoic acid	C18H36O2	284	×	$\checkmark$	×
14	N-Pentadecanol	C15H32O	228	×	✓	×
15	1-Tetradecanol	C14H30O	214	×	$\checkmark$	×
16	Phenol	C7H8O	108	$\checkmark$	×	$\checkmark$
17	1,2 Ethanediol	C14H14O2	214	×	×	$\checkmark$

#### Table 1:List of Faecal volatile compound detected in different reproductive phase of female





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18	Pyrazine	C4H4N2	80	×	×	✓
19	Nicotyrine	C10H10N2	158	×	×	✓
20	1H-Imidazole	C10H10N2	158	×	×	✓
21	2-Tetradecynal	C14H24O2	224	×	×	✓
22	Cyclotridecanepropanal	C16H27NO4	297	×	×	✓

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Table 2: Bio assay of buck behaviour on Different combination of estrus specific Faecal volatile compounds

S.No	Combination of compounds	Flehmen	Mounting
1	1-Octadecanol (1)	$3.34 \pm 0.14$	$5.15 \pm 0.17$
2	Octadecanoic acid (2)	$3.26 \pm 0.14$	$4.29\pm0.26$
3	N-Pentadecanol (3)	$3.21 \pm 0.21$	$3.41 \pm 0.17$
4	1-Tetradecanol (4)	$4.03\pm0.11$	$3.23 \pm 0.12$
5	Mixture of 1-Octadecanol and Octadecanoic acid	$4.77\pm0.26$	$5.25 \pm 0.19$
6	Mixture of 1-Octadecanol and N-Pentadecanol	$5.10 \pm 0.19$	$5.44 \pm 0.37$
7	Mixture of 1-Octadecanol and 1-Tetradecanol	$4.12\pm0.32$	$4.89\pm0.19$
8	Mixture of Octadecanoic acid and N-Pentadecanol	$4.36\pm0.16$	$5.52\pm0.19$
9	Mixture of Octadecanoic acid and 1-Tetradecanol	$4.29\pm0.07$	$5.28 \pm 0.23$
10	Mixture of N-Pentadecanol and 1-Tetradecanol	$4.34\pm0.28$	$4.48\pm0.29$
11	Mixture of 1-Octadecanol, Octadecanoic acid and N-Pentadecanol	$4.67\pm0.23$	$5.52 \pm 0.21$
12	Mixture of 1-Octadecanol, N-Pentadecanol and 1-Tetradecanol	$4.94\pm0.13$	$5.02\pm0.49$
13	Mixture of 1-Octadecanol, Octadecanoic acid and 1-Tetradecanol	$5.30 \pm 0.19$	$5.44 \pm 0.37$
14	Mixture of Octadecanoic acid N-Pentadecanol and 1-Tetradecanol	$4.77\pm0.26$	$5.55\pm0.19$
15	Mixture of 1-Octadecanol, Octadecanoic acid , N-Pentadecanol and 1-Tetradecanol	$7.52 \pm 0.13$	$7.13 \pm 0.34$
16	Phenol (control)	$2.88 \pm 0.09$	$3.49 \pm 0.08$







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FIG 7 : comparison of Reproductive Behaviour of buck between mixture of allestrus specific volatile compounds and control (phenol)



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**RESEARCH ARTICLE** 

# Medical Images Segmentation using for Haar Wavelet Techniques

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## ABSTRACT

Recently image segmentation has become one of the important tools to be used in the field of medicine and natural science. Nowadays, the uppermost problems in the computer vision system are truncated contrast and low quality of the images in the medical field. Haar Wavelet method is ideal for dealing with the treatment of such insecurity in the segmentation process. It takes up much less storage space and transmits faster electronically without reducing the resolution. This work's main objective is the concept of the Haar wavelet technique applied for the segmentation of dark bands in chromosome image. After different enhancement weights, the output chromosome image coefficients of high quality and preserves the original image's edge property efficiently.

Keywords: Chromosome, Haar Wavelet, Medical images, Enhancement, Dark bands.

## INTRODUCTION

Mathematical techniques can take so many forms but are not limited to medical systems, statistical methods, differential applications, and dynamical theoretic models. In general, mathematical models may contain logical illustrations as far as logic is concerned. Mathematical representations are applied not only in the ordinary life sciences such as community science, microbiology, earth science, weather casting, arts, and all engineering directions.

The first Haar Wavelet theory was 1910 on initiated and independently developed by Haar. The Haar theory and application have been modernized and applied to various sciences, medical and engineering applications. Nowadays, Haar Wavelets have been used extensively for image processing and signal processing in communications. Chromosome studies are utilized in the general genetics clinic to identify a reason for formative postponement/mental impediment, cell division, congenital disabilities, dysmorphic features, and autism.





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Chromosome in metaphase can be recognized utilizing special staining. Techniques called banding. A band is characterized as a piece of the chromosome, which is unmistakably recognizable from its adjacent sections by seeming darker or more splendid with all the more banding procedures. The chromosomes are pictured as comprising of a ceaseless arrangement of bright and dark bands. In this regard, the proposed model is effectively executed, utilizing the chromosome image to improve the medical field investigation.

The paper's fundamental point is to decide the dark bands in chromosome pictures, viably using Haar Wavelet calculation, and show the precision by applying it to some picture chromosomes. The paper is structured as follows: Section 2 discusses the literature survey, Section 3 illustrates the Haar Wavelet properties, Section 4 deals with the methodology, Section 5 shows the results and comparison followed by the conclusion.

#### LITERATURE SURVEY

The focus is given to many papers published related to Haar wavelet and medical image processing; The experimental analysis and result: Sivasubramanian et al. [15] proposed an Enhanced Adaptive Kernelized FCM algorithm for color image segmentation. This technique is superior to other methods in terms of evaluation metrics with less computational overhead. Avinash and Priyanka [2] proposed a Modified fast Haar Wavelet transform algorithm to reduces the calculation work and image compression. Jagadees et al.[7] investigated medical image fusion process which deals with enhancing multiple images like CT scan, MRI scan fuses them into a single or multiple imaging modalities by reducing randomness in them using wavelet transform technique proved time taken for the entire process is approximately less than one and a half second and input image without reducing the resolution of the final image. Roopali et al.[14] proposed the Medical color image enhancement method using wavelet transform and distinction stretching technique displayed medical image is decomposed and enhanced an image which conserves its edge features effectively with high quality. Jaffar and Hemachandran[6] had done wavelet transform and its applications in digital image processing. Some of the discrete wavelet transform equations are described, and review was conducted to study the different suitable areas of wavelet transforms.

Pankaj and Rekha [10] done a survey image denoising using various wavelet transforms; many researchers have worked over wavelet transform based noise removal techniques for images. It presents a vast scope for readers to understand the usefulness of these techniques. Abdulaziz Saleh and Salem Saleh [1] introduced the adaptive median filter method for speckle noise in the medical image and showed experimental results and compared mean filter, median filter, adaptive median filter applied in the four types of image and compared the adaptive median filter method results. Yadvendra and Amit [16] used a fusion algorithm based on wavelet transform, a practical approach in image fusion area scheme based on new wavelet coefficients. From the previous related works, many techniques are applied and experiment by various authors Bhavana and Krishnappa [3], Guihong et al.[5], Gayathri and Kuppusamy [4], Kanisetty and Hima [8].

#### PROPERTIES OF HAAR WAVELET

Haar wavelets' orthogonal set  $h_i(t)$  is a collection of all side equal waves with a scale of ±1 in some intervals and zeros elsewhere. In general

$$h_n(t) = h_1(2^j t - k)$$
, Where  $n = 2^j + k$ ,  $j \ge 0, \ 0 \le k < 2^j, n, j, k \in \mathbb{Z}$  (3.1)

The function y (*t*), which is square integral in the interval [0, 1) can be extended in a Haar series with more number of terms





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(3.2)

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$$f(t) = \sum_{i=0}^{\infty} p_i h_i(t)$$
, with  $i = 2^j + k$ 

Where  $p_i = 2^j \int_0^1 f(t) h_i(t) dt$  the Haar coefficients  $j \ge 0, \ 0 \le k < 2^j, t \in [0,1)$ 

The error is minimized  $\varepsilon = \int_{0}^{1} \left[ f(t) - \sum_{i=0}^{m-1} p_i h_i(t) \right]^2 dt$ , Where  $m = 2^j, j \in \{0\} \cup N$ 

If f(t) is a piecewise constant or approximated as a piecewise constant, then the sum in Eq. (3.2) will be terminated after *m* terms. That is

$$f(t) \approx \sum_{i=0}^{m=1} p_i h_i(t) = P_{(m)}^T h_{(m)}(t), \qquad t \in [0,1)$$
  
$$p_{(m)}(t) = [p_0 p_1 \dots p_{m-1}]^T, \quad h_m(t) = [h_0(t), h_0(t), \dots, h_{m-1}(t)]^T$$
(3.3)

Where "T" notation represents inversion, the subscript *m* in the parentheses denotes their dimensions,  $P_{(m)}^T h_{(m)}(t)$  which means the truncated sum. The integration of the Haar wavelets can be expressed in the following forms.

$$\int_{0}^{t} h_m(\tau) d\tau = \sum_{i=0}^{\infty} P_i h_i(t)$$

It abbreviates to the  $m = 2^n$  terms in the Eq. (3.3), then integration is done by the vector multiplication and this Haar series can be obtained with Haar matrix.

$$\int_{0}^{1} h_{(m)}(\tau) d\tau \approx E_{(m \times m)} h_{(m)}(t), \qquad t \in [0,1)$$

For different standards of *m* we can get the Haar square matrix. Then Haar matrix and Inverse Haar Matrix contain so many zeros, let us express,  $\hbar_{(m)}(t)\hbar_{(m)}^{T}(t) \approx M_{(m \times m)}(t)$ , and  $M_{(i \times 1)}(t) = \hbar_{0}(t)$  sustaining

$$M_{(m \times m)}(t)c_{(m)} = C_{(m \times m)}\hbar_{(m)}(t)$$
 and  $C_{(1 \times 1)} = c_0$ .

### PROPOSED METHODOLOGY Haar Wavelet Image Processing

The proposed new methodology for image compression for measurement and the background details of the image compression and how to compressions in images describe. Haar Wavelet transform is a mathematical tool that converts the original signal or image into different analysis and processing domains. The Haar wavelet transform is one of the space domains to a local frequency domain. Recently, Haar wavelet grown the significant attention many fields, more attention in real life image processing and the real-life medical images. The image compression can be implemented in seven steps, as shown in the block diagram of operating systems. The Haar Wavelet decomposes each image into two components: the average, another called the difference. Input images are grayscale and color medical images. The input images are Low pass level filter L(x, y) and High pass level filter H(x, y) in binary element matrices' coefficient. Transform the given input image in the rows and columns. The binary matrices L(x, y) and H(x, y) to generate the sub-images as follows LL. (x, y), (x, y) LH, HL (x, y), HH (x, y). The LL (x, y) the class contains the average image material according to the low-frequency band with the different decomposition





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The sub-images LL (x, y), (x, y)(x, y)(x, y) LH, HL, HH, which contains directional rows, columns, and diagonal (horizontal, vertical, and diagonal) information of the input image due to the angle. The inverse Haar wavelet transform is used to reconstruct the low-level pass filter images and high-level pass filter images. The altered image data factors are the low-level frequency pass strainer results, although the detail coefficients are the results of the high-level frequency pass strainer. This Haar Wavelet mathematical tool can detect the resident feature in medical image processing.

Instruction to compute the image effectiveness and density rate of the image compression technique commonly used metric, it is required an equation that can calculate the difference between the recovered and the input images. The three equations are given for this process one is called Mean Square Error (MSE), the second is called Root Mean square error (RMSE), and the third is called Peak signal Noise Ratio (PSNR) respectively, the image of size rows (r)  $\otimes$  columns (c)

$$MSE = \frac{1}{rc} \frac{r - 1}{\sum} \sum_{x=0}^{r-1} (f(x, y) - f(x, y))^{2}$$
$$MSE = \frac{1}{rc} \frac{\sum_{x=0}^{r-1} \sum_{y=0}^{c-1} (f(x, y) - f_{enh}(x, y))^{2}}{(1 - 1)^{2}}$$

PSNR = 10 log 
$$\frac{(255)^2}{MSE}$$

#### Algorithm

The proposed Haar Wavelet image segmentation algorithm contains the following steps:

**Step 1:** Read an input image:

Step 2: Check the dimension.

**Step 3:** Separate the color components of the binary matrix and noise removal.

Step 4: Apply Haar Wavelet along row and column-wise on the entire matrix of the image.

$$C_{n} = \frac{\underset{4n-3}{l} + i}{\frac{4n-3}{4} + i}_{4n-1} + i}_{4n-1}, n = 1, 2, 3 \dots \frac{N}{4}$$
$$H_{n}^{-1} = \begin{cases} \frac{(i_{4n-3} + i_{4n-2}) - (i_{4n-1} + i_{4n})}{4}, n = 1, 2, 3 \dots \frac{N}{4} \end{cases}$$
Here N= signal length

Step 5: Output of the Enhanced imageStep 6: Compute MSR, RMSE, and PSNRStep 7: Validate the enhancement image output or go to step 4.

## EXPERIMENTAL AND DISCUSSIONS

This section verified application has been investigated with different inputs chromosome images and the results analyzed for its performance and exactness. Here showed two discrete chromosome images are taken as the input image for the proposed method. Haar Wavelet technique is applied in the chromosome images by using Matlab





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software. To estimate the efficiency of the recommended process, the Haar Wavelet algorithm is established to support a numeral of images. The investigational results are shown for chromosome images given in Figure 4(i).

The weight function in Haar Wavelet transforms logic supports in grouping the parallel pixel strength values organized for the image. The final output generally depends on the weight values used in the segmentation image of dark bands in chromosomes. This weight value function improves the proposed method's performance and benefits in solving the problem related to concentration in homogeneity. It enhances the concentration of the dark region in chromosomes. Then Haar Wavelet is applied to the output of the membership function for removing the dark bands in chromosomes. The output of the weight function for the chromosome image is shown in figure 4(ii). The final output of the Haar wavelet process for the chromosome is shown in figure 4(iii), respectively. When give the different weight values of h lies between the interval 0.1 and 0.9, the segmentation of dark bands is attained successfully. When the weight values above one and less than zero, the segmentation output is distorted. The output for the weighted function and Haar process on varying h for chromosome is shown in figure 5.

## **CONCLUSION**

This proposed Haar Wavelet algorithm is devoted to studying the multi-resolution approach to this problem and computationally efficient algorithm for various chromosome image compression techniques. It is more straightforward and easy to implement the Haar Wavelet technique in the natural science and medical science field. The Haar wavelet technique for the segmentation of dark bands in chromosome image provides new potential for effectually segmenting chromosome and calculation time. This method output chromosome image after different enhancement weights coefficients of high quality and efficiently preserves the original image's edge property

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**RESEARCH ARTICLE** 

# Incidental Prostate Cancer among Patients with Benign Prostatic Hyperplasia Undergoing Transurethral Resection: A Hospital-Based Retrospective Study

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## ABSTRACT

Benign Prostatic Hyperplasia (BPH) has been known to increase the risk of urological cancers. The incidental prostate cancer frequency varies globally, as several influencers are altering the identification and malignancy in the Transurethral Resection of Prostate (TURP) specimens. This study aimed to investigate the frequency of incidental prostate cancer among patients with BPH undergoing transurethral resection. This retrospective, single-center study involving histopathological examination of TURP specimens among the BPH patients undergoing transurethral resection was conducted at Behram Medical Center Kohat during January 2018 to April 2019. All BPH patients between 41 to 100 years of age were enrolled while those with diagnosed prostate cancer were excluded from the study. The age and weight of the resected specimens were recorded for each case and the malignancy was denoted using Gleason's scores. Data was analyzed using SPSS Version 22.0. A total of 100 samples were studied as per the inclusion criteria. The incidence of prostate cancer in the study group was 13%. Out of these, 7% had high-grade prostate cancer, 3% had low grade 2% followed by intermediate grade favorable and unfavorable prostate cancers. The age group 61 to 80 years displayed a maximum frequency of incidental prostate cancer. There was a significant association between age and incidental prostate cancer (p = 0.000) whereas the resected specimen weight had an insignificant correlation with the incidence rate of prostate cancer. Hence the incidence rate was higher among thelow volume prostates weighing < 20 gm (p=0.286). The occurrence of incidental prostate cancer among BPH patients undergoing TURP was found to be 13%, indicating a significant risk of prostate cancers among patients with BPH.





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Moreover, the incidence rate was more pronounced among patients aged 61 to 80 years specifying the positive correlation between age and incidental rate.

**Keywords:** Benign Prostatic Hyperplasia (BPH), Incidental Prostate Cancer, Transurethral Resection of Prostate (TURP)

## INTRODUCTION

BPH is a common age-related disease resulting in non-malignant enlargement of the prostate [1]. The condition affects more than 70% of the male population aged 70 years or older [2]. Though the condition itself is benign but it affects the patient's quality of life (QoL) and causes lower urinary tract symptoms (LUTS) [3]. It can lead to several other health issues that are comparatively fatal such as incidental prostate cancer and bladder cancer, which are common identification on TURP specimens of the BPH patients [4-5]. The association between BPH and prostate cancer is not fully understood, several epidemiological studies have investigated the risk of prostate cancer among patients with BPH. Although, it is been recognized as one of the leading causes of cancer deaths among men [6] but the literature suggests varying outcomes and the findings are not very consistent [8-9]. The incidental prostate cancers are clinically identified during TURP which targets the Transitional Zone (TZ) of the prostat [10]. Prior to the post-prostate-specific antigen (PSA) testing era, the incidental prostate cancers were mostly detected at the time of TURP [10]. However, the diagnostic value of the TURP specimen has been questioned after the PSA introduction. Though the rate of incidental prostate cancers is high but the oncological outcomes have poorly been studied [11]. The histological examination of the TURP specimens involves embedding and analyzing of the larger part of the specimen. Based on the recommendations by the American College of Pathologists, the specimens weighing  $\leq$  12 g could be entirely for examination while those weighing > 12 g, it is recommended to use the initial 12 g with the addition of 2 g of tissue for every 10 g of the specimen [12-13]. Newman and his colleagues suggested that it is essential to assess the entire specimen ensuring a high rate of identification of prostate cancer [14]. While a few studies have indicated 90 to 100% of the detection rate with partial assessment [15-16]. There has been a long unending debate on the assessment of TURP specimens and the management of BPH and prostate cancer. It is essential to upgrade the knowledge of physicians regarding the management of BPH and urological cancers so that effective measures could be taken for prevention and early treatment could be provided in case of incidental cancers [17]. It has been found that early prostatectomy is associated with reduced mortality risk [18], a follow-up study indicated that the overall reduction in the mortality rate was 25.5%, death rate reduction up to 15.8% among men aged  $\leq 65$  years in response to early prostatectomy [19]. Through this study, we aimed to investigate the link between BPH and prostate cancer, assessing the incidental prostate cancer rate among patients with BPH undergoing transurethral resection.

## METHODOLOGY

This retrospective, single-center study was conducted at at Behram Medical Center Kohat during January 2018 to April 2019. The incidences of prostate cancer among the BPH patients undergoing TURP were identified as per the Gleason scores [20]. All patients with diagnosed BPH between 41 to 100 years of age were included in the study. While patients with a pre-operative diagnosis of prostate cancer were excluded from the study. The TURP procedure was performed by experienced consultants under a complete operational setting and the entire procedural conduct was ensured in a single sitting for each individual with BPH. The TURP specimens were examined histopathologically by Consultant Pathologist, cancer grading was determined on the basis of Gleason scores. The Gleason Score has five grade groups, Gleason Score  $\leq 6$  was considered low, 7 (3 + 4) was considered intermediate favorable, Gleason score 7 (4 + 3) was intermediate unfavorable grade cancer and the score of 8 -10 was considered high-grade prostate cancer.



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The data was obtained from the clinical records of an individual patient. Due to limited access, the pre-operative and post-operative data including age, prior diagnosis and incidental prostate cancer, was gathered and used for the study purpose. The statistical analysis was done using SPSS version 22.0, data was presented as percentages. Chi-square test was used to correlate the incidental occurrence of prostate cancer and age, p-value < 0.05 is considered significant.

## RESULTS

A total of 100 patients were identified as per the eligibility criteria, who underwent TURP procedure of the prostate. The patients aged from 41 to 100 years (Mean 69.42  $\pm$  10.15 years). The weight of the resected specimen was < 20 gm among 78% patients while a specimen weighing > 20 gm was resected from 22 % patients. Prostate cancer was identified in 13% BPH patients undergoing TURP procedure, of these 7% had high-grade prostate cancer, 3% had low-grade prostate cancer, 2% and 1% were observed with intermediate-grade favorable and unfavorable prostate cancer respectively. Correlating age with the incidental prostate cancer among the BPH patients who underwent TURP Procedure. The highest incidence of prostate cancer was observed among the patients of 61 to 80 years of age (p = 0.000). Of them, 4% of patients had high-grade prostate cancer with Gleason Score 8-10 followed by low and intermediate-grade prostate cancer, while 3% of patients from 81 to 100 years group had high grade and 2% had low-grade prostate cancer. The results of the correlation between the weight of resected specimen and the incidental prostate cancer rate indicated that the incidence was highest (9%) among the resected specimen weight < 20 gm while only 3% among those with > 20 gm weight.

## DISCUSSION

The association of BPH and prostate cancer has been widely studied, suggesting a significant risk of prostate cancer among BPH patients i.e. the risk ratio increases up to 2.9-fold among the patients with BPH [21]. Evidently, the fastgrowing BPH results in high-grade prostate cancer [22]. The incidental prostate cancer was diagnosed among 13% of BPH patients which is consistent with another study showing a similar risk of incidental prostate cancer risk [23]. Another study by Jones et al., suggested, a 14.9% rate of incidental prostate cancer which decreased up to 5.2% in the PSA era [10]. It is evident, that the incidence rate of prostate cancer is more pronounced in the older age group as compared to the younger counterparts [10-24]. The histopathological assessment of the TURP specimen, indicated the presence of prostate cancer among 13.4% young patients while 28.7% older patients [24]. Another study correlating the incidence rate of incidental prostate cancer and age indicated 58.06% of the incidence rate among patients aged 70 - 79 years [10] while no incidence detected among those of 40 to 49 years of age, indicating an agebased increase in the risk of prostate cancer among BPH patients [10]. In contrast, our study indicated the highest rate of incidental prostate cancers among patients aged 61 to 80 years (Table 2). Within this age group, significant high-grade prostate cancer was diagnosed with a Gleason score between 8 to 10. While in comparison, lesser incidences were observed among the patients aged 81 to 100 years. In addition to age, the link between the weight of resected specimens and the incidence of prostate cancer was also investigated. The incidences were higher among the samples weighing < 20 gm (Table 2) but we found no significant association between the two variables (p > 0.05). This is quite similar to another study reporting no association between resected specimen weight and incidental adenocarcinoma prostate (CaP) (p = 0.15) [10]. The findings of the present study suggest that the detection of incidental prostate cancer through TURP specimens is clinically significant. But there are several limitations within this study that need to be considered. The histopathological examination was performed by a single uropathologist increasing the chances of errors and misdiagnosis. Moreover, the serum PSA level is a better indicator of incidental prostate cancer. Therefore, studies focusing on the comparative, comprehensive diagnosis indicating pre-PSA and PSA era to ascertain the differences in the incidence rates are required for better and appropriate assessment.





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## CONCLUSION

In conclusion, the incidental prostate cancer rate among patients with clinically diagnosed BPH being examined histopathologically via TURP was found to be 13% which is consistent with other published studies but the hypothesis needs to be backed up with large-scale comprehensive studies. Age was found to be a positive predictor for the incidence of incidental prostate cancerwhereas the weight of the resected specimen had an insignificant association with incidental prostate cancer. These incidences of prostate cancer would further decrease with better diagnostic tools such as PSA.

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## **CONFLICTS OF INTEREST**

The author(s) declare no conflicts of interest.

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Variables		Age Groups			D volvo
		41 to 60	61 to 80	81 to 100	r-value
	High Grade	-	4%	3%	
Prostate	Intermediate Grade (Favourable)	1%	1%	-	0.000*
Cancer	Intermediate Grade (Unfavourable)	-	1%	-	0.000
	Low Grade	-	1%	2%	

#### Table 1: Age-specific incidence of prostate cancer in autopsy specimens

*\*p-value < 0.05 is considered significant.* 

#### Table 2: Resected weight-specific incidence of prostate cancer in autopsy specimens

Variables		Resected Weight		D l
		< 20 gm	> 20 gm	P-value
_	High Grade	5%	1%	
Prostate Cancer	Intermediate Grade (Favourable)	2%	-	0.286
	Intermediate Grade (Unfavourable)	1%	-	
	Low Grade	1%	2%	

*\*p-value < 0.05 is considered significant.* 



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Low Grade	3%	
Intermediate Grade (Unfavorable)	1%	
Intermediate Grade (Favorable	) 2%	
High Grade	7%	
Benign Prostatic Hyperplasia		87%
	0% 20% 40% 60%	80% 100%

Figure 1: Incidence of Benign Prostatic Hyperplasia (BPH) and Prostate Cancer among the studied population







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**RESEARCH ARTICLE** 

# Vital Evaluation on Status of Coir Industry in India

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## ABSTRACT

The Coir Industry is one of the most important traditional small scale industries. It converts coconut husk, a waste, into wealth. This industry is crucially important as a source of employment and income for million people. It occupies a socially and economically paramount importance in states like Kerala where one third of the villages are coir villages. It is also a fast growing industry in Tamil Nadu, Andhra Pradesh, Karnataka, West Bengal and Orissa. Out of the total coir units, Kerala represents 55.88 percent while the share of Tamil Nadu is 26.51 percent of total industries. USA and China are the major importers of Coir from India. According to the Annual Report 2011-12 of MSMEs shows that up to the year 2010-11, this sector has employed about 732 lakh persons in over 311 lakh enterprises throughout the nation and it is expected to generate additional 100 million jobs in manufacturing sector through an annual average growth rate of 12-14 % in manufacturing sector over the next decade. Thus this article reviews the status of coir industry in India.

Keywords: Traditional, Manufacturing, Economic, Coconut, Coir, Industry




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## INTRODUCTION

The word 'Coir' comes from Malayalam word 'Kayar' or 'Kayaru' which means Cord to be twisted. Coir is the fibre extracted from coconut husk. The coconut producing regions are mainly located in the tropics, particularly in South and South-East Asia and in East Africa; such as, Indonesia, Philippines, India, Sri Lanka, Ghana etc. In most of the Countries the coconut husk is used as fuel or discarded as useless materials and in few countries, coir fibre is used to produce different products like coir yarn, coir mats, carpets, as geo-textile materials, etc. This Industry is the largest traditional cottage industry mainly in the coastal region where other alternative avenues of gainful employment are few. Coir industry is one among the rural industries. Coir Products belong to the genre of cent percent nature friendly and bio-degradable products. Traditionally, the use of coir was limited to the manufacture of floor coverings, cushions, mattresses etc., The coir products have great potential to save scarce non-renewable natural resources which is being realized by customers world over. Coir Geo-textiles, Coir ply, Coir pith Organic Manure, Coir Garden Articles, etc., are the products which can contribute a great deal in respect of environment protection. Coir ornaments are latest addition to the list which are hand crafted and can be promoted as a souvenir. It provides employment to thousands of people who belong to socially and economically weaker sections of the rural population. The industry also has a strong export orientation from the very beginning. This industry plays a vital role in the economic structure of the country as a source of foreign exchange and it has earned foreign exchange of Rs. 1476.04 crores during the year 2013-14. By considering its impact on the rural economy of the coastal regions of South India and its future potentiality, any patronage extended either by the central or the state government would result in strengthening the industry in particular and the rural economy of India in general.

## **Coir Board**

The coir board was established under the Coir Industry Act 1953 for the promotion and development and of the Coir industry in India. The main functions are (a) Promoting exports of coir yarn and coir products and carrying on propaganda for that purpose; (b) Regulating under the supervision of the Central Government the production of husks, coir yarn and coir products by registering coir spindles and looms for manufacturing coir products as also manufacturers of coir products, licensing exporters of coir yarn and coir products and taking such other appropriate steps as may be prescribed; (c) Undertaking, assisting or encouraging scientific, technological and economic research and maintaining and assisting in the maintenance of one or more research institutes; (d) Collecting statistics from manufacturers of, and dealers in, coir products and from such other persons as may be prescribed, on any matter relating to the coir industry, the publication of statistics so collected or portions thereof or extracts therefrom; (e) Fixing grade standards and arranging when necessary for inspection of coir fibre, coir yarn and coir products; (f) Improving the marketing of coconut husk, coir fibre, coir yarn and coir products in India and elsewhere and preventing unfair competition; g) Setting up or assisting in the setting up of factories for the producers of coir products with the aid of power; (h) Promoting cooperative organisation among producers of husks, coir fibre and coir yarn and manufacturers of coir products; (i) Ensuring remunerative returns to producers of husks, coir fibre and coir yarn and manufacturers of coir products; (j) Licensing of retting places and warehouses and otherwise regulating the stocking and sale of coir fibre, coir yarn and coir products both for the internal market and for exports; (k) Advising on all matters relating to the development of the coir industry; (l) Such other matters as may be prescribed.

## METHODOLOGY OF THE STUDY

The study reviews the performance of coir industry by collecting and reviewing the data collected from various websites. The data on number of units, employment and export details were collected from the coir board website. The percentages and averages were calculated for this study.





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## State-wise details of coir units registered under the Coir Industry

The State-wise details of coir units registered under the Coir Industry (Registration) Rules 2008 as on 31.03.2019 were as furnished below in Table 1. Currently 36310.44 lakh husks are utilized for generating fibres. The market value of husks consumed is between Rs. 259.36 crore to Rs. 315.12 crore. It is estimated Rs. 127824.62 lakh husks can be used for fibre generation and estimated market value will be Rs. 913.03 crore to Rs. 1109.34 crore per annum. If the government succeeds to tap the husks, it has the potential to generate additional revenue of Rs. 653.67 to Rs. 794.22 crores per annum. 539815 ton fibres are being consumed in India. The market value of the consumed fibres is Rs. 890.69 to Rs. 1199.16 crore. The utilization of coir fibre stands at 28.41 %. It has the potential to generate revenue of Rs 3135.54 to Rs. 4221.44 crore per annum. With regard to Coir yarn, the country produces 323900 MT Coir Yarn in the 2013-14 while the coir production was reported to be 321701MT in the year 2012-13 and 318900 MT in the year 2010-11. The major coir yarn producing states are Tamil Nadu (131447 MT), followed by Kerala (85317MT), Andhra Pradesh (37416 MT), Karnataka (32541MT), Odisha (1706 MT) and others (35473MT). The industries / units are concentrated in two states i.e., Kerala and Tamil Nadu. Out of the total 15235 units, 7 units are public sector units. The public sector units are found in Kerala (3 units), Karnataka (2), Odisha (1) and Tamil Nadu (1). Although there is an incremental growth but in overall terms, spatial growth has happened in the country and efforts must be taken by the Coir Board to expand the industry in all coconut producing states. Out of the total, Kerala represents 55.88 percent while Tamil Nadu share is 26.51 percent of total industries. Three more states are coming up in the Coir business. They are Odisha (share 5.64 % of total industries), Karnataka (4.40%) and Andhra Pradesh (6.05%). The number of coir industries in other coconut producing states is very less looking at the potentials of the state.

## **Coir Export**

The details on coir and coir products export to major country are furnished in Table 2 Around 35.96 percent of the coir and coir products are export to China followed by USA (14.43 per cent), Netherlands (9.41 percent), South Korea (7.73 percent), United Kingdom (3.23 percent) and Spain (4.87 percent). The major returns are from USA and China and its around 47.27 percent of the total income.

## **Contribution of MSME in Coir Industry**

In the Indian economy, Micro, Small and Medium Enterprises (MSMEs) have a significant role in terms of output, employment generation, contribution to GDP, socio-economic development, export earnings etc. If the MSME industry is compared with big industries some interesting facts can be found out. As per the 3rdAll India Census of MSME, the employment-investment ratio is about seven times of MSMEs compared to big ones. The investmentoutput ratio is better in MSME industry. It is estimated that in terms of value, the sector accounts for about 45 per cent of the manufacturing output and 40 per cent of the total exports of the country. According to the Annual Report 2011-12 of MSMEs shows that up to the year 2010-11, this sector has employed about 732 lakh persons in over 311 lakh enterprises throughout the nation and it is expected to generate additional 100 million jobs in manufacturing sector through an annual average growth rate of 12-14 % in manufacturing sector over the next decade. According to the 4 thAll India Census of Micro, Small & Medium Enterprises report that there are more than 6000 product varieties which are being manufactured by Indian MSMEs Estimated State wise cumulative employment in Coir Sector in India was as furnished below in Table 3. Indian Small Scale Industries (SSIs) are commonly classified under two broad categories: traditional small industries and modern small industries. Industries like, khadi and handloom, coir, handicrafts etc. are classified under this traditional SSI. While modern small scale industries produce sophisticated products such as radio sets, television sets, various electronics control system. The traditional small scale industries are extremely labour intensive industry. Coir is a natural fibre which is extracted from the husk surrounding the seed of coconut and is extremely resistant to rot and salt water. In the beginning, the coir extraction was a domestic industry and probably originated in the coastal system, several engineering products. Mainly this type of industry works as ancillaries to large industries.





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## **Issues with Coir Industry**

It is observed only 28.41% coconut husks are utilized by the coir industry. Considering the seriousness of the issue, the State governments of Tamil Nadu and Karnataka have issued government orders banning the use of coconut husks as a fuel in brick units and similar other units. Other coconut producing States may be asked to follow the initiatives taken by the Governments of Tamil Nadu and Karnataka. The Coir industry has to muster at least 60% of the total coconut husks produced in the country for fibre extraction. Further, there is no scheme available to promote husk collection / extraction. The government may consider coming out with an incentive package. The government with the help of state government may promote to establish Husk Banks in all coconut concentrated districts of the country through PPP mode. Establishment of husk banks is certain to improve the utilization percentages of husks. The study also observed local dealers are the major source for procuring coconut husks by the coir industries. Direct sale of coconut husks to the industries by the farmers is limited to less than one-fourth of the total sale. The government may come out with a plan to directly engage the farmers in husk trade. Their direct engagement will not only help the farmers to earn more money but will also ensure high utilization of husks. Accumulation of Pith even where the de-fibering operations are taken up, is one of the critical gaps due to lack of efforts for utilizing the pith in Lakshadweep, Kerala etc, though successful pith utilization for block making for export purpose has been done in Tamil Nadu. A strategy for disposal of coir pith accumulated in the coir production centers has to be evolved and implemented. Mechanisms must be put in place so as to convert the accumulated pith into useful organic manure or growing medium at the point of production and popularization of coir pith as green house substrates. Coir industry needs higher credit facilities through financial institutions at lower interest rates. The Banks are not forthcoming in providing loans to the coir artisans/entrepreneurs and this has affected the implementation of many schemes of the Govt. of India like REMOT. Therefore, the Banks and other lending institutions may include coir in the priority lending sector and provide soft loans to start coir units. The SLBCs may also make adequate provisions in their annual credit plan for lending to the coir sector and monitored regularly.

## CONCLUSION

The coir industry is one among the traditional rural small scale industry and also a growing division in India especially in Kerala and Tamil Nadu. The states Kerala and Tamil Nadu having more number of registered coir industries in India (82.39 percent). Around 35.96 percent of the coir and coir products are export to China followed by USA (14.43 per cent), Netherlands (9.41 percent), South Korea (7.73 percent), United Kingdom (3.23 percent) and Spain (4.87 percent). The major returns are from USA and China and it's around 47.27 percent of the total income. Also it provides 4.7 lakh and 1.3 lakh cumulative employments in Kerala and India respectively. Even though it is one of the emerging sectors, there are some issues like, low usage of husks for coir production (28.41 percent only), low returns to the farmers because of unavailability of direct government procurement, lack of financial facilities etc. If the above discussed problems are rectified the industry will grow in a better way. Thus coir industry is a high potential industry in export coir and coir products and for employment.

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## Table:1 Major state wise details on coir Industry

Sl. No.	Sl. No. State/UT		Percentage
1.	Kerala	9139	55.88
2.	Tamil Nadu	4335	26.51
3.	Andhra Pradesh	990	6.05
4.	Odisha	922	5.64
5.	Karnataka	720	4.40
6.	6. Others (including 15 states)		1.52
	Total	16355	100

Source: 65th Annual Report (2018-19), Coir Board, India

## Table. 2 Major country wise coir and coir products export details

S. No	Country	Quantity (tonnes)	Percent	Value (Rs. Lakhs)	Percent
1.	USA	142700.47	14.43	69850.40	25.33
2.	China	355641.03	35.96	60514.64	21.94
3.	Netherlands	93015.32	9.41	24543.77	8.90
4.	South Korea	76414.39	7.73	15335.64	5.56
5.	UK	31903.17	3.23	13236.45	4.80
6.	Spain	48115.81	4.87	11949.94	4.33
7.	Others	241205.8	24.37	-	-
8.	Total	988995.95	275790.13	-	-

## Table. 3 Employment details

State	2017-18 (in Nos.)	2018-19 (in Nos.)
Kerala	474590	475077
Tamil Nadu	130862	132443
Karnataka	31159	31325
Andhra Pradesh	54670	55455
Odisha	18135	18421
Others	20965	21071
Total	7,30,381	7,33,792

Source: 65th Annual Report (2018-19), Coir Board, India





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**RESEARCH ARTICLE** 

# Formulation and Evaluation of Preungual Delivery System Containing Eugenol for the Treatment of Onychomycosis

Ms. Flowerlet Mathew<sup>1\*</sup>, Ms. Mini Alias<sup>2</sup>, Ms. Aneeta Varghese<sup>2</sup>, Ms. Bimi Varghese<sup>2</sup> and Ms. Maria John<sup>2</sup>

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## ABSTRACT

The purpose of the present study was to formulate a preungual delivery system of Eugenol containing two different penetration enhancers for the treatment of Onychomycosis and to find out at which concentration of penetration enhancers gave better release as well as to carry out the antifungal testing on the best formulation obtained. Nail lacquer was prepared by simple mixing method using two polymers; ethyl cellulose and eudragit RL100. Preliminary evaluation tests were performed. In-vitro diffusion studies were carried out in Franz diffusion cell using phosphate buffer pH 7.4 and methanol as a medium, whereas the permeation studies were carried out using hooves membrane. The percentage cumulative drug release was determined by UV- Spectrophotometer. The formulation containing 10%w/v of Ethyl cellulose along with 2.5%v/v of Dimethyl sulfoxide showed a good release. From the preliminary evaluations, it was found that the Ethyl cellulose was best for formulating as a lacquer. The formulation showed a zero-order release pattern and Higuchi model for the mechanism of release. The present study reveals that, the Eugenol nail lacquers are a safe topical delivery system for Onychomycosis treatment. The topical therapy is the preferred route, as it avoids the hepatotoxicity related to antifungal drugs when taken orally. Hence this work could be a promising factor for the patients in future, since it is more convincing than the conventional dosage forms.

Keywords: Nail lacquer, Onychomycosis, Preungual drug delivery, Eugenol, Penetration enhancers.





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## INTRODUCTION

Topical delivery is the application of a formulation to the skin directly with the intent of the pharmacological or other effects of the drug to the surface of the skin or within the skin. The nail is a horny structure. Preungual drug delivery system is a system associated with drug delivery through the nail to achieve a targeted drug delivery. Medicated nail lacquers are the formulations used for maximal antifungal efficacy.<sup>[3,4,8,9,12,14,16,19,20]</sup> The preungual delivery system is used to treat the fungal infection of the nail. Onychomycosis is a fungal infection of the nail bed or nail plate. [1, 7, 10, 11, 13, 16, 17] The aim of this work was to formulate a preungual delivery system of Eugenol containing two different penetration enhancers for the treatment of Onychomycosis.

## MATERIALS AND METHODS

## Materials

Eudragit RL100, Glycerine, Propylene glycol, Thioglycolic acid, DMSO, Ethyl alcohol procured from Nice chemicals, Cochin, India. Eugenol purchased from research lab chem. Industries, Mumbai. Ethyl cellulose collected from Himedia laboratories, Mumbai.

## Preparation of Eugenol nail lacquer

Eugenol nail lacquer was prepared by simple mixing method. Where in the eugenol concentration was kept constant. 12 formulations were prepared. The primary formulations a, and b contain the polymer ethyl cellulose and eudragit RL100 respectively. Among these two polymers, the ethyl cellulose shows better film formation. So the ethyl cellulose was selected for further studies. Formulations F1, F2, F3, F4 and F5 contained 10%w/v of ethyl cellulose along with the different concentrations of Thioglycolic acid and Dimethyl sulfoxide (1%v/v to 2.5%v/v) whereas formulations F6, F7, F8, F9, and F10 contained 11%w/v of ethyl cellulose with different concentrations of Thioglycolic acid and Dimethyl sulfoxide (1%v/v to 2.5%w/v). The mixture of eugenol and ethyl cellulose was dissolved in ethanol in the required quantity using a magnetic stirrer at a constant speed. To this solution, Glycerine and Propylene glycol was added and mixed thoroughly at a constant speed. To the above clear nail lacquer, the required amount of penetration enhancer was added and mixed thoroughly.

## EVALUATION OF NAIL LACQUER FORMULATION

## Gloss

The film was visually checked to determine the gloss and compared it with a standard marketed nail lacquer.

## Water resistance

This is the measure of the resistance towards the water permeability of the film. This was done by applying a continuous film on a surface and drying then immersing it in water. An increase in weight was calculated after checking the weight before and after immersion. If the increase in weight is higher then, the water resistance is lower.

## Non-volatile content

The sample was taken in a glass petri dish. Samples were spread equally. The dish was placed in the oven at 105  $^{\circ}$ C for 1hr. The petri dish was removed, cooled and weighed. The difference in weight of the sample after drying was determined that gives the volatile content present. The amount of volatile content was then subtracted from the weight of nail lacquer.



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## Drying time

With the aid of a brush, a sample film was applied on a glass petri dish. The time to form a dry to touch film was noted using a stopwatch.

## Drug content

The drug content of nail lacquer was determined by dissolving accurately 1ml of nail lacquer in ethanol. After suitable dilution absorbance was recorded by using a UV-visible spectrophotometer (UV-1700, Shimadzu, Japan) at 280 nm. Using the slope of the standard curve, drug content was determined. Drug content = (volume taken concentration dilution factor) conversion factor.

#### Measurement of pH

The pH of nail lacquer formulations was determined by using a digital pH meter.

#### Diffusion studies across an artificial membrane

Diffusion studies were performed using an artificial membrane (cellophane). The membrane was soaked for 1hr in the solvent system (phosphate buffer, pH 7.4 and methanol), and the receptor compartment was filled with solvent. Prepared nail lacquer was applied evenly on the surface of the membrane. To avoid the entrapment of air bubbles, the prepared membrane was mounted on the cell carefully. The whole assembly was maintained at own 37 C, and the speed of stirring was kept constant (600 rpm) for 12 hrs. The 5ml aliquot of the drug sample was taken after a time interval of 1hr and replaced by the fresh solvent. Each experiment was replicated at least thrice. The drug analysis was done using a double-beam UV-Spectrophotometer.

#### In vitro transungual permeation studies

In Hooves from freshly slaughtered cattle, free of adhering connective and cartilaginous tissues were soaked in distilled water for 24 hrs. From the distal part of hooves, membranes of about 1-mm thickness were cut. By using Franz diffusion cell, in –vitro permeation studies were conducted. The surface area available for permeation was 1.4. Then prepared nail lacquer was applied evenly on the surface of the nail membrane. The receptor compartment was filled with solvent A (phosphate buffer, pH7.4, and methanol). The whole assembly was maintained at 37 C with constant stirring for 12hrs. 5ml aliquot of drug sample was taken after a time interval of 1hr and was replaced by the fresh solvent A. Each experiment was replicated at least thrice. The drug analysis was done by using a double-beam UV- Spectrophotometer.

#### **Stability studies**

According to ICH guidelines at 40±2°C / 75±5% RH sample was stored in the stability chamber for one month. The samples evaluation studies were conducted for non-volatile content, drying time, gloss and smoothness of flow, water-resistance, and diffusion across the artificial membrane.

#### **Kinetic release studies**

For the determination of drug release kinetics, the in-vitro permeation data was analyzed by zero-order, first-order, Higuchi and Korsmeyer and Peppas equations.

## RESULTS

#### Gloss

The gloss of all nail lacquers was satisfactory when compared to the marketed products. The smoothness of the flow of formulations F1, F2, F3, F4, and F5 was found to be good whereas, for formulations F6, F7, F8, F9, and F10 were showed satisfactory flow property compared to marketed product.





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#### Water resistance

From the water-resistance test, it can be seen that as the polymer concentration increases the water resistance increases and vice versa. As the increase in the weight of nail lacquer film decreases, the water-resistance capacity becomes higher. Formulations F1, F2, F3, F4, and F5 showed lower water resistance as compared to F6, F7, F8, F9, and F10 (fig.1).

#### Non-volatile content

Non-volatile content depends and varies upon the concentration of polymer used (fig.2)

#### Drying time

Drying time for formulations F1 to F10 was found between 83 and 92 seconds. It was found that as the polymer concentration increases from 10% w/v to 11%w/v the drying time increases respectively. The time required for the solvent to evaporate from the more viscous solution is more than the less viscous solution.

#### Measurement of pH

The pH of all formulations was in the range of 6.8 to 7.4, which lies in the normal pH range of the skin. Therefore, it would not produce any skin irritation. There was no significant change in pH values as a function of time for all formulations.

#### Measurement of drug content

The drug content of the formulated nail lacquer was estimated by Spectrophotometrically at 280 nm (table:3)

#### In-vitro drug release

In in-vitro diffusion studies among the formulations F1 to F10, F4 contains the lowest concentration of polymer and the highest concentration of penetration enhancers. The percentage cumulative drug released for all 10 formulations ranged between 62.54% - 94.59%. It was found that as the polymer concentration decreases and penetration enhancer concentration increases the release of the drug increases. With a decrease in the concentration of polymer more sustained release is obtained.

#### *In-vitro* permeation studies

From in-vitro permeation studies, it was found that formulation F5 showed a release of 85.90% at the end of 12 hours. From in-vitro diffusion studies and in-vitro permeation studies, it was found that Thioglycolic acid was proved to a better penetration enhancer as compared to Dimethyl sulfoxide.

## Stability study

The stability study data indicated that the medicated nail lacquer, showed good stability when it was stored at the temperature of  $40\pm2^{\circ}C$  /  $75\pm5\%$  RH.

#### Kinetics of drug release (fig.3&4)

## Higuchi plot for formulation F5

The release from nail lacquer F5 follows zero-order kinetics. The release exponent value of Korsmeyer –Peppas equation for F5 was found to be 0.567(fig.5)

## Determination of the mechanism of release from diffusion exponent (n):

A plot of log (time) Vs log (%CDR) yields slope n, i.e. Diffusion exponent (fig.6). The value of diffusion exponent, (n) for F5 is found to be 0.567.





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## DISCUSSION

The present investigation deals with the design and development of Eugenol Nail Lacquer for the treatment of Onychomycosis. Formulations were subjected to different pre-formulation studies. The drug was insoluble in aqueous medium and soluble in organic solvents. As nail was very difficult to permeate two different penetration enhancers were added to the formulation. Initially, ethyl cellulose and eudragit RL100 nail lacquers were prepared. From this ethyl cellulose formulation was selected as best. So, different concentrations of ethyl cellulose polymer along with different concentrations of penetration enhancers were prepared. Nail lacquers were formulated and subjected to physicochemical studies, In vitro release studies and permeation studies. The pH of all the formulations was in the range of 6.8-7.4, which lies in the normal ph range of the skin and would not produce any skin irritation.In-vitro permeation studies of formulation F5 showed a release of 94.59% at the end of 12 hours. This result concludes that as the polymer concentration decreases and penetration enhancer's concentration increases, the release of the drug increases. With an increase in the polymer concentration, the release rate decreases. The better penetration enhancing effect of thioglycolic acid was attributed to its small molecular weight, the damage caused on the keratin network, and the decrease in lipid content in the dorsal nail layer. This action will loosen the nail structure, allowing eugenol to penetrate easier. The release kinetics data indicates that the release of drug from nail lacquer F5 best fits to zero-order release model because the correlation coefficient values are higher in the case of the zero-order equation and the release from lacquer fits to Higuchi model. The release rate is not depended on the concentration of the drug. The diffusion exponent value indicates Non-fickian transport of drug from the formulation. The stability studies of optimized formulation indicate that there were no significant changes in the evaluation parameters. That means the nail lacquer was stable at storage conditions. In this work, an attempt was made to formulate and evaluate medicated nail lacquer containing Eugenol for the treatment of Onychomycosis. The main objective of this study was to determine the effect of penetration enhancer and polymer concentration on drug release. Advantage of formulating as lacquer was to make use of its depot forming property at the site of action and better patient compliance. The above results show that the nail lacquers are a safe topical delivery system for Onychomycosis treatment. Hence, a medicated nail lacquer is recommended as being more promising than conventional dosage forms.

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Ingredients (mg, gm, ml)	Formulation a	Formulation b
Eugenol (mg)	100	100
Eudragit RL100(gm)	10	-
Ethyl cellulose(gm)	-	10
Propylene glycol(ml)	10	10
Glycerine (ml)	10	10
DMSO(ml)	1	1
Thioglycolic acid(ml)	1	1
Ethanol (ml)	100	100

## Table 1: Formulae Used for the Selection of Polymer

mg-miligram, gm-gram, ml-mililitre

#### Table 2: Formulae used for the Development of Nail Lacquer

Ingredients	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Eugenol(mg)	100	100	100	100	100	100	100	100	100	100
Polymer(gm)	10	10	10	10	10	11	11	11	11	11
Propylene glycol(ml)	10	10	10	10	10	10	10	10	10	10
Glycerine(ml)	10	10	10	10	10	10	10	10	10	10
DMSO(ml)	1	1.75	2.5	1	2.5	1	1.75	2.5	1	2.5
Thioglycolic acid(ml)	1	1.75	1	2.5	2.5	1	1.75	1	2.5	2.5
Ethanol(ml)	100	100	100	100	100	100	100	100	100	100





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#### Table 3: Drug Content

Formulation	Drug content (%)
F1	90.55
F2	92.6
F3	92.5
F4	92.45
F5	93.51
F6	93.21
F7	91.97
F8	90.69
F9	93.72
F10	92.41

#### Table 4: Regression Co-Efficient (*R*<sup>2</sup>) Values of Kinetic Models for Formulation F5

formulation code		R <sup>2</sup> Values	6
	Zero-order	First order	Higuchi model
F5	0.991	0.978	0.987

#### Table 5: Mechanism of Drug Release From F5

Formulation code	Diffusion exponent(n)	Drug release mechanism
F5	0.567	Non- Fickian

The value of diffusion exponent, (n) for F5 is found to be 0.567.







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**REVIEW ARTICLE** 

# Green Washing and its Impact on Consumers and Businesses - A Review

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## ABSTRACT

One of the important factors contributing to success of organisations is how closely ethical values are woven into their organisational culture. In the long run an ethical firm builds loyalty and trust among its customers. But even the largest of the corporates seem to overlook these ethical values by indulging in greater profiteering through green washing activities. The awareness about the drawbacks of green washing will help the consumers to make an informed decision in favour of genuine green products. It will also help the companies by educating them on how green washing activities negatively impact their brand image and brand loyalty eventually resulting in decreased revenues and market share.

Keywords: Green washing, Advertisement, Ethics, Corporate, Green marketing.

## INTRODUCTION

The rapid industrialisation and globalisation in past decade has led to severe environmental degradation. This has become a cause of great concern for individuals, companies and governments worldwide [1]. Consumers are becoming highly conscious about the products which they purchase and their environmental impacts, which is clearly evident in their purchase behaviour [2]. The acceptance of green products by increased number of consumers has led the manufacturers to adopt eco-friendly practices not only in the production process but also in the end product itself [3]. Green marketing has been considered as the most preferred strategy to attract a huge mass of eco-friendly customers [4]. Adopting green attitude is all about a continuous effort, sometimes shallow and sometimes deep in minimizing the negative impact on the environment. Research has indicated that green washing advertisements are successful in attracting customers [5]. The motive behind huge number of consumers choosing





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green products is to live a way of life which helps them makes choices that benefit the environment or has minimum impact on the environment [6]. Green claims are normally made by products and services which are not characteristically environment friendly [7]. One major supportive factor for companies claiming to sell green products is that their claims cannot be clearly verified by the consumers even after they have used the products or services [8]. There are basically three types of confusion normally faced by green consumers: unclarity confusion, similarity confusion and overload confusion. Unclarity confusion happens when the consumer has no up-to-date knowledge about the product thereby making it difficult to evaluate the product. Similarity confusion arises when the consumer is deceived by the similar physical appearance of different products. Overload confusion happens when the consumer is so overburdened with relevant information that it becomes difficult for them to make a choice between products [9].

Many companies try to project themselves as being environment friendly by spending huge amounts of money in marketing themselves as green companies. But the fact remains that instead of actually decreasing their adverse impact on environment, they just try to cover up with marketing their products as green products[1]. So consumers are now more doubtful about advertising being an authentic method of communication [10], thereby making them sceptical about advertising. There are no proper standardised rules and regulations to validate the green products claim of the companies. Still many consumers are ignorant about the usefulness of green products. It will take lot of efforts and time to convince them to switch to green products as people normally resist change in their buying behaviour. A product becomes less meaningful if it meets all the environmental norms but fails to achieve customer satisfaction. So the product must qualify the dual parameters of being environmentally friendly and should also be able to provide customer satisfaction [11]. The Boston College Centre for Corporate Citizenship (2008) and Cone LLC conducted the Green Gap Survey of 2008 which revealed that 40% customers favour green products and 48% of the customers think that green products has a positive effect on the environment [1].

#### The challenges of Green washing

The concept of green washing was first used by American environmental activist Jay Westerveld in 1986 [1].Green washing is mainly promoted through advertisements which show claims that are untrue, overlook specific information about validity of the claims or a combination of these [12].Green washing is a perilous practice as the organisations promoting it are unable to validate their green practices [13], which may influence the faith of the consumers towards genuine green products [14]. Green washing is intentionally hiding negative information and projecting the positive information about products in order to maintain a positive corporate image [8].It is a deliberate attempt initiated by companies which includes a selective information disclosure decision which are often advantageous for the companies but unsafe for the society. Under green washing the companies try to spend huge amounts of money for advertising their products as green products rather than actually spending money on improving their products which would make them environmentally friendly [11].

Green products messages are normally confusing to a majority of the consumers. So the manufacturers take advantage of this confusion and keep promoting their products as green products [15].Often there exists a thin line between promoting green products for companies own profit and for meeting social responsibility norms [15].Green washing may also negatively affect the trust of the investors [16]. It encourages negative propaganda by consumers there by confusing other consumers about the validity of green claims made by the companies [17]. Because of this the consumers fail to build a long term relationship with the companies due to the mistrust created through these misleading green washed advertisements [18]. So companies claiming to be green entities should live up to their green claims. Apart from green claim strategy some companies have adopted another strategy of green washing called as the executional green washing, where there is no clear claim of greenness but some imagery in the advertisement suggest the product to be environmentally friendly like recyclable, eco-friendly etc. [19].Some companies even try to divert the consumer attention away from the product to the social contributions which they make from proceeds by selling the product.





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## **Celebrity Endorsements**

Consumers normally can judge the intentions behind a green washing advertisement but the visual prompts in the advertisement tend to attract them to buy the product because of their affinity towards nature [7]. Some companiestake the help of credibility of some famous celebrities bypersuading them to advertise their products. The motive behind this is to indulge in immoral practice of green washing by leveraging on the trust of the consumers on the celebrities [12]. Green claims offered by the companies should come under strict cross-examination when they are endorsed by popular celebrities. It is a matter of trust which the consumers place on the celebrity and the company, and neither of them should be allowed to fiddle with the trust of the consumers. Once the trust of the consumers is diluted it leads to confusion and it becomes difficult for the consumer to distinguish between fake green companies and genuine green companies. If such situation arises it is highly demotivating for the genuine green companies who neither can afford nor believe in endorsing their products by popular celebrities [12]. Strict laws should be formulated by the concerned authorities to penalise both the companies engaged in green washing as well as the celebrity endorser who has influenced the buying behaviour of the consumers in favour of the product which they advertise [12].

#### Responses

Some studies have pointed as to how some informed consumers try to expose these misleading green washed advertisements through the use of social media. But very little is known about the response of the companies to such pressures as these companies too use social media platform to advertise their green claims. The current environmental data shows that the global CO2 emission and pollution levels are at an alarming level. This shows that majority of the companies use green washing as a tool to enhance their brand image and sales, while staying far away from actually implementing the green norms [20]. They put forward overstated and unmerited claims of producing environmentally friendly products and services with an intention to grab a larger share of the market [20]. In the wake of these false claims a company named Environmedia created Green washing index to keep a watch on environmental claims made by companies. Currently many companies are able to dodge marketing laws and sell their products with the help of green washed advertisement [21].

Terrachoice has conducted a survey in 2010 which shows different ways in which a company can mislead its customers [12]. For the awareness of the consumers they have formulated seven such ways which has been named as seven sins of green washing. They mention about sin of hidden trade-off where the companies promote their products as green products by concentrating on a few environmental attributes thereby neglecting other broad areas that concern the environment. Then, they talk about the sin of no proof where the companies' claim of being green is not validated either by complementary information or by any outside certification. Another point they talk about is sin of vagueness which indicates their claims to be too unclear for the consumer to understand and interpret. Next, they talk about a claim to be true but irrelevant in the present context of environmental practices, which they have called as sin of irrelevance. Then, they mention about the claim being totally untrue which they have called the sin of fibbing. Finally, they talk about the sin of worshipping false labels where the companies depend upon false labels and authorisations by third parties [12].Some of these immoralities should definitely be considered as criminal actions as they violate the environmental and safety laws.

## The Way Ahead

Authorities should define clearly the scope and components of green marketing by companies. In its absence the companies will be able to indulge in greenwashing activities even without directly breaking the present laws [6]. The government authorities should also conduct regular green audits to assess the degree of deviation from green advertisement benchmarks and corporate codes of conduct [22]. Stringent yet effective policies should be made at every level starting from village, tehsil, district, state and central level with proper mechanism to check green





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washing [20]. The general awareness level has to be raised among consumers so that they can clearly distinguish between green washed and genuine green products. This will also deter the companies to involve in green washing practices in the fear of losing revenue due to increased awareness of the consumers regarding green washed products [6].Awareness of consumers should also be increased so that they can distinguish been green advertisements and green washed advertisements. A major role in this direction should be played by government authorities as well as media [2].

Now the time has come when the consumer needs to have enough information regarding green washing. If green washing continues unchecked then real and credible green companies will lose their importance in the business arena. Authorities should also focus on making stringent laws to check this practice [23]. The consumers should by themselves check for the credibility of the green clams made by the companies by cross checking these claims with supporting proofs on Google and the company's websites [1]. The companies should state their green claims in a clear and logical manner displaying not only the positive effects but also the negative effects of their products. They should also support all their green claims with relevant data and certifications done by credible third [1].Public-Private Partnership (PPP) model can be implemented where the government and private bodies can together frame policies and guidelines to streamline and implement effective environmental guidelines. Environment protection and consumer protection bodies should be entrusted greater responsibility towards increasing the awareness among all the stakeholders [1].

## CONCLUSION

The green washing activities are growing due to weak existing regulatory framework and also due to the absence of any universal applicable standards and guidelines on environmental communications. The consumer is ready to pay a premium price for green products but the companies should also be responsible enough to produce quality product by refraining from green washingactivities. It is time that the companies integrate sustainable development into their marketing mix thereby making sustainable growth possible for future generations.

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**REVIEW ARTICLE** 

# A Review: Tribology of Metal Coatings Formicro-nano Scale Wear Diminution

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## ABSTRACT

Importance of Tribology for sustainable reliability cannot be over emphasized. Losses due to improper understanding and application of Tribology, it has been observed that losses of over 1.4 % of GDP of the world and 8.7% of the total cost of energy production. Tribological failures have been estimated to be responsible for about 40% of breakdowns in industries. In mechanical systems, friction and wear phenomena associated with moving modules are directly connected to reliability, efficiency and durability of the system. Thus, reducing and controlling these phenomena for achieving the desired system performance is vital. A thin film coating has received crucial attention in moderneradue to their advantages in reducing and controlling tribological properties of the bulk material. Amid the various strategies developed for decreasing friction and wear, coatings have been successfully applied in numerous engineering applications to overcome tribological problems. A key advantage of coatings is that they may be prepared by various materials in several diverse forms and structures to satisfy the necessities of the operating system. These coatings can be made by a combination of various materials and can be a multilayer form havebeen attainment much interest because of the added degree of freedom in altering the coating property. In this review paper, the properties and development of single and multilayer coating for tribological applications were reviewed along with the purpose to achieve an improved understanding and concerning their advantages and limitations. Definitely, focus wasgiven to Ti-based, carbon-based, molybdenum- based, zirconium-based and Cr-based coatings along with their significance applications. Importance was given to design concepts, materials, deposition method, tribological properties and mechanical properties of various types of coatings.

Keywords: Thin film coating; friction; wear; tribology, mechanical properties.





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## INTRODUCTION

As we know that Nanotechnology deals at Nano level (10<sup>-9</sup> meter) and by virtue of that its giving solutions to many real-world problems with the fact that improving the properties of material by decreasing the size. As we shift from macro to micro scale, surface area to volume ratio risessignificantly. In addition, the surface forces likeadhesion, fiction, viscous drag, meniscus forces and surface area significantly rise [1]. The size of the components (electrical, mechanical, optical, etc.) is decreasing at a very rapidstep and improvementin nanotechnology, MEMS, magnetic storage devices, micro-engines, allinclude basic problems of friction, wear, lubrication and adhesion. Miniaturization of the components is big challenges and hence nanotechnological/tribological study has to be done [2]. Tribology helps to improve the lifecycle of any components. Still, several industrial processes need to developed anin-depth understanding of tribology at the nano-scale [3]. In industry, the event of lubricants is subjected to monolayers to the fabric surface or adhesion of mill micron layers. Assembly of parts will rely critically on the materials adhesion at the nano-scale. Therefore, nanotribology is raising as a robust field of applied science and has become most crucial to review in today scenario. A study regarding nanotribology and nano mechanics are obligatory for development of basic understanding about interfacial phenomena at a nano-scale, in macrostructures and also to explore interfacial phenomena in nanotechnology, nano lubrication, magnetic storage devices and many more such applications. Furthermore, it provides a connection between engineering and science. In case of less weight micro/nanocomponents, friction and wear are mainly base on the surface interactions and up to some atomic layers. In addition, these structures are usually coated by metal thin films. Research in regards of adhesion, scratching, wear, friction, boundary lubrication, indentation and surface roughness on nanoscales by the nanotribometer and AFM may offer visions about materials failure mechanisms. A micro/nanotribological studies can be help to developed regimes which help to make near-zero wear and ultra-low friction.

## Global scenario of Micro-nano scale tribology

## International Status of nanotribology

A fundamental studies of nanotribology is offer insight to the wear and friction between sliding surfaces, adhesion and lubrication of coated thin film, at the atomic and molecular scale [4]. Nevertheless, nanotribology faces major contests; for instance, in reduced devices along with moving parts like microelectromechanical and nanoelectromechanical systems (MdesaiEMS/NEMS), the surface area to volume ratio and small length scale creates interfacial phenomena which come to be dominant. Hence, a good knowledge is obligatory in regards of surface interactions like capillary and van der Waals forces affect friction and adhesion at the atomic and molecular scale [4-6]. First, focusing on this topic was done by Bowden and Tabor [7]. They confirmed the actual contact among two solids is merely a fraction of apparent contact area because of surface roughness. At the nano/micro-scale, all surface is rough and they contact at asperities. Thus, the study in regards of the surface interactions amid these microscopic point (asperities) at the atomic and molecular scale would make available an improved knowledge about nanotribology.

Traditionally tribology was studied typically at length scales and load compatible along with the macroscopic devices. These widely empirical studies are frequently unsatisfactory as the resulted data was lack with quantitative analysis reliant on basic atomic-scale phenomena. In present scenario, the scanning force microscope (SFM) and other techniques have been practiced to study wear, atomic-scale frictionand lubrication phenomena together with fundamental mechanisms of adhesion, stick slip, and also single asperity interactions that finally contribute to macroscopic friction and wear. There is a remarkable gap amid traditional tribology test instruments and the parameter ranges accessible. A nanotribometer is a latest instrument designed to explore tribological property which can fill the resultant gap between macroscopic and atomic-scale techniques. The nanotribometer is related on SFM technology but along with numerous factors which is not possible with SFM instruments. The nanotribometer is offered quantitative friction and wear studies with extended regime. These take account of: (a) Forces can be change above a large range; e.g., in wear or scratch tests. The quad-cell or split -cell photodiodes frequently used in SFM





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optical lever schemes are offered benefit only for small force variations. The nanotribometer is shifted the traditional quad-diode using a continuous PIN position-sensitive photodiode.A hysteresis in the piezoelectric (PE) constituents can cause huge uncertainties in sample topography measurements and/or applied load, mainly with large displacements [14]. The nanotribometer have optical interferometers and capacitance gages in closed-loop feedback schemes which can be directly measure the X-, Y-, and Z-motions of the sample.Most marketable cantilevers are generally restricted to very small forces, usually less than a µN but nanotribometer can work with a board range of force sensors. (devork).In 2004, A.V. Desai and M.A. Haque were designed and prepared a micro-electro-mechanical (MEMS) tribometer along with 100 nN normal force resolutions and 1 nN lateral force resolutions besides this it has 50 kHz bandwidth. These nano-tribometer 0.3 mm) offers simultaneously qualitative and quantitative dynamic analysis in electron microscopes [8].Dependupon a combination of high resolution fiber-optic sensors and photo structured glass, Mollenhauer et al. have [9] developed a measurement system combiningwith innovative mechatronic systems which used for measurements of force. Moreover, precision drives functioning at high speed allow rapid sample positioning and sample motion atvaried modes. Flater et al. [10] have used a nanotractor device to study the tribological properties of polycrystalline silicon, maintaining the conditions found at an actual MEMS interface. Tribological properties of MEMS areoffering better understanding about the influence of various surface qualities on wear. In that mainly found that, monolayer coatings are seen to have an effective positive influence, while surface texturing are not mainlyaffected performance.

In 2008, Mitrovic et al. were recoded lowest coefficient of friction varies from 0.13 to 0.7, with an exception of 0.075 value on nanotribometer [11]. In 2013, Domatti et al. were studied micro/nanotribological of self-assembled monolayers (SAMs) prepared from n-alkyltrichlorosilanes film that deposited on silicon wafers which demonstratingdifferent crystallographic orientations - Si (100), Si (111) and Si (110) and its tribological behavior has been studiedby a ball-on-disc nanotribometer. They observed that the crucial parameter which controlling the tribological properties is not the length of alkyl chain likecommonlydescribed for grafted and adsorbed monolayers, nevertheless the film's homogeneityi.e. the surface coverage of the monolayer and the degree of packingin combinealong with the substrate crystallographic orientation [12].In 2015, Philippe Stempfle et al. were targeted numerous samples and coated on silicon wafers which revealingseveralnanostructures and crystallographic orientations. In addition, self-assembled monolayers which coated on silicon wafersand carbon nitride coatings were rubbing under varied environmental conditionsin regards characterized the tribology through Nano-Tribometer. So as to allow any type of wear process likeadhesion process and polishing [13] they haveapplied multi-asperity nanotribological tests. An original experimental setup was developedin 2016 by, L. Fu, et al., combine velocimetry experiments which ranging from 1 µm/s to 100 µm/s and tribological characteristics with maximum normal load 1 N, along with a direct observation of the contact area. The results were clearly signifying the fast fourier transform for analyzing the fluorescence signals, which allowing measurement of drift velocity in the interfacial zone.

A shearing of a single lipid monolayer coated on a glass slide was characterized using ananometer and also the local velocity for a contact diameter was measured i.e. ~200–300  $\mu$ m (~30 MPa). This arrangementwill help to explore the hydrodynamic property of sheared confined layer in lubrication, bio-lubrication, or friction observed on solid polymers [14]. In 2017, Amorim et al. were studied imidazolium-based ionic liquids used as additives into the base oil polyethylene glycol (PEG) for lubricating Si surfaces. Using nanotribometer the coefficients of friction were measured. All additives (2%wt) cause a reduction in friction coefficient along with an upsurge in viscosity and enhanced the Si wettability. The anionic [EtSO4] additives have an auspicious tribological behavior, that was made the strong interaction to the Si surface and confirming the development of a stable surface layer, which help to delays the contact among the sliding surfaces [15]. In 2018, Tourlonias et al. were studied wear phenomenon along with two hypotheses i.e. the friction amongfiberswhichhappensat the time weaving wasalters the sizing, and wear effects the friction value amid fibers.An obtained result reflected thata single fibre-to- fibre friction value is influence to the sizing of surface state. Actually, the friction coefficientand its variation coefficientwere related to the sizing surface state and also more indeed to the homogeneity of the coating sizing. Nevertheless, the more wear of sizing layer, the



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lessvariation coefficient was resulted. The wear of sizing layer risewith sliding distance, along with a diminution of the friction coefficient[16].

## National Status of nanotribology

In 2016, Nath et al. were studied tribological, mechanicaland oxidation resistance at high temperature (at 1000 °C under isothermal condition) characteristics of YSZ, and Al<sub>2</sub>O<sub>3</sub> thin films deposited by pulsed laser methods. As rising the substrate temperaturetribological behavior of the YSZ and Al<sub>2</sub>O<sub>3</sub> thin films were improved significantly. At room temperature, friction coefficient of YSZ thin films were exhibited a maximum value (0.406 and 0.403 at 4 mN and 5 mN, respectively) instead of deposited on 973 K (0.344 and 0.328 at 4 mN and 5 mN, respectively). A Friction coefficient of Al<sub>2</sub>O<sub>3</sub> deposited at 300 K exhibited a maximum value i.e. 0.337 and 0.332 at 1 mN and 2 mN, respectively in compared to the deposited at 973 K (0.204 and 0.251 at 1 mN and 2 mN, respectively) [17]. In 2018, Gobi Saravanan Kaliaraj and N Kumar were preparedzirconium oxynitride (ZrON) and Titanium oxynitride (TiON) thin film grown onto 316L stainless steel (316L SS) by reactive magnetron sputtering method. A TiON film was revealed improvedwear resistant and hardnessthenZrON film. A Corrosion studies reflected the admirabledefense behavior for ZrONand TiONfilms in existence and absence of hydrogen peroxidein ABP solution. Specifically, both thin films displaybetter corrosion resistant characteristics in the existence of 1 and 10% of hydrogen peroxide in ABP solution. Thus, the outcome of studyreflected that nanostructured ZrONandTiONthinfilms are the perfect materials which can be used for biomedical applications [18].

# Tribological behavior of metal thin film coated on various substrate

## Chromium-based coating

In 1996, A.K. Kulkarni *et al.*, was confirmed resistivity of the coating using base pressure: 1333 Pa, deposition rate: 0.5–0.6 nm/s, Ar pressure: 1333 Pa, Power: 100 W, Deposition temp: 200-500 °C. They were detected the diminution in the resistivity of a 100 nm thick sample i.e. from 6.70 mV/cm to 3.12 mV/cm but rise in the grain size 19.9 nm to 50.3 nm after annealing temperature at 450 °C for 1 h [19]. Afterwards F. Cosse*et al.* was used cathodic magnetron sputtering using two parameters i.e. Deposition time: 30s, sputtering pressure: 0.08 Pa. A depositedfilms along with virtuous corrosion resistance along with better mechanical properties likewear resistance, adhesionand hardness [20].Summary of mechanical property was observed in table 2. P.hones*et al.* was studied the hardness of CrWN&CrNbNthin film deposited using magnetron sputtering. They observed significant increase in hardness (27 GPa for CrWN& 24.5GPa for CrNbN) & E-modulus (Min 0.3 to 0.5)[21]. Although C. Rebholz*et al.* were demonstrated that rising in nitrogen concentrationupto x=0.29 which connectedalong with a rise in hardness i.e. from 700 up to 2400 HK[22]. In 2006, using DC reactive magnetron sputtering, Chappeand coworker was prepared chromium coated substrate with good electric conductivity, sufficient hardness and E-modulus[23].

Mechanical behavior of Cr coated thin film using pulsed reactive dual magnetron sputtering were evaluated using depth-sensing indentation by triboindenter (Hysitron) which equipped along with a Berkovich pyramidal tip (M. Benkahoul*et al.*,2008). M. Stüber*et al.* were suggested that tribological properties micro-scale hardness of (Cr,Al)N raisedasassimilation of foreign elements like Y and Si using magnetron sputtering method with the help of parameter such asDeposition time: 400 sec, Sputtering pressure:  $1.3 \times 10^4$  Pa, Ar flow rate: 15 sccm, N<sub>2</sub> flow rate: 14 sccm, Pressure of N<sub>2</sub> and Ar : amounting to 1.2 Pa.[24]Louro*et al.* were increased the hardness by modified the parameter (Deposition time: 30 min, Sputtering pressure: Below  $10^{-3}$  Pa) of DC reactive magnetron sputtering. Thickness of several tens micrometers and the highest current efficiency was achieved by F. I. Danilov *et al* at a relative pulse duration of Q = 2 using Pulsed Current method (Electrolytes composition: (mol/dm3) 0.5 KCr(SO4)2, 0.75 HCOOH, 0.5H3BO3, and 2 (NH4)2SO4 and pH 3. Deposition temperature: 298 k)[25]. During 2010, S.L. Lee *et al.* were developed good adhesion, wear resistance, fine grain size and high hardnessdeposited onsteel in planar geometry by DC magnetron sputtering run at 3-95 kW target powers, 463-575 V target voltages, 83-190 A target currents, 666 Pa pressure, 25:25 sccm Ar:N<sub>2</sub> flow, 70Hz frequency, 60mm substrate distance, 1-4.5 hr deposition time. Improved anticorrosion performance of CrN was generated by R.F Magnetron sputtering using frequency range of (NORDIKO





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3500-13.56 MHz [26]. In 2013, E. Zumelzu*et al.* were exhibited that nanometric microcrack projecting by visible basic defects of the PET polymer and demonstrating themselves as texture along with surface changes influences the function of the multilayer composite onceTi was developedbyelectrolytic chromium-coating at current density 300 and 500 A/dm<sup>2</sup> and deformations was occur from 5 to 25%, at a rate of 2.5 mm/min.[26]. Zhongzhen Wu *et al.* were studied the oxidation temperature of CrN and conclude that CrN coatings was about 500 °C as corroborated by DCMS and HPPMS and goes much higher oxidation temperature of up to 800 °C in condition of high-voltage pulses applied to the substrates amplitudes of 8 kV, 12 kV, 16 kV and 20 kV along with the same frequency and width also 1.0 Pa the working pressure for 5 min[27].Kamenetskih*et al.* were achieved maximum hardness (45 GPa) and elastic modulus (590 GPa) using Plasma Enhanced Magnetron Sputtering which operated with parameter like 120 min Deposition time,1333Pa sputtering pressure and below 300°C deposition temperature[28]. K. Bouzida, N.E. was examined the associationamid low adhesion measured in higher temperature along withhigh contact angle measurements and low Coefficient of Friction (CoF) in tribological model tests[29].

#### Zirconium based coating

In 2002 S.Venkatraj et al. investigated on zirconium oxide on two substrates (Glass and silicon).Whereas the parameter sets like target distance70 nm at room temperature having pressure 0.8 Pa by using reactive D.C magnetron sputtering as deposition process. They obtained that there is increase in Band gap (4.52 to 4.67 eV) and roughness (0.8 to 4.78) [30]. In 2008 D.H Trinh deposited zirconium oxide thin film on Si (100) by reactive D.C magnetron sputtering. In their experiment they measure the depth of 15-50 nm [31]. In 2017 Pranav y Dave et al. research done magnetron sputtering process. They concluded that zirconium oxide roughness is increase on glass (4.11 mm to 16.32 mm) which is operated under temperature500°C and target distance 50 nm [32]. In 2016 Utkarsh Patel et al.used RF magnetron sputtering as deposition process onZrO2 thin film. They obtained two parameters i.e. melting point 2880°C&ZrO2 target purity is 99.99% on glass as a substrate. They resulted crystalline size is increased from 19 to 25nm [33]. In 2005 Yasunoirohtsu et al. was confirmed coating using RF magnetron sputtering and its thin film oxygen pressure is 0.1 to 1.0 pa. In addition, theZrO2 target diameter is 10 nm and the power is 200 to 500 W. They observed the decrease in resistivity of 0.2nm thick [34]. In 2015 Prof. DR Abdul Hussein et al. used RF magnetron sputtering process. They deposited thin film as sputtering temperature evacuated down 5 × 10–5 and temperature is 150 °C. They used glass as substrate. The thickness taken is 1.97 to 3.71 nm [35].

#### Tantalum based coating

Karrina McNamara et al. [36] deposited TaO thin films using DC reactive magnetron sputtering process. X-ray diffraction (XRD) and X-ray photoelectron spectroscopy (XPS) techniques were used to study the oxidation of deposited Ta thin film. They observed a granular structure at a high magnification for the sample sputter deposited for 90 min and subsequently oxidised at 600 °C, but the morphology of film was influenced by the presence of cracks.Maureen Cheviot et al. [37] formed TaN thin films by RF magnetron sputtering process as per the processing parameters. They studied and analyzed the structure and microstructure of Tantalum nitride thin films. They found that the weight ratio of h-TaN to fcc-TaN strongly depends on nitrogen partial pressure, target power density, total gas pressure and target to substrate distance. Deposition rate decreases as increasing target to substrate distance was typically determined. The deposition rate increases linearly with an increase in target power density and slightly decrease with increase in nitrogen flow rate. D. Cristea et al. [38] developed tantalum oxynitride thin films on silicon wafers and stainless steel substrates by DC reactive magnetron sputtering process. They studied the evolution of structure and thermal stability of  $TaO_xN_x$  thin films. It was observed that the film produced with highest partial pressure of reactive gases are the most stable and manage the amorphous structure after all the annealing treatments. D. Cristea et al. [39] worked on TaO<sub>x</sub>N<sub>x</sub> thin films deposited by DC reactive magnetron sputtering and compares the mechanical properties and wear behaviour of that film. They found that the film produced with reactive gases of low partial pressure, exhibit higher crystallinity and hardness. On the other side the films produced with reactive gases of higher partial pressure are amorphous and hardness is comparatively low. The wear rate was found to increase with increase in the friction co-efficient.





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#### Molybdenum based coating

Silvia M. Deambrosis et al [40] carried out investigation on Mo sputtered coating using DC magnetron sputtering on titanium substrate (25 × 25 × 2 mm) and Mo target with distance between substrate and target is 90 mm was performed in 2015. The Background pressure was less then equal to 1 × 10-7 mbar. The gases as Ar, Kr and Xe was used as the sputtering gas at pressure of 1.0 ×10-3, 4.4 ×10-3, 1.0 × 10-2 mbar, fixed power -150 W used. Film morphology was analyzed by a SEM. It was found that hardness and modulus of elasticity for different gases with different deposition rate varies from 15±2 to 6±1 GPa and 320±27 to 110±16 GPa. Dense microstructures and decent mechanical properties would be presented by molybdenum, which would demonstrate their potential for application in worse conditionssuch as thermonuclear fusion plants. If notaltering sputtering parameter, they wereexhibited a nano-porous configuration which exhibited novel applications in lubrication and catalysis field. T.A. Stolarski et al [41] they studied the effect of spraying distance on wear resistance of Mo coatings. Here the spraying material was used as 99.5% pure Mo. The Argon and Helium gases are used as the plasma working gas for the deposition process. The result of the experiment was given as they were shows that under certain contact condition the wear of Mo coating is a strong function of the spraying distance. Here there are four totally different spraying distances were used as: 80, 120, 160, and 200 mm respectively. In whole experiment they show that spraying distance affects the wear resistance of the coating. With increase in spraying distance enhances the wear resistance, however only under low contact pressure conditions additionally the hardness of a coating depends on oxygen content which is in a function of spraying distance. In 2009, Yoshinori Takeichi et al [42] carried out investigation oninfluence of Molybdenum Trioxide on the tribological behaviour of Aluminum Bronze athigh temperature conditions.

They found that the friction coefficient of MoO<sub>3</sub>coated specimen increased from 0.19 to 0.56 with increase of the temperature. Below Figure shows the results of friction test for the pair of aluminum bronze disk and uncoated / MoO<sub>3</sub>coated stainless steel ring. A outcomewas showed the averaged value of the friction coefficient. The wear amounts of uncoated and MoO<sub>3</sub> coated specimen were increased with increase in the temperature from 673 to 973 K, except that ofMoO<sub>3</sub>coated specimen at 773 K. Majority failure modes trace to tribological considerations. Potential benefits derivable from tribological awareness are rather high, relative to our huge economy, our diversity, complexity in our industrial practices and our manpower glut. Typically tribology cost is never measured or monitored in our economy, so comprehensive tribology impact is indirectly assessed from lubricant business size with empirical weightage for energy, machine, maintenance, production, environmental hazard, etc[43] and due to tribology every year 6% GDP loss is occur. Hence more advance techniques and research have to require. Consequently, aim of the current project is the objective of the current study is to design and synthesized metal/polymer base nanostructured coating using magnetron sputtering method.

Nanostructured coating will be prepared on various substrates and its nanotribological and mechanical properties will be investigated. Nanotribometer is used to study nano-scratch, nano-wear and friction rate of nanostructured coating. The data obtain from the studies will offer as best paradigm for assessing scientific models of deposited metal/polymer base nanostructured coated film variability along with the core interest on theoretical concepts of film dynamics. In this paper mainly studied Tribological and Mechanical properties of the coatings of very dominant materials like Chromium, Molybdenum, Tantalum, Zirconium. Friction and wear are mainly depended on the deposition method and parameters together with the properties of the counter body, not only on the materials of that.

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## Table1. Processing and investigation of mechanical & tribological properties

Sr. No	Author	Techniques	Parameter	Mechanical & Tribological
1.	K.Bouzida, et al. (2015)29	RF Magnetron Sputtering	Pressure 550 mPa, Process gas: Ar, Gas flow (Ar):150 sccm, Gas flow (O2): 5, 10, 15, 20, 25, 30, 35 sccm, Bias voltage: -40V, Pulse mode – Bipolar, Frequency 1850 kHz, Reverse time: 500 nS	Coefficient of Friction (CoF) = 0.85 to 0.9
2.	Bagcivan et al.[28] (2014)	Middle Frequency Magnetron Sputtering	$N_2$ : 20 to 60 sccm Deposition time: 50 min Sputtering pre.: $5.5 \times 10^{-1}$ Pa Deposition Temp.: Below 200°C	Surface roughness for 2D roughness = 0.5136 to 5.8527 3D roughness = 0.5223 to 5.8621
3.	Kamenetskih <i>et al.</i> (2014 )[28]	Plasma Enhanced Magnetron Sputtering	Deposition time: 120 min Sputtering pre. : 10 <sup>-5</sup> Torr Deposition Temp. : Below 300°C	Hardness= 45 GPa Elastic modulus 590GPa
4.	Zhongzhen Wu et al(2014)27	high power pulsed magnetron sputtering	high-voltage pulses applied: to the substrates amplitudes of 8 kV, 12 kV, 16 kV, and 20 kV and the same frequency &width. working pressure: 1.0 Pa Deposition time: 5 min.	Hardness Before annealing=25GPa Annealing > 600°C = 6.5GPa Annealing 800°C= 18GPa
5.	Juergen M. (2013)[44]	Magnetron Sputtering	Vacuum: (2×10–3 Pa), CrNx, flow ratio N2:Ar = 3:1, Deposition pressure: 2.9 Pa., Bias voltage: $-50$ V deposition rates: ~3.4 $\mu m$ h=1 for Cr and ~2.3 $\mu m$ h=1 for CrN	Bulge size: Elastic modulus: CrNx single layer 217 ± 4; 16 bilayer Cr- CrNx 198 ± 5 32 bilayer Cr-CrNx 191 ± 4
6.	E. Zumelzu <i>et al.</i> (2013) <sup>26</sup>	Electrolytic chromium- coated	current density: 300 and 500 A/dm2, deformations in the range from 5 to 25%, at a rate of 2?5 mm/min	tensile strength 425MPa
7.	Andrei V <i>et al.</i> (2013)[45]	RF-magnetron sputtering	Sputtering pre.: 105 Pa Deposition Time: 5 min	thickness of coating 3.5 μm to 8.2 μm
8.	Shicai Yanga et al.(2012)[46]	DC magnetron sputtering	Sputtering pressure: 0.45 Pa Deposition Temp.: 650°C Deposition time: 20 min	Hardness from 3000 to 3500 kg/mm <sup>2</sup> Friction 0.35 -0.7µ
9.	T. Miyake et al. (2010)[47]	radio-frequency magnetron sputtering method	Deposition time: 120 min Sputtering pre.: 5 Pa Deposition Temp. 400°C	Water contact angle/ degree - 95
10.	S.L. Lee et al. (2010) [26]	DC magnetron sputtering	target powers:3-95 kW, target voltages: 463-575 V, target currents: 83-190 A, pressure: 5 mTorr, Ar:N2 : 25:25 sccm, Frequency: 70Hz, Substrate distance: 60mm, Deposition Time: 1-4.5 hr	Hardness values 8-12.9 GPa Residual stress range of (1.52- 1.79)Mpa
11.	F.I. Danilov et al. (2010) <sup>25</sup>	Pulsed Current	Electrolytes composition: (mol/dm3)0.5 KCr(SO4)2, 0.75 HCOOH, 0.5H3BO3, and 2 (NH4)2SO4 and pH 3. Deposition temperature: 298 k	Microhardness=638-804 kg/mm²
12.	Grzegorz Greczynski <i>et</i> al. (2010)[48]	high-power impulse magnetron sputtering	Deposition time: 30 min Sputtering pressure: 1-2 mPa Deposition Temp.: 200°C	Hardness value 18.2 GPa – 21.1GPa
13.	Louro <i>et al.</i> (2009) <sup>25</sup>	DC reactive magnetron sputtering	Deposition time: 30 min Sputtering pressure: Below 10 <sup>-2</sup> Pa	Hardness: 15-30 GPa
14.	Y.Zou et al.(2009)[49]	RF dual magnetron sputtering system	N <sub>2</sub> : saturated level Deposition Temp. 200°C	Hardness 9-15GPa Roughness -10.7 -30nm
15.	M. Stüber <i>et al.</i> (2008) <sup>24</sup>	magnetron sputtering	Deposition time: 400 sec, Sputtering pressure: $1.3\times10^4$ Pa, Ar flow rate: 15 sccm, $N_2$ flow rate: 14 sccm, Pressure of $N_2$ and Ar : amounting to 1.2 Pa	Hardness: 1100-1200 HV0.05(non-reactive sputtering) & 2200 to 2500HV0.05 (Reactive sputtering)
16.	M. Benkahoul et al. (2008)[50]	pulsed reactive dual magnetron sputtering	Deposition time: 400 sec Sputtering pressure: 1.3×104 Pa Ar flow rate: 15 scm N: flow rate: 14 scm, Pressure of N: and Ar : 1.2 Pa	Hardness: 18-24 GPa
17.	Chappe <i>et al.</i> (2006) <sup>23</sup>	DC reactive magnetron sputtering	NIL	H <sub>n</sub> : 15.8 GPa E <sub>r</sub> : 5.2GPa
18.	C. Rebholz et al.(1999) <sup>22</sup>	reactive magnetron sputtering	Deposition time: 30 min Sputtering pressure:1.5Pa	Hardness from 700 up to 2400 HK.





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19.	P. hones et al (1998) <sup>21</sup>	Magnetron Sputtering	Total sputtering pressure: .66 pa Nitrogrn partial pr: .20,.20,.33,.35 Pa Sputtering power:100,150,100,120 W	Max Hardness value 27 GPa for CrWN & 24.5GPa for CrNbN Hardness & E-modulus: Min 0.3 to 0.5, Hardness increase of 85% against 10% Tu addition
20.	F. Cosse <i>et al</i> . (1995) <sup>20</sup>	cathodic magnetron sputtering	Deposition time: 30s Sputtering pressure: 0.08 Pa Deposition Temp.: 200-600°C	Corrosion resistance 8-9 × 10⁵Ω Hardness 6GPa Wear resistance1.5 &2 µm
21.	A.K. Kulkarni <i>et al.</i> (1996) <sup>19</sup>	Magnetron sputtering	base pressure: 10.8 Torr, deposition rate: 0.5–0.6 nm/s, Ar pressure: 10 mTorr, Power: 100 W, Deposition temp: 200-500 °C	resistivity 6.70 mV cm to 3.12 mV cm after annealing



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**RESEARCH ARTICLE** 

# Biodiversity of Marine Fishes in Karaikal - Southeast Coast of Tamil Nadu

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## ABSTRACT

Karaikal port is located in the Eastern coast of India. During the period of study 2018-2020 a total of 108 species of fishes were observed belonging to 78 genera and 43 families. Among the species enumerated maximum number of fishes belonged to the family of Scombridae. Karaikal Harbour provides a wide variety of fishes. Fishes caught from this harbour are exported to the neighbouring states of Kerala, Karnataka, Andhra etc. A significant and crucial discovery in the present study reveals that the species named *Pristis pristis* is critically endangered. The fishes like *Carcharinus limbatus, Scoliodon latikudus, Carcharinus macloti, Harpodon nehereus and Anguilla bengalensis* are found to be nearly threatened. The fishes like *Thunnus orientalis, Gadus morhua and Rhynchobatus leavis* are found to be among the vulnerable ones. The vital data obtained from the study is used for comparing the biodiversity of fishes at Ayikkara, Kannur in the western coast of India.

Keywords: Eastern coast, fishes, Karaikal, study, endangered.

## INTRODUCTION

Fishes are poikilothermic, aquatic vertebrates having jaws, gills and fins. Fishes constitute more than half of the living vertebrate species [1]. Fishes are classified into different classes like Chondrichthyes, Osteichthyes etc. Among these half of them are marine fishes. Marine fishes spend their life cycle in different ways such as anadromous, catadromous, and amphidromous [2]. Diversity consists of two dissimilar concepts of variety and variability; it means richness and evenness of the marine species [3]. The paramount importance of the marine biodiversity





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conservation made UN declare Marine diversity as the theme for the International day for Biological Diversity in 2012 [4]. The Indian peninsula covered by water is known for its wide variety of fishes. The coastline of peninsular India consists of 9 states and 2 union territories [5]. In Tamil Nadu a major fishing harbour and ten minor harbours were commissioned during 2018-19 apart from the 20 fish landing centres in the same period [6]. Karaikal is located near the town of Karaikal Harbour in the Union Territory of Puducherry. Karaikal district has 10 fishing hamlets within its coastal belt spread across 24 km. Karaikal port, a centre of fishing activity is located on the eastern coast of India. The port is in Vanjone Village tucked away from the metropolitan city of Chennai towards the south at a distance of 300 km. The latitude of Karaikal is 10° 93' N and 79° 84'E. The port assumes significance as it acts as a rich source of many varieties of fishes in the eastern coast of India. Fishes caught from this small town are exported to many parts of the country, especially to nearby states like Kerala, Andhra, Karnataka, etc. There are millions of diverse organisms found in a marine habitat of this kind. Fish diversity in scientific terms refers to the number of species in a particular area, abundance of the species in that area and phytogenic diversity.

## MATERIALS AND METHODS

Fishes were collected at monthly intervals from troll by the catch landed in Karaikal Harbour (latitude 10.93° N and longitude 79° 84′E) during 2018 January to 2020 January. Harbour starts its operation from 4 a.m. and the fishing activity ends by 9 a.m. Identification of nature and type of fishes in a scientific study is based mainly on external features such as shape, size, depth, nature of spines, scales, position of mouth, etc. It is necessary to carry out tests and observations in order to identify the species, genus and family name of the fishes obtained from the catch in the harbour. Fishes caught from the harbour are segregated mainly on the basis of scales in the body. If scales are present they are further separated based on body shape, number and length of fins. After the process of segregation they are identified according to the Keys available in the FISH BASE computer application or integrated photo based online fish identification system, local reference collection, image recognition system etc. FAD species identification sheets are also used to identify the fishes besides standard books available as reference such as Commercial Sea fishes in India [7], Annotated Checklist of Fishes [8], Fishes of the world [9], an updated checklist of the Marine fish of Fauna of Redang Islands, Malaysia [10], etc. The fishes are collected separately in different sessions of the year during specific intervals and the activity is repeated for two years and compared with the data availability in the various sectors in the other coastal regions of India.

# **RESULTS AND DISCUSSION**

India is known for its mega diversity in marine species with a coastal line of 8500kms [11]. During 1971-75 worldwide marine fish production ranged from 56.9 to 60.7 million tonnes with an average of 58.6 million tonnes. Tamil Nadu is the second largest producer of marine fishes behind Gujarat with 6.55 lakh tonnes [12]. During this period India ranked 8th position in the global marine fish production. Now India has reached 7th rank [13]. The coastal area mainly depends on fishing and allied economic activities like catching, sale of the catch, transportation etc. Overfishing and catching during trawling season damage the fish resources. The present scrutiny and study conducted will serve as an important document of the distribution of marine fishes along the Karaikal coastal region. The habitat of the fishes is determined by physiographic features such as substrate type and depth [14] . A total of 108 different species were identified belonging to 43 families and 78 genera from collection site of this southeast coast of India. Some of the fishes noticed during this period are endangered [15]. The US national Oceanic and Atmospheric Administration has opined that 95% of the world's ocean is yet to be explored. The impact of human interventions in the habitat of fishes affects their biota and forces them to become endangered species [16]. The wide variety of fishes found in Karaikal coastal region belong to different family of fishes and were identified along the collection site such as Scombridae(15), carangidae(13), engraulidae(8), clupeidae(6), sciaenidae(5), leiognathidae(5),





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carcharhinidae(4), lutjanidae(4), synodontidae(3), acanthuridae(2), tetraodontidae(2), hemiramphidae(2), trichiuridae(2), sphyraenidae(2), coryphaenidae(2), gerreidae(2), serranidae(2), lethrinidae(2), priacanthidae(2), haemulidae(2), istiophoridae(1), bregmacerotidae(1), monacanthidae(1), anguillidae(1), nemipteridae(1), mugilidae(1), mullidae(1), monodactylidae(1), pristidae(1), belonidae(1), exocoetidae(1), chirocentridae(1), polynemidae(1), latidae(1), rhinidae(1), cynoglossidae(1), rachycentridae(1), gadidae(1), dasyatidae(1), chanidae(1), stromateidae(1), rhinopteridae(1).

Fishes like Harpodon nehereus, Mughil cephalus, Pampus argenteus, Hemiramphus far, Rastrelliger kanagurta, Stoleophorus indicus, Thryssia malabarica, Trichiurus lepturus, Sardinella longiceps, Anguilla bengalensis, Sphyraena barracuda, Karalla daura, Thunnus albacores are present throughout the study period. The marine species Pristis pristis is on the critically endangered list and fishes like Carcharinus limmbatus, Scoliodon laticaudus, Carcharinus macloti, Harpodon nehereus, and Anguilla bengalensis are near threatened species and Thunnus orientalis, Gadus morhua and Rhynchobatus leavis are vulnerable species listed by IUCN.

## CONCLUSION

One of the embarrassing situations that the entire world is facing is the problem of malnutrition and to find the means and ways to curb this menace in the near future. As the global population is projected to exceed 9 billion by 2050, it is widely acknowledged that fishes have the capacity to alleviate the challenges of hunger, food security and malnutrition to a great extent. It is quiet alarming to see that 30 to 40% of the world population is suffering from nutrient deficiency. Fish is an important alternative source of nutrients from the animal source which can provide essential nutrients otherwise found in limiting amounts in the normal diet. Karaikal harbour in this part of world will serve as a significant source of marine diet for a section of humanity with its wide variety of fishes.

But these fish species need to be conserved for the future generation by restricting fishermen to the traditional way of fishing and prohibiting trawling in the nursery ground and there by preserving the components of the marine ecosystem. Lunar Periodicity can influence the spawning cycle of marine fishes [17]. Another important finding is that the life history of fishes in Karaikal depends on seasonal fluctuations, monsoon influence, cyclones, tidal surge etc. Oil spillage from shipping vessels, catch of juveniles among the marine fishes, untreated sewage, inadequate protection of marine parks and reserves, global warming and climate change, introduction of alien species etc. are the major threats to the diversity of fishes existing in the world [18]. Cyclone is another significant threat faced by marine ecosystem. It usually consists of sustained wind with a speed 65 to 125 km/hr. It results in extreme wave action that leads to destruction of many flora and fauna [19]. In 2009 M Rajasegar recorded 196 species of fin fishes in Karaikal. In the present study it is observed that only 108 species belonging to 43 families and 78 genera are detected. It becomes imminent to update and examine the information related to the marine ecosystem for the benefit of research which will create awareness to the fisherman about the changes in the Marine habitat and suggest and advocate the use of proper crafts and gears in fishing and allied activities. A well prepared data base is required for planning of research and development of marine fisheries across the world to analyse and find solutions for the sustenance of the marine ecosystem [20]

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S.No	Name of the fishes	Name of the fishes Scientific Name	
1	Indian oil sardine	Indian oil sardine Sardinella longiceps	
2	Goldstripe sardinella	Sardinella gibbosa (Bleeker,1849)	Clupeidae
3	White sardine	Sardinella albella	Clupeidae
4	Fringe scale sardine	Sardinella fimbriata (Valenciennes,1847)	Clupeidae
5	Indian mackerel	Rastrelliger kanagurta (Cuvier,1817)	Scombridae
6	Seerfish/kingfish	Scomberomorus commerson	Scombridae
7	Indopacific king mackerel	Scomberomorus guttatus	Scombridae
8	Kawa kawa	Euthynnus Affinis (Cantor,1849)	Scombridae
9	Pacific Bonito	Sarda chilensis	Scombridae
10	Pacific blue fin tuna	Thunnus orientalis	Scombridae
11	Striped Bonito	Sarda orientalis	Scombridae

Table 1. Biodiversity of Marine Fishes in Karaikal - South East Coast of Tamil Nadu





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12	Frigate tuna	Auxis thazard	Scombridae
13	Little tunny	Euthynnus alletteratus	Scombridae
14	Yellow fin tuna	Thunnus albacares	Scombridae
15	Long fin tuna	Thunnus alalunga	Scombridae
16	Spanish mackerel	Scomberomorus maculatus	Scombridae
17	Wahoo	Acanthocybium solandri	Scombridae
18	Blue mackerel	Scomber australasicus	Scombridae
10		Escualosa thoracata	Character
19	White sardine	(Valenciennes,1847)	Ciupeidae
20	T T'1 '1' - 1	Tenualosa ilisha	Character
20	Filisa llisna	(Hamilton,1822)	Ciupeidae
21	Skipjack tuna	Katsuwonus pelamis	Scombridae
22	Horse mackerel	Trachurus trachurus	Carangidae
23	Indian scad	Decapterus russelli	Carangidae
24	Selar scad	Selar crumenophthalmus	Carangidae
25	Hard tail scad	Megalspis cordyla	Carangidae
26	Malabar trevally	Carangoides malabaricus	Carangidae
27	Bluefin trevally	Caranx melampygus	Carangidae
28	Giant trevally	Caranx ignobilis	Carangidae
29	Black trevally	Caranx Iugubris	Carangidae
30	Mackerel scad	Decapterus macarellus	Carangidae
31	Leather jacket fish	Oligoplites saurus	Carangidae
32	Black pomfret	Parastromateus niger	Carangidae
		Scomberoides lusan	0
33	Double spotted queen fish	(Forsskal,1775)	Carangidae
34	Malayan half beak	Dermogenys pusilla	Hemiramphidae
35	Spotted halfbeak	Hemiramphus far	Hemiramphidae
		Pristis pristis	
36	Saw fish	(Linnaeus,1758)	Pristidae
		Belone belone	
37	Needle fish	(Linnaeus,1761)	Belonidae
38	Flying sail fin fish	Parexocoetus dorab	Exocoetidae
39	Dorab wolf herring	Chirocentrus dorab	Chirocentridae
10	Fourtinger thread fin		
40	Fourfinger thread fin fish/Indian salmon	Eleutheronema tetradactylum	Polynemide
40 41	Fourfinger thread fin fish/Indian salmon Barramundi	Eleutheronema tetradactylum Lates cakarifer	Polynemide Latidae
40	Fourfinger thread fin fish/Indian salmon Barramundi	Eleutheronema tetradactylum Lates cakarifer Trichiurus lepturus	Polynemide Latidae
40 41 42	Fourfinger thread fin fish/Indian salmon Barramundi Belt fish	Eleutheronema tetradactylum Lates cakarifer Trichiurus lepturus (Linnaeus,1758)	Polynemide Latidae Trichiuridae
40 41 42 43	Fourfinger thread fin fish/Indian salmon Barramundi Belt fish Small head hairtail	Eleutheronema tetradactylum Lates cakarifer Trichiurus lepturus (Linnaeus,1758) Leptuaracanthus savala	Polynemide Latidae Trichiuridae Trichiuridae
40 41 42 43 44	Fourfinger thread fin fish/Indian salmon Barramundi Belt fish Small head hairtail Red drum	Eleutheronema tetradactylum Lates cakarifer Trichiurus lepturus (Linnaeus,1758) Leptuaracanthus savala Sciaenopus ocellatus	Polynemide Latidae Trichiuridae Trichiuridae Scianidae
40 41 42 43 44 45	Fourfinger thread fin fish/Indian salmon Barramundi Belt fish Small head hairtail Red drum Yellow croaker fish	Eleutheronema tetradactylum Lates cakarifer Trichiurus lepturus (Linnaeus,1758) Leptuaracanthus savala Sciaenopus ocellatus Larimichthys polyactis	Polynemide Latidae Trichiuridae Trichiuridae Scianidae Scianidae
$ \begin{array}{r}     40 \\     41 \\     42 \\     43 \\     44 \\     45 \\     46 \\ \end{array} $	Fourfinger thread fin fish/Indian salmon Barramundi Belt fish Small head hairtail Red drum Yellow croaker fish Queen fish	Eleutheronema tetradactylum         Lates cakarifer         Trichiurus lepturus         (Linnaeus,1758)         Leptuaracanthus savala         Sciaenopus ocellatus         Larimichthys polyactis         Seriplus politus	Polynemide Latidae Trichiuridae Trichiuridae Scianidae Scianidae Scianidae
40 41 42 43 44 45 46 47	Fourfinger thread fin fish/Indian salmon Barramundi Belt fish Small head hairtail Red drum Yellow croaker fish Queen fish Atlantic croaker	Eleutheronema tetradactylum         Lates cakarifer         Trichiurus lepturus         (Linnaeus,1758)         Leptuaracanthus savala         Sciaenopus ocellatus         Larimichthys polyactis         Seriplus politus         Micropogonias undulates	Polynemide Latidae Trichiuridae Scianidae Scianidae Scianidae Scianidae
40 41 42 43 44 45 46 47	Fourfinger thread fin fish/Indian salmon Barramundi Belt fish Small head hairtail Red drum Yellow croaker fish Queen fish Atlantic croaker	Eleutheronema tetradactylum         Lates cakarifer         Trichiurus lepturus         (Linnaeus,1758)         Leptuaracanthus savala         Sciaenopus ocellatus         Larimichthys polyactis         Seriplus politus         Micropogonias undulates         Stolephorus indicus	Polynemide Latidae Trichiuridae Scianidae Scianidae Scianidae Scianidae
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$ \begin{array}{r}     40 \\     41 \\     42 \\     43 \\     44 \\     45 \\     46 \\     47 \\     48 \\     40 \\   \end{array} $	Fourfinger thread fin fish/Indian salmon Barramundi Belt fish Small head hairtail Red drum Yellow croaker fish Queen fish Atlantic croaker Indian Anchovy	Eleutheronema tetradactylum         Lates cakarifer         Trichiurus lepturus         (Linnaeus,1758)         Leptuaracanthus savala         Sciaenopus ocellatus         Larimichthys polyactis         Seriplus politus         Micropogonias undulates         Stolephorus indicus         (Van Hasselt,1823)         Thryssa malabarica	Polynemide Latidae Trichiuridae Scianidae Scianidae Scianidae Scianidae Engraulidae





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50         Commerson's anchovy         Stolephorus commersonni         Engraulidae           51         Spotty face anchovy         Stolephorus baganensis         Engraulidae           52         Bagan anchovy         Stolephorus baganensis         Engraulidae           53         New jersy anchovy         Thrussa encrasichloides         Engraulidae           54         Gangetic anchovy         Thrussa mustaw         Engraulidae           55         Hamiltons thryssa         Thrussa mustaw         Engraulidae           56         Pick handle barracuda         Sphyraena barracuda         Sphyraenidae           57         Great barracuda         Sphyraenidae         Carcharhinus           58         Black tip shary         Carcharhinus limbatus         Carcharhinidae           60         Bignose shark         Carcharhinus macloti         Carcharhinidae           61         Hardnose shark         Carcharhinus macloti         Carcharhinidae           62         Grey mullet         Mugli cephalus         Muglidae           63         Red mullet         Mullus barbatus         Mullidae           64         Pompano dolphin fish         Coryphaena equiselis         Coryphaenidae           65         Mahi mahi         Gorgeres langerostris					
51         Spotty face anchovy         Stolephorus toaitei         Engraulidae           52         Bagan anchovy         Stolephorus bagarensis         Engraulidae           53         New jersy anchovy         Thryssa mystax         Engraulidae           54         Gangetic anchovy         Thryssa mystax         Engraulidae           55         Hamiltons thryssa         Thryssa hamiltonni         Engraulidae           56         Pick handle barracuda         Sphyraenia jello         Sphyraenidae           57         Great barracuda         Sphyraenia jello         Sphyraenidae           59         Spadenose shark         Carcharhinus altimus         Carcharhinidae           60         Bignose shark         Carcharhinus macloti         Carcharhinidae           61         Hardnose shark         Carcharhinus macloti         Carcharhinidae           62         Grey mullet         (Linnaeus,1758)         Mugilidae           63         Red mullet         Mulliba         Coryphaena hippurus         Coryphaenidae           64         Pompano dolphin fish         Coryphaena equiselis         Coryphaenidae           65         Mahi mahi         (Linnaeus,1758)         Coryphaenidae           66         Bombay duck         Harpodon nehreus <td>50</td> <td>Commerson's anchovy</td> <td>Stolephorus commersonni</td> <td>Engraulidae</td>	50	Commerson's anchovy	Stolephorus commersonni	Engraulidae	
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57         Great barracuda         Sphyraena barracuda (Edwards,1771)         Sphyraenidae           58         Black tip shary         Carcharhinus limbatus         Carcharhinidae           59         Spadenose shark         Scoliodon laticaudus         Carcharhinidae           60         Bignose shark         Carcharhinus altinus         Carcharhinidae           61         Hardnose shark         Carcharhinus altinus         Carcharhinidae           62         Grey mullet         Mugil cephalus         Mugilidae           63         Red mullet         Mullus barbatus         Mugilidae           64         Pompano dolphin fish         Coryphaena hipppurus         Coryphaenidae           65         Mahi mahi         (Linnaeus,1758)         Coryphaenidae           66         Bombay duck         Harpodon nehereus         Synodontidae           67         Greater lizard fish         Surida tumbil         Synodontidae           68         Indian lizard fish         Sundotnitus equulus         Georeidae           70         Silverbelly roach         Gerres subfasciatus         Gerreidae           71         Common pony fish         Eubleakeria splendens         Leiognathidae           72         Splendid pony fish         Karalla durarCuvier,1829) </td <td>56</td> <td>Pick handle barracuda</td> <td>Sphyraena iello</td> <td>Sphyraenidae</td>	56	Pick handle barracuda	Sphyraena iello	Sphyraenidae	
57     Great barracuda     (Edwards,1771)     Sphyraenidae       58     Black tip shary     Carcharhinus limbatus     Carcharhinidae       59     Spadenose shark     Scoliodon laticaudus     Carcharhinidae       60     Bignose shark     Carcharhinus macloti     Carcharhinidae       61     Hardnose shark     Carcharhinus macloti     Carcharhinidae       62     Grey mullet     Mugil cephalus     Mugilidae       63     Red mullet     Mullus barbatus     Mullidae       64     Pompano dolphin fish     Coryphaena equiselis     Coryphaenidae       65     Mahi mahi     (Linnaeus,1758)     Coryphaenidae       66     Bombay duck     Harpodon nehereus     Synodontidae       67     Greater lizard fish     Saurida tumbil     Synodontidae       68     Indian lizard fish     Synodontidae     Gerres longirostris     Gerreidae       70     Silverbelly roach     Gerres subfasciatus     Gerreidae       71     Common pony fish     Leiognathus equulus     Leiognathidae       72     Splendid pony fish     Karalla daura(Cuvier,1829)     Leiognathidae       73     Short nose pony fish     Karalla dausunieri     Leiognathidae       74     Gold stripe pony fish     Karalla dausunieri     Leiognathidae		Great barracuda	Sphyraena barracuda	Sphyraenidae	
58         Black tip shary         Carcharhinus limbatus         Carcharhinidae           59         Spadenose shark         Scoliodon laticaudus         Carcharhinidae           60         Bignose shark         Carcharhinus altimus         Carcharhinidae           61         Hardnose shark         Carcharhinus macloti         Carcharhinidae           62         Grey mullet         Mugil cephalus         Mugilidae           63         Red mullet         Mullus barbatus         Mullidae           64         Pompano dolphin fish         Coryphaena equiselis         Coryphaenidae           65         Mahi mahi         Coryphaena equiselis         Coryphaenidae           66         Bombay duck         Harpodon nehereus         Synodontidae           67         Greater lizard fish         Surida tumbil         Synodontidae           68         Indian lizard fish         Synodons indicus         Synodontidae           69         Strong spine silver biddy         Gerres longirostris         Gerreidae           71         Common pony fish         Leiognathus equulus         Leiognathus equulus           73         Short nose pony fish         Karalla duusumieri         Leiognathidae           74         Gold stripe pony fish         Karalla duusumieri	57		(Edwards,1771)		
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61         Hardnose shark         Carcharhinus macloti         Carcharhinidae           62         Grey mullet         Mugil cephalus (Linnaeus,1758)         Mugilidae           63         Red mullet         Mullus barbatus (Linnaeus,1758)         Mullidae           64         Pompano dolphin fish         Coryphaena equiselis         Coryphaenidae           65         Mahi mahi         Coryphaena equiselis         Coryphaenidae           66         Bombay duck         Harpodon nehereus         Synodontidae           67         Greater lizard fish         Saurida tumbil         Synodontidae           68         Indian lizard fish         Synodontidae         Gerres longirostris         Gerreidae           70         Silverbelly roach         Gerres subfasciatus         Gerreidae         Leiognathidae           71         Common pony fish         Leiognathus equulus (Cuvier,1829)         Leiognathidae           73         Short nose pony fish         Karalla dussumieri         Leiognathidae           74         Gold stripe pony fish         Karalla dussumieri         Leiognathidae           75         Berbis pony fish         Karalla dussumieri         Leiognathidae           76         Malabar reef cod         Ephinephelus malabaricus (Bloch and Schneider,1801)	60	Bignose shark	Carcharhinus altimus	Carcharhinidae	
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82       Lunar tailed big eye       Priacanthus harmer       Priacanthidae         83       Indo pacific sailfish       Istiophorus platypterus       Istiophoridae         84       Unicorn cod       Bregmaceros mcclellandi       Bregmacerotide         85       Unicorn leather jacket       Alterus monoceros       Monacanthidae         86       Slate sweetlips       Diagramma pictum (Thunberg,1792)       Maemulidae         87       Silver moony/Finger fish       Monodactylus argentus       Monodactylidae         88       Bengal tongue sole       Cynoglossus semifasciatus       Cynoglossidae	81	Japanese thread fin bream	Nemipterus japonicus	Nemipteridae	
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86     Slate sweetlips     Diagramma pictum (Thunberg,1792)     Maemulidae       87     Silver moony/Finger fish     Monodactylus argentus     Monodactylidae       88     Bengal tongue sole     Cynoglossus semifasciatus     Cynoglossidae	85	Unicorn leather jacket Slate sweetlips	Alterus monoceros	Monacanthidae	
87     Silver moony/Finger fish     Monodactylus argentus     Monodactylidae       88     Bengal tongue sole     Cynoglossus semifasciatus     Cynoglossidae	86		Diagramma pictum (Thunberg,1792)	Maemulidae	
88 Bengal tongue sole <i>Cynoglossus semifasciatus</i> Cynoglossidae	87	Silver moony/Finger fish	Monodactylus argentus	Monodactvlidae	
	88	Bengal tongue sole	Cynoglossus semifasciatus	Cynoglossidae	





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89	Cod fish	Gadus morhua	Gadidae	
		(Linnaeus,1758)		
90	Sting ray	Dasyatis pastinaca	Dasyatidae	
01	Milk fish	Chanos chanos	Chanidae	
91		(Forsskal,1775)		
92	Black king fish	Rachycentron canadum	Rachycentridae	
93	White/Silver pomfret	Pampus argenteus	Stromateidae	
		(Euphrasen,1788)		
94	Javanese cownose ray	Rhinoptera javanica	Rhinopteridae	
95	Big eye snapper	Lutjanus lutjanus (Bloch,1790)	Lutjanidae	
96	Checkered snapper	Lutjanus decussatus	Lutjanidae	
97	Bluespine unicornfish	Naso unicornis	Acanthuridae	
98	Lunar tail puffer	Logocephalus lunaris	Tetraodontidae	
99	Spotted sickle fish	Drepane punctata	Drepaneidae	
100	Mangrove red snapper	Lutjanus argentimaculatus (Forsskal,1775)	Lutjanidae	
101	Sharptooth job fish	Prstipomoides typus	Lutjanidae	
102	Pomadasys/Javelin grunt	Pomadasys kaakan	Haemulidae	
103	Barred queen fish	Scomberoides tala	Carangidae	
104	Elongate surgeonfish	Acanthurus mata	Acanthuridae	
105	Smoothnose wedged fish	Rhynchobatus laevis	Rhinidae	
		(Bloch and G.Schneider, 1801)		
106	Starry puffer	Arothron stellatus	Tetradontidae	
107	Tiger tooth croacker	Ootolithes ruber	Sciaenidae	
108	Lunar tailed big eye	Pricanthus hamrur	Pricanthidae	
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**REVIEW ARTICLE** 

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# A Review on Potential of Eco-Tourism as a Tool for Community Development in Rural Areas of India

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## ABSTRACT

Ecotourism comprises of a highly sensitive yet potential sector within the tourism sector in India. Ecotourism is a multidimensional science aiming to educate the tourist about the local environment rather than earning profits. Ecotourism is not about changing the local area and culture to accommodate the tourists. It is about caring for the environment and giving back to the local communities. In relation to this the following paper discusses about various dimensions of ecotourism and its distinction from normal tourism. It discusses about the pros and cons of ecotourism industry with specific reference to Indian scenario. The challenges faced by the tourism sector and initiatives taken by the government and other stakeholders have also been discussed.

Keywords: Ecotourism, Rural, Sustainability, Local Community, Development

## INTRODUCTION

Tourism is essentially a highly social business [1]. The social nature of tourism is manifested by the inclusion of varied nature of stakeholders in the tourism process and also in the interaction of individual tourist with the local community [1]. Tourism researchers believe that the concept of tourism is deep rooted in the model of sustainability [2] and that it has the potential which would help in achieving the assured goals of sustainable development [3]. Recent trends in global tourism indicate a division in the tourist market where a majority of tourists are opting for specialized types of tourism [4]. Tourists are moving away from traditional package holidays and choosing





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ecotourism activities like sporting and recreational activities [5]. Gradually the rural population in developing countries have also moved away from farming as a sole source of income. In fact they have discovered multiple strategies to make a living, eco-tourism being one of such sectors [6]. The tourism sector has over a period of time distinguished itself as a rapidly growing sector in the world [1]. The industry has a special significance for the developing countries as for 83% of them tourism sector is the major foreign exchange earner [7]. India as country is considered to have a vast potential for ecotourism as it is one among twelve mega bio-diverse countries of the world [8]. Around 6.23% of the India's GDP and 8.78% of country's employment is generated through tourism industry [9]. India provides matchless geographical range and diversity that justifies its popularity as a favoured ecotourism destination. Directly or indirectly the ecotourism sector contributes to around 3.8% of total new employments in the country every year [8].

#### The Concept of Ecotourism

Ecotourism is a considered as a part of sustainable tourism. The only point of difference is that ecotourism focuses more on ecology [10]. Ecotourism aims at deriving maximum pleasure with a concern for conservation needs. So any tourism that does not decrease the resources base of an area and ensures the same experience for future travellers is sustainable tourism. Ecotourism is grounded on four things – nature orientation, eco sustainability, research and involvement of the community [11]. The premise of ecotourism is that income generated from foreign tourists can be ploughed back for the development of the local community. The advantages of ecotourism provides them employment opportunities and a source of alternative income. In absence of that the local community depend heavily on the surrounding ecosystem thereby causing gradual degradation in their environment. Apart from this ecotourism concept encourages socio-cultural and physical wellbeing of the local community by making them aware about environment friendly approaches [12]. Welfare of the local community and health of the ecosystem are synergistic in nature. Welfare for the people of the area increases staff self-esteem resulting in higher quality of services and customer satisfaction [13]. An important part of ecotourism is involving local community in the tourism activities thereby ensuring the development of tourism on one hand as well as the economic development of the region on the other. In ecotourism the tourists show a high degree of attachment towards the environment [12].

Ecotourism involves a number of stakeholders like local communities, tourists, tour operators, NGOs, Govt. officials etc. [6]. Eco tourism site can be developed easily if local communities see their role and benefits in the project. When a new ecotourism project is implemented the local communities undergo fundamental changes in their traditional ways of living which mostly are not negative [14]. Ecotourism projects and promotes active citizenship among local communities when they join hand for successful implementation and functioning of the projects. In the process many new skills are gained by the local people like increased communication skills, learning new languages and making friendships. Through this process the pride and respect of local communities are increased for their own environment. The local people also feel motivated to celebrate and enhance their experiences by celebrating various festivals and traditions [14]. The economic benefits of ecotourism to local communities can be further extended by involving more local products and services, increasing joint venture partnerships, encouraging charity among its stakeholders and focusing on marketing plans that aim at increasing the tourist average daily spend [15]. Local community involvement helps in decreasing environmental pressure by engaging the locals in tourism activities. It also helps in ploughing back some of the revenues back to the community [12]. Eco tourists prefer those tourism companies who use environmentally suitable equipment and products. Tourism operators are now giving more importance to understand the likings and requirements of specific ecotourism destinations. Invariably the environmentally conscious customers prefer to link with ecotourism agents following environmentally sustainable practice [16]. In ecotourism private businesses also hold an important place as they help in extending sustainable practices as a whole and also to individuals. The shared revenue with the local community could help them to decrease their dependence on environmentally degrading practices like mining, hunting, logging etc. It would also instil a sense of pride in them about their dwelling in environmentally friendly habitation [17].




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### CHALLENGES

The eco-tourists also should have a social responsibility towards the environment and other stake holders in the tourism process. There are examples where many natural habitats have been destroyed due to ever increasing demand of tourists for luxurious facilities and other services during their stay in ecotourism sites [18]. Ecotourism has been criticized on several occasions for polluting the local culture by interfering with their value system. Some instances of interference with the local value system include addiction of drugs, thefts etc. [12]. Under traditional tourism setups various multinational corporations have tied up with various star hotel chains in India providing monotonous services to tourists which have very little to do with learning about local culture and environment. It instead shows no respect for the fundamental elements of tourism like sun, climate, water and sand [19]. There exists a lack of awareness about ecotourism and its benefits among local communities, while other stakeholders have reservations about the effectiveness of ecotourism activities in rural areas [10].

In cases where the local communities were said to be beneficiaries of ecotourism projects, the offerings were limited to small job roles like guides, cooks, sweepers or cleaners etc. The benefit of revenue sharing with the local community was completely ignored. Also the need for capacity building programs before assessing the eligibility of locals for various jobs in ecotourism was also ignored by the authorities and other stake holders [19]. The entertaining activities of ecotourism have become more self-indulgent and pleasure seeking activities posing a negative threat to the cultural, environmental and natural heritage of the ecotourism areas. Such activities create a dichotomy of interests between the tourists and local communities [20]. It has been observed in some cases of ecotourism development that local communities are prohibited from entering into their own habitat (forest area) by the tourism authorities in the pretext of causing damage to the forest environment. In the present scheme of things all stakeholders have benefitted from the ecotourism development efforts except the local communities themselves [20]. Another threat to sustainable development of ecotourism is 'greenwashing', where the businesses operating in the area mislead the tourists in to believing that the organisation and the site endorse sustainable practices. Such practices cause severe damage to the surrounding ecosystem and culture [17]. The discovery of new ecotourism sites also increases the dangers of hit and run tourism where there is sudden burst in number of tourists visiting the new site within a short span of time and soon after abandoning it after its degradation. This type of practice by the tourists has very detrimental effect on the local economies and ancient cultures [18]. There may be heavy inflow of tourists upon discovery of a new ecotourism site. So the authorities should be careful about the increased deposits of solid wastes in these sites [21].

#### RESPONSES

In order to popularise India as a preferred tourist destination, Govt. of India announced the Incredible India campaign in 2002; this increased the volume of foreign tourists into India by 16 per cent in the next year [17]. In spite of the huge potential of tourism as a tool for development, its scope has been questioned in the wake of adverse environmental impact of tourism. So ecotourism emerges as a viable tool for sustainable development of the rural areas in the long run [1]. If the potential rural tourism sites can be converted into places of ecotourism it will lead to economic development as well as help to protect the rich flora, fauna and cultural heritage of the areas [22]. An important step in this direction would be adoption of joint forest management system, where the benefits of conservation efforts can be extended by the state govt. to the local communities. There are already 1, 18,213 JFM committees currently operating in India which manage around 22.9 million hectares of forest land. Adopting this method will ensure justifiable sharing of gains derived out of the forests [12]. While framing ecotourism plans for a particular area the basic resource characteristics of the region should be kept in mind [23]. The feasibility of ecotourism projects should be judged keeping in view the strengths of the local community knowledge. Such knowledge can be acquired from the local community through trust, respect and empowerment [12]. In ecotourism the local community members can have multiple roles to play which may help them in increasing their incomes further. For example, a member who offers a home stay to the visitors can act as a guide for tourists to their site [17].





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Several efforts have been made for including multi- stakeholder collaborations, multipurpose aid agencies, foreign businesses and conservation charities. Any of these efforts require strong collaboration between local communities, NGOs, govt. officials from developing countries with their contemporaries in developed countries [24]. Strategic collaboration and cooperation between these agencies has become significant for the successful development of any ecotourism spot [16]. Other initiatives which should be taken by tourism authorities should include water reuse, energy efficiency, recycling and employment opportunities for the local community. The duration of tourist's stay at any ecotourism should depend to a greater extent of their perception of the local ecotourism environment [25]. There is a need to increase awareness among local community that they are responsible for the preservation of the product which offers them a way of living [26]. The local community normally takes ownership first by incorporating a formal business. This business is informed by the local community's knowledge about the area [24]. Sustainable ecotourism needs not only to be ecologically and economically feasible, but also socially and ethically justifiable with the local community [27]. In relation to sustainable infrastructural development of ecotourism the local authorities have to give proper attention to infrastructure and building codes. The amount of impact generated by construction of infrastructure can be minimized by using the local building materials as they do not require any transportation and traditional forms of construction is maintained [17]. NGOs can often act as a bridge between government, businesses and local community. They can play varied roles including providing certifications to local people and businesses on ecotourism, helping in ecotourism research in the area etc. They can also act as enforcement agencies for the ecotourism policies of the government, providing timely feedback on improving those policies [17]. Various stakeholders need to be sensitised about responsible behaviour towards the local community and environment through various capacity building programs like training and counselling activities [16]. The tourism authorities have devised various methods to secure the local communities, their environment and economy. They have advised to employ local people as much as possible in the ecotourism business and to train them for developing their personal as well as professional life.

Most of the goods and services should be purchased locally supporting the local community economically and morally. As far as possible the expertise of the local crafts men are to be used for building the infrastructure of the ecotourism site. All energy needs of the ecotourism site are to be met through sustainable ways like solar energy. A strict waste management policy should be formed by taking into confidence the local municipalities, tourists and staffs. A robust channel of financial support from tourists for encouraging local art and culture should be developed. Revenue generated from ecotourism activities should be used for creating a value addition to the lives of lower rank service providers like cooks, drivers, watchmen etc. [16]. The centre as well as state government should take steps to remove any infrastructural hindrances being faced by foreign eco tourists [10]. Baseline surveys and long-term monitoring tools should be used to minimize adverse effects of ecotourism on the environment and local culture. Such continuous studies can provide a base for understanding the positive and negative impacts of the ecotourism development programs that were implemented in the area. With such information the government authorities and other stakeholders can fine tune the development policies to mitigate the negative impacts and improve the positive impacts. Incorporating live case studies of other areas in addition to baseline surveys and long-term monitoring tools would help further in finding issues which nobody has thought of beforehand [17]. The constitution of India (Schedule XI) confers some decision making powers with Panchayati Raj Institutions. These powers can be used effectively to materialise the immediate goals of ecotourism: conservation of nature and culture, livelihood opportunities and regular supervision .Therefore a provision should be made to get the approval of local selfgovernance institutions (LSGIs) before implementation of any ecotourism plan in any area [19].

## CONCLUSION

Now the community driven ecotourism ventures play a peripheral role in the ecotourism development agenda of the government as there is a lack of targeted schemes specifically for community engagement. In the absence of such targeted schemes local communities fail to prevent the large tour operators to purchase large rural areas and convert



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them into private sites of ecotourism. The need of the hour is a paradigm shift in the outlook of the policy makers and enforcing authorities that keep the interests of the communities in the centre of ecotourism policies and not the profiteering of the large tour operators. At times implementing an ecotourism project in an area may not be in the interest of the local communities at all. The authorities must give required attention to such issues also. The authorities and the policy makers should aim to produce a multiplier effect in the economies of local communities.

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**RESEARCH ARTICLE** 

## Sardar Vallabhbhai Patel an - Analysis

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## ABSTRACT

He was an Indian barrister, a senior leader of the Indian National Congress and a founding father of the Republic of India who played a leading role in the country's struggle for independence and guided its integration into a united, independent nation. After this, Nehru was invited by the British Government to form the Interim Government. If Sardar Patel would have been elected as the President of the Congress, perhaps Sardar Patel could have been the first Prime Minister of the country. During the first three years of independence, Sardar Patel was the Deputy Prime Minister, Home Minister, Information Minister and Minister of State. Sardar Patel may not have been the first Prime Minister of India but he will always be the father of a united India. After Independence, he became India's first Deputy Prime Minister. On the first anniversary of Independence, Patel was appointed as the Home Minister of India. He was also in charge of the States Department and the Information and Broadcasting Ministry. As the first Home Minister and Deputy Prime Minister of India, Patel organised relief efforts for refugees fleeing from Punjab and Delhi and worked to restore peace.

**Keywords:** First Deputy Prime Minister of India. Nehru Called Sardar. The Builder and Consolidate of new India.

## INTRODUCTION

Partel, along with Gandhi and Nehru, was a leading member of the triumvirate which conducted he last phase of India's freedom struggle. He was the "savior" and the "builder". Non- violently, he demolished the princely order Lord Wellesley had created; and in January 1946, he had nearly buried Pakistan in Karachi. Post – independence,





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Patel was the creator of New India just as Surendranath Banerjea was the father of political consciousness to the newly educated class of Indians is the 19<sup>th</sup> century; and Gandhi, the father of mass awakening pre-independence. united, but also safeguard Muslim interests. Nehru, however, voiced his opposition to grouping, as it related to the NWFP and Assam. He even suggested that there was "a big probability" that "there will be no grouping". Patel was more blunt than others in telling Wavell that the mission's "proposed solution was 'worse than Pakistan'; and he could not recommend it to Congress". Bharat Rattan Sardar Vallabhbhai Jhaverbhai Patel (31 October 1875 – 15 December 1950), popularly known as Sardar Patel, was an Indian politician. He served as the first Deputy Prime Minister of India. He was an Indian barrister, a senior leader of the Indian National Congress and a founding father of the Republic of India who played a leading role in the country's struggle for independence and guided its integration into a united, independent nation. In India and elsewhere, he was often called Sardar, meaning "chief" in Hindi, Urdu, and Persian. He acted as Home Minister during the political integration of India and the Indo-Pakistani War of 1947.

## **OBJECTIVES**

In India and elsewhere, he was often called Sardar, meaning "chief" in Hindi, Urdu, and Persian. He acted as Home Minister during the political integration of India and the Indo-Pakistani War of 1947. They complemented each other. The two great leaders of Indian National Congress had mutual admiration and respect. There were differences in approach - but end goal for both was to find what is best for India.

## **Education of Sardar Patel**

He studied in primary school in Karamasad and high school in Petlad. Sardar Patel took a long time to complete his school education. He passed the 10th examination at the age of 22 years. In August 1910, he moved to London for further studies. He completed the 36-month course of advocacy in just 30 months. He returned to India in 1913 and settled in Ahmedabad and became a barrister in criminal law at Ahmedabad bar. From 1917 to 1924, Patel served as the first Indian municipal commissioner of Ahmedabad and he was the president of Municipality from 1924 to 1928. Sardar Patel made his first mark in 1918, when he launched a movement with the help of farmers and zamindars of Kairana (Gujarat) against the decision of the Bombay Government to recover the tax even after the bad crop season. In the year 1928 Patel successfully led the agitation of Zamindars of Bardoli against the increased taxes. After the successful leadership in the Bardoli; he was awarded the title of "Sardar", which means "Leader".

#### Contribution to India's independence movement

During the 1930 Salt Satyagraha; Patel was sentenced to three months imprisonment. In March 1931, Patel headed the Karachi session of the Indian National Congress. Vallabhbhai Jhaverbhai Patel had participated in Gandhi's individual disobedience, and arrested in 1940 and imprisoned for nine months. Patel lost more than 20 pounds weight during his period in jail. During Quit India Movement (1942), sardar Patel was arrested and imprisoned from 1942 to 1945 at the fort in Ahmednagar. He led the Congress Party in the 1937 elections and was a major contender for the post of Congress President for 1937 but due to Gandhi's pressure, Patel withdrawn nomination and Jawaharlal Nehru was elected congress President. Pate/ was once again the leading candidate for the post of President of the Indian National Congress but Gandhi once again intervened and Jawaharlal Nehru was elected as the President of the Congress. After this, Nehru was invited by the British Government to form the Interim Government. If Sardar Patel would have been elected as the President of the Congress, perhaps Sardar Patel could have been the first Prime Minister of the country. During the first three years of independence, Sardar Patel was the Deputy Prime Minister, Home Minister, Information Minister and Minister of State. Sardar Patel may not have been the first Prime Minister of India but he will always be the father of a united India. Patel, one of the six children of Jhaverbhai Patel and Ladba, was born in Nadiad, Gujarat[10]. Patel's date of birth was never officially recorded; Patel entered it as 31 October on his matriculation examination papers. He belonged to the Leuva Patel Patidar community of Central Gujarat, although after his fame, the Leuva Patels and Kadava Patels have also claimed him as one of their own. Patel travelled to attend schools in Nadiad, Petlad, and Borsad, living self-sufficiently with other boys. He





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reputedly cultivated a stoic character. A popular anecdote recounts that he landed his own painful boil without hesitation, even as the barber charged with doing it trembled. When Patel passed his matriculation at the relatively late age of 22, he was generally regarded by his elders as an unambitious man destined for a commonplace job. Patel himself, though, harboured a plan to study to become a lawyer, work and save funds, travel to England, and become a barrister. Patel spent years away from his family, studying on his own with books borrowed from other lawyers, passing his examinations within two years. Fetching his wife Jhaverba from her parents' home, Patel set up his household in Godhra and was called to the bar. During the many years it took him to save money, Patel – now an advocate – earned a reputation as a fierce and skilled lawyer. The couple had a daughter, Maniben, in 1904 and a son, Dahyabhai, in 1906. Patel also cared for a friend suffering from the Bubonic plague when it swept across Gujarat. When Patel himself came down with the disease, he immediately sent his family to safety, left his home, and moved into an isolated house in Nadiad (by other accounts, Patel spent this time in a dilapidated temple); there, he recovered slowly.

#### **Patel Practised Law**

Patel Practised law in Godhra, Borsad, and Anand while taking on the financial burdens of his homestead in Karamsad. Patel was the first chairman and founder of "Edward Memorial High School" Borsad, today known as Jhaverbhai Dajibhai Patel High School. When he had saved enough for his trip to England and applied for a pass and a ticket, they were addressed to "V. J. Patel," at the home of his elder brother Vithalbhai, who had the same initials as Vallabhai. Having once nurtured a similar hope to study in England, Vithalbhai remonstrated his younger brother, saying that it would be disreputable for an older brother to follow his younger brother. In keeping with concerns for his family's honour, Patel allowed Vithalbhai to go in his place. In 1909 Patel's wife Jhaverba was hospitalised in Bombay (now Mumbai) to undergo major surgery for cancer. Her health suddenly worsened and, despite successful emergency surgery, she died in the hospital. Patel was given a note informing him of his wife's demise as he was cross-examining a witness in court. According to witnesses, Patel read the note, pocketed it, and continued his crossexamination and won the case. He broke the news to others only after the proceedings had ended. Patel decided against marrying again. He raised his children with the help of his family and sent them to English-language schools in Mumbai. At the age of 36 he journeyed to England and enrolled at the Middle Temple Inn in London. Completing a 36-month course in 30 months, Patel finished at the top of his class despite having had no previous college background. Returning to India, Patel settled in Ahmedabad and became one of the city's most successful barristers. Wearing European-style clothes and sporting urbane mannerisms, he became a skilled bridge player. Patel nurtured ambitions to expand his practice and accumulate great wealth and to provide his children with a modern education. He had made a pact with his brother Vithalbhai to support his entry into politics in the Bombay Presidency, while Patel remained in Ahmedabad to provide for the family.

#### **Patel Became the Secretary**

At the urging of his friends, Patel ran in the election for the post of sanitation commissioner of Ahmedabad in 1917 and won. While often clashing with British officials on civic issues, he did not show any interest in politics. Upon hearing of Mohandas Karamchand Gandhi, he joked to the lawyer and political activist, Ganesh Vasudev Mavlankar, that "Gandhi would ask you if you know how to sift pebbles from wheat. And that is supposed to bring independence." A subsequent meeting with Gandhi, in October 1917 fundamentally changed Patel and led him to join the Indian independence struggle. In September 1917, Patel delivered a speech in Borsad, encouraging Indians nationwide to sign Gandhi's petition demanding Swaraj – self-rule – from Britain. A month later, he met Gandhi for the first time at the Gujarat Political Conference in Godhra. On Gandhi's encouragement, Patel became the secretary of the Gujarat Sabha, a public body that would become the Gujarati arm of the Indian National Congress. Patel now energetically fought against veth – the forced servitude of Indians to Europeans – and organised relief efforts in the wake of plague and famine in Kheda. The Kheda peasants' plea for exemption from taxation had been turned down by British authorities. Gandhi endorsed waging a struggle there, but could not lead it himself due to his activities in Champaran. When Gandhi asked for a Gujarati activist to devote himself completely to the assignment, Patel volunteered, much to Gandhi's delight. Though his decision was made on the spot, Patel later said that his desire and



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commitment came after intense personal contemplation, as he realized he would have to abandon his career and material ambitions. After Independence, he became India's first Deputy Prime Minister. On the first anniversary of Independence, Patel was appointed as the Home Minister of India. He was also in charge of the States Department and the Information and Broadcasting Ministry. As the first Home Minister and Deputy Prime Minister of India, Patel organised relief efforts for refugees fleeing from Punjab and Delhi and worked to restore peace.

## Princely States in British India

The early history of British expansion in India was characterized by the co – existence of two approaches towards the existing princely states. The first was a policy of annexation, where the British sought to forcibly absorb the Indian princely states nto the provinces which constituted their Empire in India. The second was a policy of indirect rule, where the British assumed suzerainty and paramountcy over princely states, but conceded some degree of sovereignty to them. During the early part of the 19<sup>th</sup> century, the policy of the British tended towards annexation, but the Indian Rebellion of 1857 forced a change in this approach and subduing annexed states, and the usefulness of princely atates as a source of support. In 1857, the policy of annexation was formally renounced, and British relations with the princely states thereafter were based on indirect rule, whereby the British exercised paramountcy over all princely states with the British crown as ultimate suzerain, but at the same time respected and protected them as allies. The exact relations between the British and each princely state were regulated by in individual treaties, and varied widely, with some states having significant autonomy, some being subject to significant control in internal affairs, and some being in effect the owners of a few acres of land with little autonomy.

During the 20<sup>th</sup> century, the British made several attempts to integrate the princely states more closely with British India, creating the Chamber of Princes in 1921 as a consultative and advisory body, transferring the responsibility for supervision of smaller states from the provinces to the centre in 1936, and creating direct relations between the Government of India and the larger prinvely states superseding political agents. The most ambitious was a scheme of federation in the Government of India Act 1635, which envisaged the princely states and British India being united under a federal government. This scheme came close to success, but was abandoned in 1939 as a result of the outbreak of the Second World War. As a result, in the 1940s, the relationship between the princely states and the states. Neither paramountcy nor these arrangements could continue after Indian independence directly between the British crown and the princely states, they could not be transferred to independent India. At the same time, they imposed obligations on Britain that it was not prepared to continue to carry out, such as the obligation to maintain troops in India government therefore decided that paramountcy, together with all treaties between them and the princely states, would come to an end upon the transfer of power.

## A Freedom Fighter

At the urging of his friemds, Vallabhabhai Patel won an election to become the sanitation commissioner of Ahmedabad in 1917. While often clashing with British officials on civil issues, he did not show any interest in politics. Upon hearing of Mohands Gandhi, he joked to Mavlankar that "Mahatma Gandhi would ask you if youknow how to siftpebbles from wheat. And that is supposed to bring independence". But Patel was deeply impressed when Gandhi defied the British in Champaran for the sake of the area's oppressed farmers. Against the grain of Indian Politicians of the time, Gandhi wore Indian style clothes and emphasized the use of one's mother tongue or any Indian languages as opposed to English – the lingua franca of India's intellectuals. Patel was particularly attracted to Gandhi's inclination to action – apart from a resolution condemning the arrest of political leader Annie Besant, Mahatma Gandhi proposed that volunteers march peacefully demanding to meet her. Patel gave a speech in Borsed in September 1917, encouraging Indians nationwide to sign Gandhi's petition demanding Swaraj – Independence from Britain Meeting Gandhi a month later at the Gujarat Political Conference in Godhra, Patel become the secretary of the Gujarat Sabha –a public body which would become the Gujarat arm of the Indian National Congress –at Mahatma Gandhi's encouragement. Patel now energetically fought against veth – the forced





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servitude of Indians to Europeans and organized relief efforts in the wake of plague and famine in kheda. The kheda peasants' plea for exemption from taxation had been turned down by British authorities. Gandhi endorsed waging a struggle there, but could not lead it himself due to his activities in Champaran. When Gandhi asked for a Gujarati activist to devote himself completely to the assignments Sarder Patel volunteered, much to Gandhi;s delight. Though his desire and commitment came after intensive personal contemplation, as he relised he would have to abandon his career and material ambitions. In what was to become Sardar Patel's most lasting legacy, he took charge of the States Department and was responsible for the accession of 565 princely states into the Union of India. Paying tribute to him, Nehru called Sardar 'the builder and consolidator of new India.' Nehru and Patel was a rare combination. They complemented each other. The two great leaders of Indian National Congress had mutual admiration and respect. There were differences in approach - but end goal for both was to find what is best for India.

## Nehru and Patel

There were differences in the choice of Congress presidential candidates in 1950 between Nehru and Patel. Nehru supported J.B. Kriplani. Patel's choice was Purushottam Das Tandon. In the end, Kriplani was defeated by Patel's candidate Purushottam Das Tandon. However, it should be noted that the differences were never big enough to result in a major split in the Congress or the Government. Patel was always loyal to Gandhi. However, he differed with Gandhiji on certain issues. Following Gandhiji's assassination, he said: "I claim to be nothing more than an obedient soldier of him like the millions who obeyed his call. There was a time when everyone used to call me his blind follower. But, both he and I knew that I followed him because our convictions tallied". Patel supported Gandhi's non-co-operation Movement and toured the state to recruit more than 300,000 members and raise over Rs. 1.5 million in funds. Helping organise bonfires in Ahmedabad in which British goods were burned, Patel threw in all his English-style clothes. Along with his daughter Mani and son Dahya, he switched completely to wearing khadi, the locally produced cotton clothing. Patel also supported Gandhi's controversial suspension of resistance in the wake of the Chauri Chaura incident. In Gujarat he worked extensively in the following years against alcoholism, untouchability, and caste discrimination, as well as for the empowerment of women. In the Congress, he was a resolute supporter of Gandhi against his Swarajist critics. Patel was elected Ahmedabad's municipal president in 1922, 1924, and 1927. During his terms, he oversaw improvements in infrastructure: the supply of electricity was increased, drainage and sanitation systems were extended throughout the city. The school system underwent major reforms. He fought for the recognition and payment of teachers employed in schools established by nationalists (independent of British control) and even took on sensitive Hindu-Muslim issues. Patel personally led relief efforts in the aftermath of the torrential rainfall of 1927 that caused major floods in the city and in the Kheda district, and great destruction of life and property. He established refugee centres across the district, mobilised volunteers, and arranged for supplies of food, medicines, and clothing, as well as emergency funds from the government and the public.

#### Sardar Patel – The Iron Man of India

His life has been an inspiring and motivating one. Firstly, he achieved his professional goals with very little support from others and thereafter playing a major decisive role in bringing the people of India together to fight for the nation's independence. His belief in the principle of Unity in Diversity and stand united for the common cause of India's Independence made him the Iron Man of India. he has been given the title of Sardar Patel, meaning leader Patel. A charismatic leader who spoke straight from his heart, respected the opinion of those who disagreed with him – Sardar Patel, strongly believed in the unity of Indians who fought the British together and their ability to progress from 'Swarajya' to 'Surajya'. He was a staunch believer in equality, stood for women empowerment and self-sufficiency through rapid industrialisation.



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## 15 facts about Sardar Vallabhbhai Patel

### Fact 1 – Integration of 562 princely states into the Republic of India

Diplomacy, negotiations and his great foresight helped Sardar Patel integrate the numerous princely states into the Indian Union without bloodshed. His efforts in uniting a scattered nation lives on as his biggest legacy, where his powers of persuasion and his statesmanship came into full play.

#### Fact 2 – Contributions to the Constituent Assembly

Sardar Patel played an important role in the selection of members of the drafting committee. He took a strong stand on key issues such as fundamental rights, the position of the prime minister, the election procedure of the President and the status of Kashmir. He worked to ensure that the princely states accepted the constitution of India – a pivotal step towards unification of India.

#### Fact 3 – The founder of Modern All India Services

Sardar Patel was instrumental in the founding the Indian Administrative Service and the Indian Police Service. He ensured the defence of Indian civil servants from political attack and is remembered as the "patron saint" of India's services.

#### Fact 4 – The protector of Kashmir

In September of 1947, when Pakistan attempted to invade Kashmir, Sardar Patel ruthlessly protected Kashmir from Pakistan. Nehru passed on reports to Patel that forces in Pakistan were "making preps to enter Kashmir in large numbers". On October 26, at a meeting held in Nehru's house, Patel promised Mehr Chand Mahajan, the Prime Minister of Maharaja Hari Singh, that India will extend her unwavering support to Kashmir.

#### Fact 5 – A strong leader of the Non-cooperation Movement

During the Non-Cooperation Movement he toured the country and recruited 300,000 members and collected Rs 15 lakhs towards the party fund. His support to the Non-cooperation movement and Gandhian ideals of satyagraha, aided by his oratory skills – short but straight from the heart, would mark the beginning of mass participation in the Indian freedom struggle.

#### Fact 6 – The 'Sardar' of Indian satyagraha in absence of Gandhiji

He led the Satyagraha in Nagpur in 1923 against the British law banning the hoisting of the Indian flag. He was a great orator, leader and unifier who in the absence of Mahatmaji kept the spirits of the satyagraha. Patel negotiated a settlement, which involved the release of prisoners and hoisting of the national flag in public.

# Fact 7 – A strong voice against untouchability, caste discrimination and a voice for emancipation of women

In 1922 a session of the Indian National Congress, when Sardar Patel a separate enclosure for the Dalits, instead of occupying a seat earmarked for him in the main enclosure, he straightway proceeded to the enclosure meant for Dalits and sat there and delivered his speech from that enclosure. During the Bardoli Satyagraha, Sardar Patel consulted with large number of women to prepare the strategy of the Satyagraha and brought them into the lexicon of politics. Sardar Patel's support to the Hindu Code Bill brought out his commitment to the rights of women and their empowerment, by ensuring every citizen was treated equal.

#### Fact 8 – The strongest advocate of Secular India

In June 1947, when he was suggested that India should be declared a Hindu state, with Hinduism as the official religion, Sardar Patel rejected the suggestion. Sardar Patel strongly endorsed Mahatmaji's vision for a Secular India, and said "we must not forget that there are other minorities whose protection is our primary responsibility ". In





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1950, he declared that "Ours is a secular state and we cannot fashion our politics in the way Pakistan is doing it. Here every Muslim should feel that he is an Indian citizen and has equal rights as an Indian ".

## Fact 9 – Iron fist against the perpetrators of Mahatmaji's assassination

Sardar Patel banned the RSS after the assassination of Mahatma Gandhi. In a letter to Shyama Prasad Mukherjee written on 18 July, 1948, Sardar Patel said "as [a] result of the activities of these two bodies [the RSS and Hindu Mahasabha], particularly the former, an atmosphere was created in the country in which such a ghastly tragedy became possible. There is no doubt in my mind the extreme section of Hindu Mahasabha was involved in this conspiracy. The activities of the RSS constituted a clear threat to the existence of the Government and the State.

## Fact 10 – A strong voice for communal harmony and against violence

In 1949, a mob descended upon the Babri Masjid, chased away the muezzin, installed an idol of Ram in an attempt to claim it as a temple. Sardar Patel wrote to the then chief minister of Uttar Pradesh, GB Pant, that "there can be no question of resolving such disputes by force". Patel opined that "such matters can be resolved peacefully if we take the willing consent of the Muslim community with us"

## Fact 11 - Building of the party machinery in the struggle for freedom

Mahatmaji gave the Congress a programme for broad-based action. Sardar Patel built up the Party machinery to carry out that programme, ensuring the wide participation of masses. He realised the pivotal role of a party machinery in the struggle for freedom, something that went unnoticed before him. He realised this need during his campaigns and devoted his organisational talents and energy to building up the strength of the Party which could now fight in an organised and effective manner.

### Fact 12 – The fight for self-rule

In the fight for self-rule Sardar Patel's contributions began when he became the sanitation commissioner of Ahmedabad in 1917. He then became the Municipal President in 1922, 1924, 1927. He ensured electricity supply and educational reforms came to Ahmedabad, with the limited resources and power at his disposal.

## Fact 13 – The farmer's Sardar

His devotion to work for the farmers' rights gave Patelji the title "Sardar". In 1918, he led the 'No Tax Campaign' and urged the farmers not to pay taxes after the British imposed heavy taxes after the floods in Kaira. In 1928, the farmers of Bardoli again faced massive tax hikes and the government seized their lands in retaliation when farmers were unable to pay the heavy taxes. After negotiations by Patel, the lands were returned to farmers.

## Fact 14 – The saviour of refugees, weak and marginalised

In the intense violence that ensued as a consequence of partition of India in 1947 Sardar Patel led organising of relief camps, providing emergency supplies, and visited border areas to encourage peace.

## Fact 15 – Foresight and vision

The first Gujarati typewriter was commissioned by Sardar Patel in 1924 for the Ahmedabad municipality. He also stood for the transformation of the country into an industrial power. Sardar Patel aided the setting up of a public health laboratory within Dudheshwar waterworks at Shahibaugh.

## Life after India's Independence

After Independence, he played a prominent role in the Integration of India. He persuaded the rulers of princely states to be united and be part of One India – One Nation, by traveling to far-flung areas and border areas. Initially, after Independence, he was appointed as 1<sup>st</sup> Home Minister of India and simultaneously the Commander in Chief of



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Indian Armed Forces. Later he also became the 1<sup>st</sup> Deputy Prime Minister of India He is among one of the three leaders who led India from 1947 to 1950. Sardar Patel started keeping unwell rapidly since the summer of 1950 and Patel died on 15<sup>th</sup> December 1950 after suffering a massive heart attack at Birla House in Bombay, now Mumbai in Maharashtra, India.

## CONCLUSIONS

In what was to become Sardar Patel's most lasting legacy, he took charge of the States Department and was responsible for the accession of 565 princely states into the Union of India. Paying tribute to him, Nehru called Sardar 'the builder and consolidator of new India. Nehru and Patel was a rare combination. They complemented each other. The two great leaders of Indian National Congress had mutual admiration and respect. There were differences in approach - but end goal for both was to find what is best for India. Sardar Patel's contribution to the Indian Freedom struggle has been remarkable and incomparable. He was an immense source of inspiration for the youth of Nation, not only during the Freedom movement but also in the current day. He is being termed as the self-made man in True sense. His ideologies of Integration have laid the foundation of Unity. He was conferred as the Bharat Ratna Award posthumously in 1991.

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**REVIEW ARTICLE** 

## A Review on Trusted Node, Attacks and Security Challenges in Wireless Sensor Network

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## ABSTRACT

Wireless sensor networks (WSNs) are mostly found in situations where any fixed facilities are just not available. WSN provides some fundamental responsibilities such as routing, packet forwarding message and network management etc over self structured network. This particularly affects the energy, bandwidth and memory computation requirements. Providing trust in WSN is an extra serious task because of deficiency of centralized infrastructure. Since during the deployment of WSN nodes that are fresh unceasing returning and aged ones go from the network, there is demand for maintaining the record also to provide sequestrate certification for the arriving node(s) that are fresh as well as the present node(s) in the network. But due to various types of interruption intimidates and attacks it is tough to fully inspect any new node so as to permit only secure nodes to get linked with the existing safe system. In a network of large size these trusted node(s) will likely be communicating together, all the while permitting or rejecting entry or communication of the conciliated node(s) or trusted model to continue to maintain a stable, secured, trustworthy group of motion nodes. All the problematic techniques have been steadily categorized and their positive and negative points have been discussed.

Keywords: WSN, Bandwidth, Attacks, Security, Trust.





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## **INTRODUCTION**

The interest of research community has significantly increased in Wireless Sensor Networks WSN) during last few years. The nodes in these networks are self organized in order to provide flexible topology for the dissemination of gathered information. Sensor nodes are called as particle. Such networks have been used in variety of applications such as military surveillance, emergency services, commercial and civilian environments [1]. Due to the wireless nature of the nodes, security is the major issue in WSN. Various safety mechanisms e.g., authentication, confidentiality and message honesty are proposed to avoid safety threats, message replay invention of messages. The prime objective of this paper is to find trusted node with various security attacks and challenges of wireless sensor networks.

## Security Issues in WSN

Now a days, existing trust management mechanisms [2,3] designed originally for wired networks, e.g., traditional trust management mechanisms [4,5] that are established for wireless ad-hoc networks aren't suitable for WSNs due to higher consumption of resources like memory and power. Table 1 shows some research issues. So, many trust management mechanisms, e.g., RFSN [6], PLUS [7] and ATRM [8], have been proposed for WSNs. Trust based security is a new way of providing security without using cryptography approaches [9]. Trust based approaches are very useful to deal with node is behavior. The problem to address uncertainty in decision making is dealt with trust and reputation management systems by maintaining past behavior of nodes [10]. The security attacks in WSN may be compared and classified in two categories. The monitoring and listening of channel by unauthorized attackers are referred to as passive attacks. Figure 1 graphically demonstrates passive attack. The eavesdropper and traffic investigation does not make any changes for the data or the system. The unauthorized attackers can be monitoring, listening and modifying the data in channel are known as active attacks. Figure 2 graphically illustrates active attack. Some of the attacks are selective forwarding, black hole and sink hole, hello flood attacks and denial of services.

## Malicious attacks against trust models

One way of categorizing attack is based on abilities and resources a rival has in his control. Sensor nodes are located in large numbers in hostile environment, which makes difficult to guard against interfering or captured by a rival.

## Hello Flood

In this attack, the malicious node can send repeat messages with high transmission power. Many protocols HELLO message are needed to route discovery, the nodes receiving that packet assume that the node is in its transmission range of the sensor [11]. It creates a delusion of being a neighbor to several nodes in the networks and perplexed the network routing.

## Sybil Attack

In this attack, a malicious node gather various identities for posing as a gaggle of many nodes rather than one. This is not relevant as a routing attack alone. It could be used against any crypto-schemes that split the trust between multiple parties. This attack can reduce the effectiveness of fault tolerant schemes [11]. In sybil attack, malicious node can create several fake IDs, then emulate different nodes in the network. The sybil node can operate the recommendations and uphold themselves as trust nodes. So, this attack can be effectively handled by ID or federal trust methods, in which the base station can identify the fake identities.

## **Conflicting behavior attack**

In this attack, a malicious node behave in a various way towards various nodes. For example, malicious nodes can provide good suggestion about node *A* to node *B* and provides bad suggestion about node *A* to node *C*. This way, the conflicting suggestions about the node *A* can baffle the trust model to calculate trust worthiness of node *A*. For the similar reasons as that of bad mouthing attack, conflicting behavior attack can be handled by the trust methods



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which based on direct neighbor sensing (e.g., ATSN [12] and TTSN [13]) or aggregations of multiple observations (e.g., DFDI [14] and TMBBT [15]).

## **DoS** attack

In DoS attack, malicious nodes send misleading information, e.g., misleading recommendations, as much as possible to consume large amount of computing resources. Thus, DoS attack can be effectively handled in the trust model with power conscious, e.g., TMCDE [16] and DFDI [17]. However, the rest of the trust methods depend on event reports can be affected by DoS attack.

## **Collusion attack**

This attack is encouraged by more than one malicious node collaborating and giving wrong recommendations about normal nodes. This attack is much more caustic than above mentioned attack models which executed by one malicious node. Trust models depends on direct inspection of each node (e.g., RFSN [6], ATSN [12], TTSN [13] and GTMS [18, 19]) are not prone to collusion attack. All other trust calculation methods suffer drastically by collusion attacks.

#### Selective forwarding attack

A malicious node can selectively send some packets alone. This dropping of node increases when it is pooled with sink hole. The attack can be used to make a DoS attack targeted to a particular node. In this the malicious node will act as a black hole and refuses to forward the packet [11].

#### Challenges

Providing security in WSN is even more difficult due to the resource limitation of sensor nodes and security concerns remains a serious obstacle to pervasive version of these WSNs [20]. The highly hostile environment corresponds to serious challenges for safety researches. Secure model should use battery lifetime efficiently. WSN goals [21] include confidentiality, Integrity, Data origin authentication, Access control and Availability. It has to plan against the attack like eavesdropping, fabrication, injection, modification and node capturing. The main research area s for security in WSN include key management, secure location, secure routing, attacks and prevention.

#### **Secure Node Selection**

In WSNs, sensor nodes assist with each other to perform selected tasks like localization and tracking. However, the cooperative characteristic among nodes can be easily utilized to attack the whole network by malicious nodes. If suitable nodes are chosen, they have no ability to achieve the task, or cannot complete the task in a satisfying way. So, depends on trust mechanism, Han et al. projected a Reliable Sensor Selection algorithm with power-aware [22,23]. In the trust model, a sensor node is indicated by Node ID, element set of node ID, trust value set of attributes. The trust value for attribute A<sub>i</sub> can be computed as:  $T_{Ai} = \frac{Si}{Ci}$ , where C<sub>i</sub> is the number of the cooperation between neighbor nodes, S<sub>i</sub> is the successful cooperation. The trust model contains direct trust module, indirect trust module and integrated trust module. The direct trust value is calculated as follows:

$$T_{direct} = \frac{\prod_{i=1}^{n} T_{Ai}}{\prod_{i=1}^{n} T_{Ai} + \prod_{i=1}^{n} (1 - T_{Ai})}$$
  
The indirect trust value is calculated as follows:

 $T_{indirect} = W_{reliable} \times T_{reliable} \times W_{strange} \times T_{strange}$ 

Where  $T_{reliable}$  and  $T_{strange}$  denote as the trust value returned by there liable third-party nodes and the strange third-party nodes respectively,  $W_{reliable}$  and  $W_{strange}$  denote as the weight of the reliable third-party nodes and the strange third-party nodes respectively,  $W_{reliable} + W_{strange} = 1$ . Finally, the integrated trust value can be calculated by weighting the direct trust and the indirect trust.





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## Trusted node

Trusted node refers to the node which behaves normally, that is sensing and forwarding packets to exact destination without any information loss. Many types of schemes are used to find the trust node and malicious node detection, some of them are discussed here. Figure 3 graphically illustrates factors affecting malicious node detection. In trust based method, trust values can be calculated from the reputation and behavior of the node [24]. The system is given through the threshold above the threshold the node is normal node otherwise it is malicious. Table 2 compares threshold level. In cryptography key swap mechanism used to find malicious nodes.

## Agent technology

Software agents are software importunate, target oriented computer program that reacts to its background and runs without unremitting direct supervision to perform some task for an end-user. The agents offer effectiveness, clarity and enhancement. The agents are mobile and static. Mobile agents move from system to a different and do their execution, features include autonomy, learning. Static agents are static in nature, it do an equivalent work as mobile agents aside from mobility.

## **Trust computation process**

In wireless sensor network, it is utmost important for the nodes to exchange accurate coordinate information about their location. A misbehaving node, for the purpose to keep itself undetected, may exchange false coordinates information. Therefore, it paved the way for the applicability of trust in secure localization. In [25] authors proposed a distributed trust framework, called DRBTS2), for secure localization of nodes. There are two types of nodes in model: the beacon node (BN) and sensor node (SN). BN have pre-determined information about its location, whereas a mathematical triangulation method is used for determining the location of a SN [26]. In triangulation, sensor node broadcast location request message and wait for specific amount of time. Beacon node responds with its location coordinates and reputation information for each of its neighbor nodes. SN exploits the location information provided by BN and compares the coordinates with its true location. If the difference is between the ranges of error, BN is considered to be trustworthy. Otherwise, it is considered as malicious and its trust rating is decreased. DRBTS enables the sensor nodes to exclude malicious beacon nodes propagating false location information.

## Trust Model

In order to make misbehavior unattractive in ad-hoc networks, CONFIDANT protocol is proposed by [27]. It makes use of node-centric trust model to compute reputation of nodes and exploit potential punishment mechanism for the nodes having low trust rating then predetermined threshold and results in permanent exclusion from the network. Table 3 provides trust establishment factors. The major objective of the protocol is to discourage malicious behavior of the nodes. Figure 4 graphically illustrates trusted behavior identification model. The nodes maintain firsthand and secondhand information for other nodes. The dynamic source routing (DSR) protocol is used for route discovery process. In CONFIDANT, each node consists of four components: i) Monitor, ii) Trust manager, iii) Reputation system, and iv) Path manager. The monitoring component incorporate promiscuous mode to monitor packet forwarding behavior of 1-hop neighbor nodes. Figure 5 graphically illustrates node reputation and behavior of node. The ALARMS messages are also forwarded by monitor to trust manager for evaluation. The trust manager is responsible for handling all incoming and outgoing ALARM messages. The trustworthiness of the node sending ALARM message has to be verified by evaluating its trust levels. Some of the other responsibilities of trust manager includes: take part in route origination, allowing a node to be the part of route and accept routing information. Figure 6 graphically illustrates selection of trusted node.

## Security schemes in WSN

In this section, various types of algorithm and architecture are available to find the trusted node and to find the secure routes are discussed.





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## Algorithm: Neighbor based malicious node detection in WSN

In this paper [28] they propose neighbor based malicious node detection scheme, in this they consider event and periodic modes of operation, due to transient fault may mislead the network that results in wastage of energy and incorrect decision sometimes the normal nodes are removed. This method has two methods to find accurate malicious node as Data smoothing, variation test and confidence level evaluation. Filter performs the smooth reading with the threshold value. In confidence level evaluation the initial value zero or one is assigned to node depends on the neighbor node decision. It represent the trust worthiness of node, each node updates its confidence node level and its neighbor node during event and periodic detection. This method accurately detects and isolates the malicious node which behaves normally. Exact malicious node isolation, It has low false rate. Malicious node detection rate and non-detection rate should be maintained in faults and events.

#### Algorithm: Trust and energy aware routing protocol WSN

In this paper [29] they propose a trust and energy conscious, it is a location based protocol for WSN. The trust values are calculated by the ATMP [30], in addition to that we adding up location and energy to find the trustworthy path. This method incorporates of two phases, setup phase and forwarding phase. In setup phase every node calculates it cost value based on the trust values, energy point of the neighbor node, and location based on the distance between the node to the neighbor node, and the node to the base station. Such as the next best hop node is selected depends on the trust value, energy level and location information. If the cost value is low, that node is preferred to send the packets. In forwarding phase the node forwards the packet depends on its trustworthiness of packets, it is resolute by the trust value of source node, trust limit and MAC. It has Load balancing capacity and Energy efficient. Setup phase is done frequently, when the network size increases.

#### **Proposed Work**

In our work, the comparative study is made based on the fundamental requirement as Energy efficiency, overhead, and security features include authentication, data confidentiality and integrity. Energy efficiency is the target is achieved with minimum energy, overhead is due to memory, computation time.

By the comparative study, the different methods or architecture for malicious node detection are found. The various techniques are cryptography, trust and reputation. Cryptography is the method of encrypting the message using key, it can be decrypted only the key is know. Trust and reputation, trust value is based on the reputation and behavior of the node. From the survey, we identified that, the scheme which offers energy efficiency, less overhead and security features are measured as best scheme to route the data packet securely.

#### Inference from the literature study

Trust models of WSNs should calculate direct trust and indirect trust separately. Direct trust is calculated based on First-Hand Information, while indirect trust is calculated based on Second-Hand Information or recommendations from neighbor nodes. Only calculating direct or indirect trust in not sufficient enough for trust evaluation [31]. Trust models of WSNs should be as simple as possible, i.e. without restrictions on software, hardware, memory usage, computing, processing speed, communication bandwidth, detect the dissimilar attacks easily, and update trust relationships accordingly. Especially, energy efficiency should be considered. In trust models, trust and reputation should be evaluated at the same time, since reputation is a node's opinion of other nodes in the network. Trust can be defined as the mathematical representation of reputation. Therefore, trust is a derivation of the reputation of an entity. Compare to calculating trust directly, using reputation to calculated trust can get a reliable trust value. Trust models based on only one type of feedback are insufficient. The trust models based on previous positive feed backs only can be cheated in a way that, colluded sensors send good reports for each other. Thus, positive and negative feed backs should be taken in to account at the same time. Trust models are designed to improve network security. However, when trust models defend against malicious nodes, they may also be attacked by adversaries. Therefore, in order to improve the robustness of trust models, the related malicious attacked models should be taken in to account.





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## **RESULTS AND DISCUSSION**

Trust table contains the trust entry objects which includes the trust values. Intended design is to have one trust table per node in the network. This will be very similar to the routing table except that it has only trust values for different destination route nodes within the network. Figure 7 graphically illustrates completely 7 Nodes are used with different IP address. The routes are framed from node 1 to node 7. Table 4 illustrates routing table with different parameter. Table 5 shows the trust value with neighbor node. Among these entire node, malicious node have detected and trusted nodes are identified.

## CONCLUSION

In WSNs all nodes share common sensing tasks. This implies that not all sensors are needed to calculate trust worthiness during the whole system lifetime. Choosing some nodes does not affect the overall trust management system. Therefore, if we can plan sensors to work alternatively, the system lifetime can be prolonged. In order to improve accuracy of trust value, more trust metrics can be considered, such as transmission range or radio range packet, packet loss, energy consumption, ling latency, path quality, hop count and so on. From all the work concluded that, most of the work does not provide high level of security. In proposed work took this as major concern and designed an agent based secure routing using trust worthy nodes, have to simulate it by using DNS3 or Packet tracer.

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Table 1: Some Research Issue		
Identified Research issues	Major factor of the issues	Resolution
False reporting	Use of secondhand or indirect information makes the trust building process fast	It makes the system vulnerable to false report attacks.
Bootstrapping	For disaster monitoring and time-critical applications, this type of delay is not acceptable.	To reduce this startup time is still an issue to solve.
Monitoring node's behavior	Majority of the existing trust and reputation models discussed in the literature monitors the behavior of neighboring nodes through promiscuous mode.	Obtained results may not always be true due to noise and other factors that may cause interference. Similarly, it becomes very difficult to monitor the behavior of nodes if directional antennas are used.
Mobility	WSN may exposed to security threats due to high node mobility and frequent changing of neighboring nodes.	Future research should consider this issue in the design of trust and reputation model.
Resource constraints and communication overhead	Some of existing TRMs incorporate indirect trust and key management to evaluate trust. This requires extra data structure, storage and computation resources which is not suitable for resource constraint networks such as, WSN.	In order to disseminate and update trust among the nodes, most of the TRMs discussed in literature employ flooding approach. Such flooding results in high network traffic and increase communication overhead.
Node's collusion	Most of the existing TRMs have not given appropriate attention to this issue. Existing models assume that network is free from node's collusion. However, compromised nodes may collude to decrease reputation value of normal node or increase reputation value of malicious node. This act of compromised nodes badly affects the overall performance of network.	The solution for detection collusion may be derived from sociology, evolutionary biology or psychology, as human communities also exhibit same problem [30].
Weight assignment	The direct and indirect trust evaluates the trustworthiness of node. There are several schemes in literature which weight direct and indirect trust differently. Few schemes assign high weight to direct trust while some schemes assign high weight to indirect trust. The assignment of appropriate weight to relevant information is important factor in TRM.	It is desired to have such a mechanism that enables the nodes to dynamically assign optimal weights.
Quantitative comparison	The qualitative comparison of TRM systems has been provided by most of the	The quantitative comparison of existing TRMs and software test





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literature which is not sufficient to assess	beds should be provided under
the pros and cons of reputation systems.	variety of network
	configurations and node
	densities.

## Table 2: Threshold Table

Level	Threshold	Meaning
1	>= TH1	Trusted node
2	<= TH1 and	Partially
	>=TH2	Trusted Node
3	<=TH3	Black hole
		node

### **Table 3: Trust establishment factors**

Methods name	Techniques
	High trust
Bootstrapping Method	Neutral trust
	Low trust
	Indirect trust
Trust evidence method	Direct trust
	Both direct and indirect
	Probability
	Game theory
Trust computation mathed	Weighting
Trust computation method	Neural network
	Bayesian
	Entropy based
	Ranking based
Decision making method	Weight based
	Threshold based

## Table 4: Routing Table

Destination	Gateway	Interface	Flag	Expire	Hops
10.0.0.2	10.0.0.2	10.0.0.1	UP	2.53	1
10.0.0.3	10.0.0.2	10.0.0.1	DOWN	12.52	2
10.0.0.4	10.0.0.2	10.0.0.1	DOWN	12.01	3
10.0.0.5	10.0.0.2	10.0.0.1	DOWN	13.01	4
10.0.0.6	10.0.0.7	10.0.0.1	UP	2.01	2
10.0.0.7	10.0.0.7	10.0.0.1	UP	2.51	1
10.255.255.255	10.255.255.255	10.0.0.1	UP	9223371981.85	1
127.0.0.1	127.0.0.1	127.0.0.1	UP	9223371981.85	1





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Table 5: Trust table		
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**RESEARCH ARTICLE** 

## Checklist of Available Marine Fishes in Ayikkara Fishing Harbour Kannur, Kerala in the Western Coast of India.

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## ABSTRACT

Kannur is one of the districts in Kerala that has the longest coastline in the state. Ayikkara is a harbour in Kannur, located in the western coast of India. A total of 51 different species belonging to 39 genera and 27 families were observed during the study 2018-2020. The fishes like *Sardinella gibbosa, Rastrelliger kanagurta, Thryssa malabarica and Sardinella fimbriata* are observed throughout the entire study period. The species like *Epinephelus dicanthus,* and *Mugil cephalus* are found to be threatened. The species *Acetabulus narinari* is in the nearly threatened list where as *Rhynchobatus leavis* is found to be among the vulnerable species. The data obtained from Ayikkara is used to compare the biodiversity of Karaikal in Tamil Nadu.

Keywords: Species, Biodiversity, Harbor, Threatened, Coast.

## INTRODUCTION

The west coast of India is located between Kerala in the south and Gujarat in the north extending from the Arabian Sea to the Western Ghats in the east. Kannur is a district in the north of Kerala having the longest coastal area in Kerala state. Total coastal line measures to a distance of 1400 km. The west coast is a region of intense upwelling associated with southwest Monsoon. This coast is generally exposed with heavy surf and rocky shores; and headlands [1]. Fishes are the important source of economy in many countries [2] and Ayikkara is a significant coast, rich in marine fishes for the city of Kannur. Ayikkara or 'city' as it is referred by local community is a small coastal village in kannur district of Kerala. Mappila Bay is a natural Harbour of this small village. On one side of the Bay





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lies the Fort Saint Angeles facing the Arabian Sea with its grandeur which was built by the Portuguese in the 15<sup>th</sup> century. The latitude and longitude of Kannur is 11.87°N and 75.37°E. The harbour is in west coast region. Fish and its products contribute nearly 20% of world's animal based protein consumption and is also a rich source of many micro-nutrients [**3**]. The data of fish catch from this part of southern India is used for our study to make a comparison of the biodiversity of fishes in Karaikal, southeast coast of Tamil Nadu. The foundation of fish research in Kerala is initiated by Francis Day through his book 'Fishes of Malabar' portraying the diversity in marine fishes off the Kerala coast[**4**]. The methods and procedures are repeated as done for Karaikal to make observations and to make an assessment of the differences in the two marine ecosystems using the available statistics.

## MATERIALS AND METHODS

The systematic identification of fishes is done, based on its morphological features such as shape, size and depth, nature of spine, scales, position of mouth, position of eyes, colour, etc. The fishes caught from the harbour are separated mainly on the basis of scales on the body. If scales are present, they are further separated based on the body shape, number and length of fins. After the segregation they are taken to the lab and stored in 5% formaldehyde solution. Then they are identified according to the keys available on integrated photo based online fish identification system, FISH BASE app, image recognition system, taxonomic reference collection and use of scientific experts in the field of marine studies. FAD species identification sheets are also used to identify the fishes besides standard books and journals available as reference such as A Code of list of common Marine Living Resources of the Indian Seas [5], Commercial Sea fishes in India [6], Checklist of Marine fish from Nagapattinam Coastal waters, Southeast coast of India [7], An updated checklist of the Marine fish of Fauna of Redang Islands, Malaysia [8], Present Status of Ichthyofaunal Diversity of Indian Seas [9], Annotated Checklist of Fishes [10], and A checklist of the Marine and Eustarine fishes of the South Orissa, East Coast of India [11].

## **RESULTS AND DISCUSSION**

Out of the total fishes known in India 76% of them are marine fishes. It includes 2492 species belonging to 941 orders and 240 families. In India the average contribution of fish production from west coast is 67% and from east coast is 33% [12]. Kerala got tenth rank in the major fish producing states of India with 5.63 lakh tonnes during 2017-18 and got 6th position in marine fish producing states during the same year with 4.14 lakh tones [13]. The seasons of Kerala falls into three climatic sessions- Pre- monsoon (February to May), Monsoon (July to September), and Post-Monsoon (October to January) [14]. The coastal area of Ayikkara mainly rely on fishing related activities but economical conditions of this area have been badly damaged by the unexpected climatic conditions, floods, over fishing, irrational use of fishing resources at an ever increasing rate over the past years. Due to the Okhi Cyclone which devastated the coast of South India, Sri Lanka, Lakshdweep and Maldives the marine fish production has been reduced by 31% when compared to the previous years [15]. The Chondrichthyes is the class showing the highest percentage of threatened species in the marine ecosystem in Europe [16]. The present scrutiny of the coast forms our document of the recent studies carried out in the coastal area. The distribution of marine fishes along the Ayikkara coastal water amounts to a total of 51 different species which were then identified to be belonging to 27 family and 39 genera from the collection site along the West Coast of India. Different family of fishes were identified along the collection site such as Clupeidae (7), Carangidae(7), Scombridae(6), Serranidae(3), Engraulidae(2), Leiognathidae(2), Sphyraenidae(2), Coryphaenidae(2), Gerreidae(2), Hemiramphidae(1), Belonidae(1), Mullidae(1), Chirocentridae(1), Cynaglossidae(1), Stromatidae(1), Myliobatidae(1), Mugilidae(1), Sciaenidae(1), Bregmacerotidae(1), Xiphidae(1), Rhinidae(1), Trichiuridae(1), Platycephalidae(1), Balistidae(1), Anguillidae(1), Elopidae(1), Nemipteridae(1). The life history of many fishes in this region are influenced by seasonal changes in climate, monsoon influence, floods, availability of phytoplanktons, salinity, tidal surge, etc. Some species are found to be dominant in certain seasons of the year. The maximum number of species was observed in the family of Clupeidae (7) and Carangidae (7). There are





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51 different species belonging to 39 genera and belonging to 27 families. The fishes is *like Sardinella gibbosa, Sardinella fimbriata, Rastrelliger kanagurta,* and *Thryssa malabarica* are observed throughout the study period. The *Epinephelus dicanthus* is threatened, *Acetabulus narinari* is nearly threatened; *Mughil cephalus* is threatened and *Rhynchobatus leavis* is vulnerable. The population of Oil sardine (*Sardinella longiceps*) is decreased in population. The marine fish diversity is influenced by a number of physical and biological factors or sometimes by both the factors. Unusual use of improper crafts and gears in fishing, catching small fishes etc reduce the number of varieties found in the region. Over exploitation of fishing is another cause which leads to the growth of other aquatic forms and resulting in imbalance in the ecosystem. Usage of plastic substances and chemicals in marine water is another cause of worry which has detrimental influence on the growth of marine fishes. These factors underlines the importance of a serious discussion, study and research in the area of marine ecosystem in the world for improving conditions to pave way for preserving diversity in the coastal areas.

## CONCLUSION

Ayikkara once known for its rich source of sardines and other varieties of fishes have seen a decline in the type and variety of fishes in the last decade. Human intervention has always remained as one of the main threats to any of the ecosystems existing in the world. Let us look at the important causes which have lead to its destruction. Temperature, salinity, habitat loss and acidification are the important factors which affects the species richness in an area [17]. Unprecedented floods and climatic conditions pose great threat to the survival of the marine organisms in this part of the marine habitat. There are other reasons as well like unscientific and improper methods of fishing leading to over exploitation of the marine resources with the advent of modern and sophisticated fishing boats. The aquatic and terrestrial management should be correlated because the aquatic habitat's health is related to the incidents of nearby coastal areas [18]. The rate at which certain fishes are disappearing is alarming and is observed that only one or two genera in a family are found in this part of the marine habitat when compared with the rich resources once it had in the past. It has become imperative to analyse and find the solutions to preserve the marine ecosystem. Number of marine fin fish and shell fish species are included in the schedules of I- IV of the wild life (protection) act, 1972 in the year of 2001by Government of India in this regard to promote and sustain conservation activities [19]. A serious study and research in this direction is very much essential to bring back the yester year glory of Ayikkara harbour with diversity and variety. Stringent measures will have to be imposed to preserve and protect the diversity of this marine habitat. A world class and cost effective ecological and socio economic monitoring and evaluation system should be established to improve sustainable growth in marine management [20].

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# Table 1. Checklist of Available Marine Fishes in Ayikkara Fishing Harbour in The Western Coast of India.

S.No	Name of the fishes	Scientific Name	Family
1.	Indian oilsardine	Sardinella longiceps	Clupeidae
2	Goldstripe sardinella	Sardinella gibbosa (Bleeker,1849)	Clupeidae
3	White sardine	Escualosa thoracata (Valenciennes,1847)	Clupeidae
4	Deep bodied sardine	Sardinella albella	Clupeidae
5	Fringe scale sardinella	Sardinella fimbriata (Valenciennes,1847)	Clupeidae
6	Chacunda gizzard	Anodontostoma chacunda (Hamilton,1822)	Clupeidae
7	Hilsa ilisha	<i>Tenualosa ilisha</i> (Hamilton,1822)	Clupeidae
8	Indian mackerel	Rastrelliger kanagurta (Cuvier,1817)	Scombridae
9	Streated Spanish mackerel	Scomberomorus lineolatus	Scombridae
10	Skipjack tuna	Katsuwonus pelamis	Scombridae





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11	Chub mackerel	Scomber japonicus	Scombridae
12	Mackerel tuna	Ethynnus affinis	Scombridge
12		(Cantor,1849)	Scombridge
13	Mackerel scad	Decapterus macarellus	Carangidae
14	Crevalle jack	Caranx hippos	Carangidae
		(Linnaeus,1766)	Culturigitute
15	Double spotted queen fish	Scomberoides lysan	Carangidae
16	Bucknosed trevally	Trachinotus blochii	Carangidae
17	Barred queen fish	Scomberoides tala	Carangidae
18	Giant trevally	Caranx Ignobilis	Carangidae
19	Yellow tail king fish	Caranx heberi	Carangidae
20	Hamilton's thryssa	Thryssa hamiltoni	Engraulidae
21	Malabar anchovy	Thryssa malabarica (Bloch,1795)	Engraulidae
22	Ribbon fish	<i>Trichiurus lepturus</i> (Linnaeus,1758)	Trichiuridae
23	Common pony fish	Leiognathus equulus (Forsskal,1775)	Leiognathidae
24	Pompano dolphin fish	Coryphaena equiselis	Coryphaenidae
25	Gold strip pony fish	Karalla daura	Leiognathidae
26	Blue line grouper	Cenhalonholis formosa	Serranidae
27	Greasy grouper	Eninenhelus tauvina	Serranidae
		Epinephelus dicanthus	Containdade
28	Spiny cheek grouper	(Valenciennes,1828)	Serranidae
29	Pick handle barracuda	Sphyraena jello	Sphyraenidae
20		Sphyraena barracuda	
30	Great barracuda	(Edwards,1771)	Sphyraenidae
31	Barred half beak	Hemiramphus far (Forsskal 1775)	Hemiramphidae
		Belone helone	
32	Gar fish	(Linnaeus, 1761)	Belonidae
		Mullus barbatus	
33	Red mullet	(Linnaeus,1758)	Mullidae
34	Wolf herring	Chirocentrus nudus	Chirocentridae
35	Four lined tongue sole	Cynoglossus bilineatus	Cynoglossidae
36	Silver pomfret	Pampus argenteus (Fupbrasen 1788)	Stromatidae
37	Whipfin silveo biddy	Gerres filamentosus	Gerreidae
38	Spotted eagle rav	Aetobatus narinari	Myliobatidae
00	oponea cagie ray	Muoil cenhalus	in jiiobatidae
39	Flat head grey mullet	(Linnaeus.1758)	Mugilidae
40	Spotted codlet	Bregmaceros mcclellandi	Bregmacerotidae
		Johnius belangerii	
41	Belangeris croater	(Cuvier,1830)	Sciaenidae
42	Silver belly roach	Gerres subfasciatus	Gerreidae



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43	Indopacific king mackerel	Scomberomorus guttatus (Bloch and Schneider,1801)	Scombridae
44	Sword fish	Xiphias gladius (Linnaeus,1758)	Xiphidae
45	Smoothnose wedge fish	<i>Rhynchobatus leavis</i> (Bloch andSchneider,1801)	Rhinidae
46	Grey trigger fish	Balistes Capriscus	Balistidae
47	Mahi-mahi	Coryphaena hippurus (Linnaeus,1758)	Coryphaenidae
48	Indian long fin eel	Anguilla bengalensis	Anguillidae
49	Deep water flathead	Neoplatycephalus contatus	Platycephalidae
50	Tenpounder/Ladyfish	Elops saurus	Elopidae
51	Threadfin bream	Nemipterus Japonicus	Nemipteridae

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**REVIEW ARTICLE** 

## The Nature of Education

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## ABSTRACT

Freedom and inevitability are nature of human life. When humans utilize labor as tools to liberate themselves from the natural world, the emergence of cultural, traditional and ethical norms that make man become slaves are popular. The fact that dishonesty of norms make people become the means of living for each other could be seen as educational corruption. The historical religions and states had produced robotic humans via educational systems for achieving their purposes. If struggles among religions, societies, and political regimes for interests manifested in debates about different norms and the deceit of the inevitability, modern people have been removing those dishonesty and deceit by scientific knowledge. It is undoubted that norms and scientific knowledge makes people and products become robots accordingly. Humans live by standards and programmed robots are of the same nature, but robots serve the real life of humans, and humans comply with standards to obey uncommon things. Peace is gained if nations, societies, religions will have the common understanding of each other thanks to the inevitability of all the truth.

Keywords: Freedom, inevitability, norms, scientific knowledge, education, modern, tradition.





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## **INTRODUCTION**

If entities are concrete, they will exist in relation to their objects. Entities have attractive relation, so it is inevitable that they have mutual interaction, connection, constrain and transformation. An entity that is an object gives away what it has and receives what it lacks. The existence of entities is by themselves, from themselves and free. Freedom only has meaning when it is placed in an actual relation and constrain with objects. The existence of an entity that has an object is the premise for perception, so it is completely different from the concept of existence and nonexistence. The concept of existence and non-existence as the premise for "interpreting the world in different ways" will make sense in thinking, imagination; thus, following the conventional way that stagnant entities have no longer existed, but its mindset has existed. However, if there is no natural world but its mindset has still existed, the existence of mindset is meaningless; as a result, mindset reflects the inevitability of nature, so there cannot be existed mindset of imagination. The entities and phenomena that exist in a mutual interaction and constrain are generally reflected through the relation between the common and the individual, of inevitability and random, cause and effect, content and format, nature and exterior, possibility and reality; simultaneously lie in the process of mobilizing and developing contradictions, the accumulation of quantity leading to the changes the quality, the negation of the negation. All these relations and transformations are objective, popular, diversified, so scientific knowledge reflects the inevitability of relations as well as the development of entities and people. Knowledge that is not able to reflect the inevitability can only be imagined, it is not realistic, so it merely is a product of the spirit, satisfying needs in the illusion. The market economy has eliminated counterfeit and poor quality goods; thereby, the education market has eliminated falsehoods and mistakes of people. This article aims to clarify the nature of education which is approached from the dialectical and historical materialism.

### **Science of Education**

The actual human is the object of life. "All objects that matter to life have a certain value, so people are always the value of life. Man constantly accepts and protects their life with all their body, shape and circumstances. There is nothing that can save humans' life more effectively than humans themselves. If there is no human, life is meaningless" (Nguyen Anh Quoc, Nguyen Minh Tri, Nguyen Mai Lam, 2020: 2714).All objects that are significant to humans' life have a certain value, so humans are always the value of life. To protect the life, humans tend to exchange everything regardless of their body shapes or circumstances. Nothing is able to protect the life as effectively as the owner of that life, "the human body can survive thanks to its human". The body and extremities are bound together to form a human life; similarly, the fact that human is closely bound to the shape of life is inevitable. The natural world demands to be produced, so life is rewarded with pleasure. When human body fails to derive the pleasure of nature, the purpose of maintaining the life is meaningless. Natural life is a objective and the need of life is a means.

If the need is a means, there is no pure means because the means always aims to achieve the objective that is the attainment of pleasure. If the objective of pleasure is achieved, the fertility, or sexual relationship between a man and a woman will become meaningless. If there is no direct sexual relationship between men and women but pleasure can still be achieved, giving birth no longer carries the meaning of nature but the meaning of social responsibility. The child is born no longer due to the need of nature but the need of society, so it is no longer purely a product of nature but also a product of social needs. Life is not only determined by natural conditions but also inevitably regulated by social conditions; therefore, if natural life does not exist, the need of life will lose its meaning; moreover, social life does not exist, life will not exist with the nature's inevitable pleasure-satisfying characteristics. Changing the inevitability between means and objective in satisfying the need leads to the distortion of natural life. Life existing fully complies with natural rules in the process of transforming each other, it is a complete biological apparatus with full of functional parts to ensure that life exists, develops and operates. The necessary natural conditions for living activities including maintaining temperature, implementing biological mechanisms and motor movement require living materials, metabolism between body and environment, the necessary stored energy, for





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manifesting its nature. Life exists with objects, so it requires minimum and necessary energy; hence, life is an entity that needs to breathe, drink, eat, and so forth. The metabolic process between body and environment need to be ensured, so substances such as Na, Mg, K, Ca, Fe are important but people cannot eat stones or metal; however, the fact that those substances are processed and produced in dishes has human nature meaning. Dishes having human nature are not only produced but also meet the need to be created, the scarcity of the natural world becomes humans' object.

Humans explore the natural world by their own labor. Labor is life; as a result, all kinds of labor are respectfully equal, so there is no discrimination between laborers. Labor became a demand; thus, when there was a scarcity of production materials that led to the division of labor, individual, creative and inactive labor were created. Unskilled labor regards traditional production materials as objects, while individual, creative and inactive labor use humans as objects to live on. Unskilled labor does not add value but ensures essential needs of life. Inactive labor is a unique phenomenon manifested in the act of dishonesty, fraud, theft, murder which are gradually eliminated by practice, so people are like to be self-aware thatdishonesty, theft, robbery, murder are nefarious. Education only makes sense for talented people whose talents have not been revealed, shown or who have not understood about the knowledge of human living, so they need to help them to clarify that knowledge. If once the learners cannot understand or they have already known, the requirement for them to have that knowledge is meaningless; therefore, no one educates about dishonesty, theft, robbery, murder because they are certainly eliminated by practice. Regarding the talents that have been developed, the education becomes redundant, so the only task of the society is to create the best conditions for maximizing those talents. When talent has been developed or knowledge has been understood, talent or knowledge is no longer an object to be educated, but the subject of education, it is not only self-education but also educating others. Unique and creative labor is illustrated in the fact that the talent takes humans as objects to live in, the exploitation of human is inevitable, unique but dedicated, that is education.

The relation between the laborers and their products is the relation between their internal and external factors. The workers themselves and their products are different in the form of existence, but have common properties. How humans confront themselves are as identical as how they also confront their products. Humans are manifested by their products of labor; consequently, individual and creative labor is demonstrated by its products. The relationship between individual, creative labor and its products is that of people. Although there are differences between those people in the form of existence, they all have the same nature. When people confront their products, they are revealed sincerely, inevitably, fully and completely. The knowledge that a teacher acquires will be transferred to his or her student. The exchange between human beings is to help everybody gain the inevitable knowledge of human nature in general. Education has the nature of inevitable knowledge and creates actual people. "The senses created by life become humans' objects, so that life has a mutual need among people; as a result, the need of life to be a human is a common phenomenon. That is why no one wants to become animals; in contrast, creatures gradually accumulate human nature" (Nguyen Anh Quoc, Nguyen Minh Tri, Nguyen Mai Lam, 2020: 2715). Everyone in a community becoming various educators brings universal meaning that makes each other's products become human beings of the same nature. Education is a reality of living in the relation between people in order to be inevitably created. It can be seen that each life has different biological and genetic factors, so the emergence of unique phenomena is inevitable. Individual phenomena that meet the needs of specific circumstances and conditions will be honored.

In the context of a large population where living materials become scarce, the possibility of cannibalism may have taken place or limiting fertility needs is necessary. Although the physiological weakness leading to failure of sexual functions is an indispensable exclusive phenomenon, it meets the needs of reality that "do not make lewdness" popularly honored as the norm. Nevertheless, if the standard of "do not make lewdness" becomes a need of life, it deals with the large population problem, solves the scarcity of living materials, the emergence of "respecting parents" standard and "do not murder" is necessary. The norms of "do not make lewdness", "respect parents", "do not murder" ... become the needs in the imagination expressed in the spiritual life."The needs among human society are





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not only the sufficiency of food, drink, fertility, but also communication, search, study, knowledge exchange to live, initiate and make themselves and others better" (Nguyen Anh Quoc, Nguyen Minh Tri, Nguyen Mai Lam, 2020: 2715). Uniquely individual behaviors appear inevitably but have become the need for standards that are common in the imagination manifested in the notions of commandments, precepts, morals, culture, tradition and law. If there was no occurrence of exclusive or unique behaviors, the criteriawould not appear and if a criterion could be followed by everyone, it became meaningless. Even if everyone completely follows the inevitability, it becomes redundant to enact the law on implementing the inevitability. Indispensability is the object of scientific knowledge, and norms are the object of imagined concepts. The corruption of education occurs when standards are produced as a common equity in exchange among people.

In very early times, no one had a need for standards but just wanted to live instinctively with all the inevitability; subsequently, education has trained people for a long time by standards, creating habits, hobbies and becoming the need to live in the imagination, thereby humans have become slaves to the standards, that is the human need for spiritual life. If lives complied fully with natural laws, humans would becomeslaves to such concepts of standards. In other words, lives and humansare imprisoned by prisons and norms respectively. Labor liberates human, but education of standards and norms makethem become slaves. If scientific knowledge educates about the inevitability, the traditional humanities and social sciences educate about imagined norms. Scientific knowledge embodied in creative labor has a social value illustrated by the price of money. Money, norms are popularly produced leading to the money inflation and the standard devaluation, so a value shock is inevitable. Relations among people have been natural and inevitable until standards appear to become living objects of human life. If knowledge of inevitability is scientific, knowledge of norms is imagined that is manifested in the form of concepts. Actual people live by scientific knowledge; the abstract people satisfy the imagined need. If the creative labor produces products with scientific knowledge, education has produced people by knowledge of standards. If knowledge of inevitability is the criterion of scientists, knowledge of standards is the criterion of educators in general, but in fact, the unity between scientists and educators is hard to achieve. Nevertheless, inevitable standards are exclusive and unique, so real educatorsare unique and exclusive, having both scientific knowledge and complying with standards that are manifested in the talents of those who do the teaching job, and the educators living in imaginary are popular. Educators in general have the nature of standard knowledge, so that knowledge becomes ideal in satisfying the spiritual needs of others. If the fact that educators are ordinary labors who have a better life than other professions, the whole society will become educators. Educators are the intermediate class in the process of social classification. The term "educators" could be first seen in the leaders, the priests who had the personality and creativity of the movements, and were honored when meeting the spiritual aspirations of the majority.

Later, religious organizations and the states have educated and transformed people into products to be used in religious purposes or the states' aims. States and religions have followed the standards of their imagination, so those standards have educated and produced their own epochal people; as a result, there are differences in standards and conceptions among various organizations. Different states and religions have educated people about loyalty, love, and serving to each other in a very ambiguous and contradictory way; thus, when putting it in relation to living reality (interests), each state, religion understands those loyalty, love, and service differently. "If every human live in a scientific basic which is full and comprehensive, they will no longer argue about right and wrong but regard everything as an inevitable phenomenon of life. Living by scientific knowledge is a means of exchanging information among humans with all the facts" (Nguyen Anh Quoc, Nguyen Minh Tri, Nguyen Mai Lam, 2020: 2716). Even those who follow the same religion, they have not accepted each other due to the standards, so they divided into many different sects. The offensive against each other between religions, political institutions and societies that have taken place in history is ultimately covered by the different norms. The imagined norms have made it difficult for people to understand by calling forgiveness for each other but not forgiving those who live by norms. The traditional humanities and social sciences are of the nature of religion and the state has not educated people, but are turning people into products like robots of various goods. The traditional humanities and social sciences are not science but an art of living in response to norms thatis manifested in the form of artificial life tricks as nowadays. The art of





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living becomes a popular demand, so educators appear as a profession that can make a living. They can either serve a religion or a particular state. Educators become salaried workers whose job is to produce robotic people to serve the religion and the state.

Bureaucrats and clergy cannot live by the conception and imagination of the standards but live on the basis of citizenship, the religious followers of these standards. If labor takes the means of production as an object to live, exclusive people exploit the standards as the object to live. All those who survive by the practice of norms are exclusive such as the clergy of the religions, the bureaucrats in the state having a private nature. The clergy and the bureaucrats cannot consume the norms to live, but have to eat rice, drink water and breathe air to live; in other words, the life of clergy and bureaucrats depending on the products that are ultimately generalized by educators. The relation among clergy, officials, educators and employees is the exchange of standards with living documents, all expressed by monetary relations. In the conditions of clergy, officials, educators become scarce, standards are valuable, the counterfeit clergy, officials, educators appear; however, when clergy, officials, educators appear popularly, workersare fully exploited and become impoverished. The impoverishment of the workers is satisfied in their spiritual needs in accordance with the standards imagined by clergy, bureaucrats and educators to comfort them. The standards had promised and gave workers hope to live, replacing real life with being prepared to live. The object of education is the promise, hope, and preparation to live for imaginary people, so the object of education is no longer inevitable scientific knowledge, but is prepared by alternative standards that makethe social studies, traditional humanities bearing the nature of religion and the state appeared. If the falseness of knowledge is unable to clarify the inevitability in the relations among entities, the traditional humanities and social sciences conceal the inevitability of particular individuals by standards. "All people no longer believe in the standards, no one can earn nobility, cowardice with the standards as "the parity".

The standard becomes "the parity" but only has a specific history. If no one achieves benefits from the standards, those standards are meaningless for all. Standards that do not become meaningless when being socialized turns into a need in imagination expressed in ethics, laws, commandments, precepts, customs, beliefs, culture, tradition" (Nguyen Anh Quoc, Nguyen Minh Tri, Nguyen Mai Lam, 2020: 2718). When socialism, humanism considered from a stereotypical imagined norm are appreciated but not seen from the inevitability of individuals leading to the discouragement of humans' creativity. If scientific knowledge education is used to create actual people, the traditional humanities and social sciences create abstract people living by ideal standards. "Those who live by standards consider it a necessity of life, so it is common to see the groups of people in the history have favor of standards will live a counterfeit life" (Nguyen Anh Quoc, Nguyen Minh Tri, Nguyen Mai Lam, 2020: 2718).Knowledge of the social sciences, traditional humanities is built on the foundation of concepts, so that knowledge can be seen as "morning is right, afternoon is wrong but tomorrow morning is right". Yet, the natural life and the social life are not separated from the actual people, so clergy, bureaucrats and educators live with the same nature which regards people as objects to make money for their living. The careers using people as the objects to make a living have the same nature of the educational corruption. The corruption of education is not likely to create initiative people, but robotic people to be used for unwanted things.

## The Role of the Science of Educational Makert in the Development of Scientific Knowledge

Human perfection is a process of creating values by living activities, so life is lifelong self-education, depending on specific conditions and circumstances, the goals, methods and objects of education are modified to meet the demands of living activities. The emergence of organizations and educational institutions has been guaranteed by religious organizations or the state, but when scientific knowledge becomes the need of productive working life, especially after the emergence of science and technology, education is not only the needs of religious organizations and the states, but also the needs of workers who need scientific knowledge. The monopoly in religious and state educational institutions has gradually disappeared, while non-religious and non-political educational institutions emerge to meet the needs of scientific knowledge. Scientific knowledge has conditions to develop in the commodity production, it has a certain role to improve labor productivity, product quality, changed designs, and reasonable prices to meet the





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customers' demand. Scientific knowledge becomes the value of life and is manifested in money, is standardized on qualifications in the respective diplomas. The transition of education is intertwined between religious institutions, the state and competitive enterprises, but they all bring a private nature of the living rights because they all use people as objects to make a living. Teaching, educational management, educational services, as well as other professions are salaried jobs. Learners wishing to be granted diplomas and having the knowledge to live in general should pay tuition fees. In any form of educational institutions invested, by political organizations, society or businesses, all staffs in the education sectors and learners are objects to make money in different forms of various educational institutions. The emergence of the education market has made a strong change in education, a shift in religious educational institutions and the states' educational institutions have been made to meet the demand of being more scientific. Moreover, private educational institutions appear make drastic changes in education; the traditional humanities and social sciences have reformed and are increasingly replaced by more scientific knowledge.

Educational products and goods as well as other products and goods that are produced fully comply with the laws of the market, the laws of competition, supply and demand, value; nevertheless, the educational goods are special, so they never lose their values, they have just not met the needs of the society yet. Educational institutions invest in facilities, content, programs, market surveys, accreditation, salary for employees and tuition fees intake; in other words, they make profits mainly from both teachers and learners. Economic institutions are efficient since they are less risky, more advantageous in creating people to meet social needs than other products and goods. In terms of exchange, integration and globalization, the educational sectors have still been a fertile land to exploit. Any education sectors meeting the needs of learners will develop; in contrast, educational sectors that does not meet the needs of learners will be ineffective and bankrupt. The need of learners is to get a degree or acquire scientific knowledge for their prospect careers. In a particular society, when diplomas are appreciated to rationalize the capabilities, qualities, and virtues in working for earnings, the need for diplomas becomes a culture of diplomas. Degrees are not only the conditions to earn money, even a large amount of money and high positions, but can also conceal weak capacities, poor qualities and bad virtues. The promotion in career prospect need diplomas as the main support, those working in education sectors still earn a large sum of money by awarding diplomas.

Regarding a degree or a diploma rewarded as one of the conditions for having scientific reputation, getting a good job, higher salary, and worthy job position, people are willing to pay money to buy it. If there is really the need of people who need degrees to rationalize their lives, the educational environment will be a fertile land to make a lot of money. If educational institutions manage it well, it will limit losses. The problem is how to help owners of the educational institutions work effectively. If there is a group of people still need degrees, the educational institutions will aim to provide learners the degrees, it is more suitable, effective, economical and highly profitable. However, the educational institutions will carefully consider how to make money most effectively regarding of immediate and long-term comparative advantage, then there will be careful calculation to suit the education market. In the society in which capacities, qualities, and virtues evaluated by work performance, the degree culture will not have appropriate conditions to flourish. If in society in which scientific knowledge is needed to serve the work, the degree will become the inferior. Educational objectives, programs and objects have been adjusted to suit the education market. The laws of education has been enacted to standardize the diplomas in the assignment of functions, tasks and job positions because the ordinance actually guarantees educational institutions to do business effectively in accordance with the laws.

If learners need scientific knowledge for their jobs to make a living, education will return to its true value. Scientific knowledge equips students with knowledge to be creative, while standard knowledge turns learners into products. If the phenomenon that businesses, religious institutions, the states get benefits from the "product people" is popular, the actual people who earn money only by their creations become exclusive. People who are creative subjects are educated by scientific knowledge are prestigious, the brand of the educational institutions is confirmed by their quality. Therefore, educational institutions do business effectively when they know how to produce





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products with the nature of common labor to generate large amounts of revenue, gain a large amount of money, and simultaneously create people who are able to meet the difficult market to reserve the brand. The education market is a transition education, with healthy competition in taking advantage of both salaried workers and learners who aim to work in the market economy. It becomes a source of revenue and a driving force to expand the scale, structure, improve the quality of education and economic efficiency. If educational institutions are really profitable business units, the education sector is one of the driving forces of socio-economic development, so it is taxed like other profitable business enterprises. It is effective for the educational institutions operate like a business in the commodity economy. Educational innovation takes practical social needs as a premise in renewing educators in accordance with content, programs, targets and methods. Successful educational innovation career leading to teachers are all measured by the needs of scientific knowledge of learners. In educational institutions with a team of actual teachers to help learners develop their talents in earning money for a living, the student's investment is effective; on the contrary, the opposite wastes both time and money of learners. Thus, the driving force of social development has not been maximized its potential. When learners invest in education, they also aim to reap practical profits via jobs with stable incomes. If the investment in education is really an investment in the future, learners will thoroughly consider before investing in an educational institution, not all general educational institutions.

If the society really has a need of scientific knowledge, a group without the teaching capacity will be unemployed, so the group of qualified teachers becoming scarce will bring education back to its nature. The demand for scientific knowledge is real, the teaching profession is valued. Actual teachers who have their own personality and creativity will teach with their own knowledge because they are confident, responsible and reputable. Other teachers have to depend on textbooks documents and teaching facilities since they do teaching profession with the aim of earning money, although they know the fact that teaching according to the curriculum, textbooks is to produce the "ordered learners". Education totally depending on textbooks and general documents make people with different talents and inborn merits become the same products. Nevertheless, if education does not rely on textbooks and teaching facilities, a part of society will lose their jobs and have no income. The educational economic sector will not have conditions for restructuring, science and technology in the education sector will not have conditions to expand. The teaching process is strictly organized according to the purposes, contents, programs, curricula, textbooks, teaching facilities, training quality accreditation according to a standard process aimingto meet the need of labor market; on the other hand, to handle the situation of poor quality teachers and help educational institutions create jobs for workers, increase revenue sources. If we really want to eliminate the poor quality teachers effectively, we need to turn the educational economy into an educational market and erase the education with knowledge of traditional social science and humanities.

Education between knowledge contained in textbooks, curricula, teaching facilities and experienced from life are different in methodology. Theoretical knowledge and experience with deterrent properties to avoid mistakes in practical historical-specific activities are acquired from textbooks and learning materials. However, the fact that the market economy has abundant goods and a diversified division of labor makes textbooks and teaching materials backward is inevitable. If scientific knowledge has become a popular phenomenon of life, it is not necessary to educate, because it is no longer anexclusive property but becomes a living resource with the nature of the society's common knowledge. The training relying on the educational style of the traditional humanities and social sciences with the concept of standards is also necessary when it is still a need of life. However, it is not proper to teach learners "being afraid of fire but not afraid of burn, being afraid of chili but not afraid of spicy". Education by books and learning materials is only meaningful in orienting and helping learners to have a method of creating their own values, promoting personal talents, meeting social needs in specific conditions and circumstances. Educating people according to given standards is turning people into programmed robots. If the content in references, textbooks, materials is not practical to the needs of learners but still being taught, it may be caused from many reasons including intention and momentumof educational administrators, a group of teachers, or custom-made teaching.




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For an educational business aiming to make profits, the educational institutions tends to prolong the course time of teachers and learners by a curriculum with enough amount of subjects and certificates to ensure their income. Being educated from the young age until working age is a long time; however, when participating in the labor market, people do the same tasks day by day, and their lifestyle has no changes over the years. Educators would like guarantee their income, they prone to show off their abilities, knowledge and quality to fulfill enough periods; consequently, the content is so superior that learners cannot understand. If the aim of teaching is to provide information, there is no way more effective than teaching learners how to use the Internet and master foreign languages. If the teaching method is to deter learners with the thoughts from thousands of years, it will turn learners into antiques, while the socio-economic situation will be backward to the past. If learners really have needs of scientific knowledge, the teacher will only guide and evoke those knowledge. Knowledge that learners do not understand sinceit is not associated with real life needs. If the education market maximizesits strength, the people who do not have enough qualifications and virtues to be a teacher will be eliminated. The education market will eliminate poor quality educational institutions that have no protectionist policy. Therefore, investment in facilities, teaching materials, programs, curricula, accreditation and textbooks will be outdated. Although the educational institutions have different intentions in making profits, the most wise intention is to invest in improving the quality of the teaching staffs. Teaching is a profession easy to make profits, but not earn money at any cost. Money that is not gained by the external, but by the internal qualifications of each teacher is most righteous.

The most ideal education is the one that scientific knowledge may meet the people's needs of living. Yet, education is always in natural circumstances, social conditions that have specific history, so it cannot escape from a certain institution, the concept of beliefs, cultural traditions of a specific ethnicity. If the states certainly need an education to serve their regime, the states can invest funds to the training of institutional loyalty, and religion can invest funds to produce products used for its purposes, the traditional humanities and social sciences educational contents need to be renovated in the direction of taking natural science and technology as the foundation. The innovation in education is a long process that is intertwined between the old and the new, progressive and conservative, scientific and standard knowledge, but educational innovation is inevitable. The most effective change in education is the commercialization of education because education market become an education market traded as other goods, scientific knowledge is socialized, human nature is socialized by scientific knowledge. Nevertheless, the commercialization of education is effective only when does its content create people who meet labor market needs. The market economy is eliminating stalls, counterfeit goods, poor quality goods; similarly, the commercialization of education, the imagination, the illusion of knowledge. However, the most effective education is when everyone lives by scientific knowledge.

#### The Role of Living by Scientific Knowledge in Human Perfection

Natural sciences are studied to help people understand the complexity of the world in inevitable simplicity, while the traditional social sciences and humanities make the inevitable simplicity become a complex popularity in spiritual life. While the correctness of scientific knowledge turns the natural world into products, modern social science makes conventional humans become slavers of those products, and modern humanities make those conventional people become actual people who create all the needs. Modern humanities, social sciences are the science of human beings, and humans' liberation. Labor takes the inevitability of the natural world as the object to create products; meanwhile, education takes humans' inevitability as the object for the creation of humans. How productive labor takes nature as an object to produce material wealth liberates humans from the slavery of the inevitable, scientifically knowledge-based education takes people as the object to liberate them from slavery of pervasive standards correspondingly. When the traditional humanities and social sciences are erased, scientific knowledge becomes popular, and humans are the object of scientific knowledge, so human inevitability is fully researched. The natural sciences that show the inevitability about human will flourish such as medicine, biology, and psychology. If the biology studying the physiology of the human body which has genetic structure, anabolism, catabolism, mutation, and so onin relation to the environment creating the body shape is inevitable; furthermore, the





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medical researches on diseases and the difference of the body reactions is inevitable, psychology could help to see the behaviors derived from body physiology has such inevitability. In general, the inevitability of nature underpinning human science will eliminate moral, ethical, cultural, traditional and legal norms. Changing the objects of social sciences and humanities from traditional to modern is indispensable for the scientific development of humans.

With the development of biology, medicine, and psychology, scientific knowledge is likely to analyze the inevitability of life, death, sickness, and diseases; clearly clarify that no sexual desire due to physiological weakness, no food consume due to fullness, gestures revealing inviting or responding to objects are inevitable. If the lifelong effort of avoiding sexual desire from thousands of years ago has not been succeeded, the surgical medicines could help resolve only in a few hours. If labor is the prerequisite for making a living, the dishonesty, fraud, and inactive labor also dissipate. The beauty, ugliness as the inevitability could bevaried by cosmetic surgery. All bringing humans to the natural sciences, human phenomena are clearly understood. When the natural science of humans is clarified, the existence of all standard notions of beauty and ugliness, good and evil, right and wrong becomes redundant. If these standards are still the society's needs, medicine, biology, and psychology may gain benefits on those needs, so human science has the conditions for strong development.

If each person has different biological, medical, and psychological structures, the inevitability of each individual is different, so it is undoubted that each individual is unique and exclusive. Hence, there are various people with different talents which called "innate". The larger the population, the more considerable the talents of individuals; in other words, those are unable progress in this field can advance in another field. Technology 4.0 may help science of humans have a firmer basis to understand the inevitability of each specific person. Discovering individual talents is an inevitable phenomenon in the diversity of the world. In addition, it is instrumental to know how to maximize each individual's talents in the diverse world, bringing the ubiquitous complexity of the society back to the simple inevitability of the natural world. At that time, each individual is unique and exclusive in not only creating themselves but also creating the entire natural world, the universe covered in the blue color of the Earth. If in the past freedom could be seen that humans were slaves of the inevitability based on their awareness; however, nowadays freedom meansthat knowledgeof inevitability is the slave of humans."If the scientific knowledge is fully disclosed, its nature is well understood, all that become indispensable to life are equal and free. In the process of exchange and integration today, when there is a diversity of professions that take scientific knowledge as the "parity", tradition, morality, commandments, precepts and laws will become the value of the past" (Nguyen Anh Quoc, Nguyen Minh Tri, Nguyen Mai Lam, 2020: 2719 - 2720). If all societies with different religions, traditions, cultures, and morals had taken the inevitability and truth as the standards for mutual understanding, humanity was certainly different. If everyone was born with freedom, there would not appear fraud, dishonesty and murder, or they would appear in the form of psychiatric symptoms that require treatment. If fraud, honesty, inactive labor are still existed in the society, robots will be produced to handle those evils as the medicine for people with mental illness. Human science is not only educated for people to be creative, but also to produce initiative humanunderstandable and human-related products. The products are produced with artificial intelligence thanks to how people connect everything by capturing the scientific knowledge of the entire world.

The products produced carry the status of scientific knowledge like people who were once the products of education with traditional humanities and social science knowledge. If in the past humans were robots of the education of the social sciences and traditional humanities used in religion and what the state wanted, today robots are becoming educated humans. education by social science, traditional humanities like that. If traditional social science has produced robots that have human status in the past few thousand years, then modern social science will make manufactured products into human beings. Robots became popular. While standards are models of human beings, scientific knowledge are essentially the same. "In life when the inevitable is hidden by standards so the inevitability is not revealed. If the indispensable is not hidden by standards, morality, law, tradition, culture, beliefs and religion, it will





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become meaningless. If the inevitable is still commonly hidden by standards, the outlook of liberating people cannot be seen" (Nguyen Anh Quoc, Nguyen Minh Tri, Nguyen Mai Lam, 2020: 2718-2719). The traditional humanities science has created people of imagination, and modern humanities have created actual people.

Modern social science makes all manufactured products containing human nature with the indispensable standards embodied in robots. If robots were humans' objects, they would become tools to create actual humans. Hence, without the existence of humans, robots become meaningless and vice versa. If robots are popular, they will become the object of modern humanities. This humanistic science makes the robots created as humans have been created in the history, those robots are no longer tools of religion or the states but used depending onpeople's purposes. As a result, the scientific management of the world is not to turn people into greatness, but to make them become the needs of all; in other words, without man everything in the universe becomes meaningless, people's interference in the existence of the world is indispensable. Strength is no longer in satisfying needs, but real power is achieved when humans become the need of all. The duty of life is to erase all the inherent abstractions that alienate the actual people. Humans do not create things for humans themselves but for everything having human nature. That is the goodness in which humans are always subjects. After that, the humans' instinct to live becomes the boundless power of the intellectual inevitability, their talents manifested in the truth of life. Strength, wealth is only a means to create a world in accordance with human nature that is the quietand unobtrusive protection of other species and entities, but also very serene when they havefulfilled their responsibilities as actual humans. All defects, if any, are considered humans' responsibility with their altruism. They never blame for other species or entities because everything can be seen as their products. The possession of actual individuals makes humans become the need of all not only for human species but also for the whole world. Human's weakness is turned into external strength by scientific knowledge; meanwhile, the strength of the unusual things are turned into the strength of humans by modern humanities scientific knowledge. Owning the whole universe is still insufficient, but developing the internal humans is always prosperous. Scientific knowledge is the science of humans. If the natural science, the social science and humanities are unusual to actual people, they will become metaphysical and imaginary.

## CONCLUSION

Humans liberate themselves from the slavery of nature's inevitability through creative labor, science and technology; on the contrary, education with knowledge of traditional social sciences and humanities makes humans become slaves of standards. The standards of loyalty, love, service, sacrifice are always abstractly considered lofty and noble, but when those standards are placed in the relation of interest among different countries, societies and religions, they become contradictory and ambiguous. The struggles among different countries, societies and religions in the history have cost money, effort, tears and blood of innocent, and gullible people. All struggles up to now have continued to be threatened by conflicts of religion, ethnicity, culture, and political regimes. History would not repeat itself if there was a simple, effective educational revolution that would create value shocks. However, to achieve the liberalization of human, it is essential to encounter the value shocks to make a change from the value of norms to the indispensable values of all the truth. The struggle for power at the expense of blood and tears has also become the lessons of history, and the revolution of mindset has been partial as a natural history process. If the fact that humans live by scientific knowledge is popular, those who insincerely live by standards will become psychopaths in need of treatment.

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**RESEARCH ARTICLE** 

# **Operations Research and Insurance Industry**

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### ABSTRACT

In operations research, various new algorithms, new modeling techniques and even new approaches are being developed very rapidly. These new methods have been proposed to solve larger and even more complex real world problems. The purpose of this paper is to present the application of operations researchfor modeling and solving different types of problem in the insurance industry.

Keywords: Operations research, Algorithm, Modelling, Linear programming, Insurance.

## INTRODUCTION

Early overviews of operations research in insurance were presented by Zubey [1] who discussed the feasibility of applying operations research methods to the insurance industry Denenberg [2] provide a review of operations research in insurance and Jewel [3] provided another excellent survey recently Haehling Von Lanzenauer and Wright [4]. Presented a very useful overview of the interface of operations research and insurance in the broader context of risk management with a unique feature of explicitly dealing with the decision problems by insurends. The paper is organized as follows : Mathematical Programming Models and their applications in insurance and presented in the next section. This paper is intended to be more technique – oriented, an approach that is consistent.

### **General Mathematical Programming**

A general mathematical Programming problem can be formulated as :

Maximize f(x, y) subject to condition :

$$g_i(x, y) = 0, \text{ for } i = l \dots p;$$
  

$$g_j(x, y) \le 0, \text{ for } j = p, \dots, p + q,$$

(1)



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where x is a non-negative real-valued n-vectors and *y* is a non-negative integer-valued m-vectors. Without loss of generality, it is not difficult to show that the non-negative restriction on the vectors x & y can be made. It is also notice that the general formulation above can encompass both minimization and maximization problems, since minimizing an objective function is equivalent to maximizing the negative of the objective function. It is also easy to transform a "greater than or equal" into "less than or equal to" inequality constraint by simply multiplying the inequality by -1. This confirms that formulation (1) indeed encompasses the most general mathematical programming models. Accordingly, in this paper, we use either maximization or minimization interchangeably without explicit explanation. In the next section, we see how added restriction on the function or on the constraints and variable domain generate the specific type of mathematical Programming problem.

#### Linear Programming Model

For the general mathematical formulation (1), a linear programming problem is obtained when the objective function and the constraints are all linear in the unknown variables. Hence, a linear programming problem can be expressed as follows: Maximize  $\Box_c T_x$  subject to  $Ax \leq b$ , and x is a real-valued vector. Where **A** is an m × n real-valued matrix, **b** is an m-dimensional real-valued vector, and **c** is n-dimensional real-valued vector; that is, we are maximizing a linear function subject to linear inequality constraints. We now present one illustration of LP in the insurance industry, a linear programming method for measuring the cost of whole life insurance Schleef [5].

Compared to more traditional methods (the measure of interest adjusted surrender cost method and Linton's rate of return), the linear programming method requires fewer assumptions, because the only input required is the rate of return that is relevant to the policyholder. The method does not attempt to directly separate the protection and savings components of the whole life policy. It assumes that the insured individual requires a given level of protection and is not concerned with how the insurer breaks down the received premium into loading charges, reserves, and so forth. The method also has the additional flexibility of considering the time at which the insured requires protection. The flexibility of varying the year of required protection is the primary characteristic of the LP method that differentiates it from the more traditional methods. In the LP formulation, the three types of decision variables are the amount  $W_t$  lent externally by the insured at the beginning of year t, and u, the face value of insurance purchased at the time t = 0. It is assumed that the rate of return, i, or borrowing and lending rate are the same (although this could be relaxed in the

LP formulation), so only the net position  $(w_t - z_t)$  appears in the formulation. The objective function is to maximize the discounted cash flows associated with a given policy, which is constrained by the amount that the insured is willing to budget for insurance, and the amounts of protection required in each year to the horizon. The linear programming formulation is shown below:

**Maximize** 
$$(\mathbf{1}+i)^{-n} C_n u + \sum_{i=1}^{n} (\mathbf{1}+i)^{-(t-1)} (w_t - z_t)$$

subject to  $P_t u + w_t - z_t \le b_t$ , for  $t = 1 \dots, n$ ;

$$u + \sum_{i=1}^{j} (1 + i)^{-(t-j)} (w_t - z_i) \ge l_j$$
, for  $j = 1, ..., n$ ; and

 $u, w_t, z_t$  are non-negative, where  $w_t, z_t$  and u are decision variables;  $w_t$  is the amount lent externally by the insured at the beginning of year  $t; z_t$  is the amount borrowed externally by the insured at the beginning of year





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*t*; *u* is the face value of insurance purchased at the time  $t = \mathbf{0}$ ;  $P_t$  is the net premium rate in year *t*;  $C_t$  is the cash-value rate at the end of year *t*;  $b_t$  is the amount budgeted by the insured at the beginning of year *t*;  $I_t$  is the insurance protection required at the beginning of year *t*; and *n* is the number of years in the planning period.

From this primal linear programming model, the dual linear programming model is obtained. By using the "shadow price" interpretation of the dual parameters corresponding to the constraints in the primal problem, the dual LP model can be used to analyze the marginal discount factors for each year and the marginal discounted cost of increasing the death benefit requirement in each year. Linear programming is a very general category programming problem. There are many other interesting applications of LP to insurance. For example, Chan et al [6], Schuette [7] and Hickman [8] provide theoretical discussion and formulation of LP approaches to graduation. Financial management is another mature area in insurance and actuarial science in which the LP method has been widely used Hofflander and Drandell [9], for example, use a linear programming model to discuss profitability, capacity and regulation problems in insurance management Schleef [10] uses a linear programming model for decision-making in life insurance purchases. Conwill [11] develops several linear programming models for maximizing policyholder value in problems of making combined decisions of life insurance product purchasing and asset investment. In his long paper, Conwill discusses the techniques used in building linear programming models for insurance problems, the computational issues involved in solving the linear programming problems, and the interpretation of the results produced from computation. Haehling von Lanzenauer et al. [12] show how to formulate the problem of developing a manpower planning policy as a linear programming problem. Linear programming is also suggested by Jennergren [13]for use as an asset valuation method. Navarro and Nave [14] use linear programming for dynamic investment immunization problems. Indeed, there are many applications of LP methods for problems in financial areas such as capital budgeting, portfolio management, duration matching, and immunization. These applications are also of substantial interest to actuaries and to insurance management.

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**RESEARCH ARTICLE** 

# Analysis of the Efficacy of Larvicide Activity of Neem Bark (*Azadirachta indica* A. Juss) Extract Pesticide on African Malaria Vector *Anopheles gambiae* (*Diptera Culicidae*)

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## ABSTRACT

Mosquito transmits serious human diseases such as malaria, yellow fever elephantiasis, etc., which have been the cause of millions of deaths annually. The use of synthetic insecticides to control vector mosquitoes has developed physiological resistance in the mosquitoes and adverse environmental effect in addition to high operational cost. Insecticides of botanical origin have been reported as useful for the control of such mosquitoes. *Azadirachta indica* (Neem) and its derived products have shown a variety of insecticidal properties. This paper aims at the analysis of the efficacy on Larvicide activity of Neem bark (*Azadirachta indica*) extract pesticide on African malaria vector Anopheles *gambiae* (*Diptera culicidae*) for the control of such mosquitoes. 80 grams of *Azadirachta indica* powder was weighed and extracted with soxhlet using the standard WHO procedures (WHO, 2005). The result shows that the bark extract has a larvicidal activity against Anopheles. This might be due to the effect of phytochemical constituents in the extract such as flavonoid, alkaloid and tannin. Further investigation might be needed for the use of this extract to elucidate active ingredients responsible for larvicidal activity which could be identified and utilized in preparing a commercial product. Index terms: anopheles, *Azadirachta indica* bark extract, phytochemical screening, larcidal bioassay.

Keywords: Efficacy, Larvicide activity, Azadirachta indica, African malaria vector, Anopheles gambiae.

# INTRODUCTION

Mosquitoes are of a family (*Culicidae*) of dipteran flies with females that have a set of slender organs in the proboscis adapted to puncture the skin of animals and to suck their blood and that are in some cases vectors of serious diseases





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(Merriam-Webster, 2019); also, they are small, midge-like flies that constitute the family Culicidae and the two main subfamilies are the Anophelinae and Culicinae, (Lawniczak et al., 2010). Many species of mosquito that bite humans routinely serve as vectors of diseases, that is, they are disease-carrying insects affecting millions of people annually (Molavi, 2003). The two subfamilies comprise about 43 species. The Old and New Anopheles species are believed to have subsequently diverged about 95 million years ago (Calvo et al., 2009). Others that do not bite humans but are the vectors for animal diseases may become disastrous agents for zoonosis of new diseases when their habitats are disturbed, for instance by sudden deforestation (Wilcox and Ellis 2006). Mosquitoes are responsible for the transmission of pathogenic organisms such as Wuchereria bancrofti, Plasmodium species which includes P. malariae, P. vivax, P. falciparum, P. ovale (Caraballo, 2014) and P. knowlesi, etc., that causes some of the extremely harmful infections such as malaria, yellow fever, dengue fever, *filiarasis* (elephantiasis) and other arboviruses in passing from host to host, rendering it the deadliest animal family in the world within almost all tropical and sub-tropical countries (Chandra et al., 2008). These mosquito-borne diseases are controlled by chemical methods which include the use of insecticide sprays or treated nets and these methods have been in use for many years, but these years, the consequences of this approach became quite harmful due the development of physiological resistance by the mosquitoes, its non-intended harm to human health and non-target organisms that could be beneficial, which leads to environmental pollution (Caraballo, 2014). Therefore, there is need of an alternative means of approach that is effective and environmental friendly to non-target organisms.

Plants are one of the most important sources of medicines and chemical molecules for the treatment of various human disorders. Some plant phytochemicals also act as insect repellent and fungicide. New chemical molecules are being discovered for effective treatment of bacterial and fungal diseases. Hence, in view of this, medicinal plants are being explored and their phytochemistry and pharmachemistry are being investigated (Arora, 2007). Mosquito control in view of their medical importance sums as global importance. In the context or ever increasing trend to use more powerful synthetic insecticides to achieve immediate results in the control of mosquitoes, an alarming increase of physiological resistance in the vectors, it increased toxicity to non-target organism and high costs are noteworthy (Jang, 2002). Chemical control methods involve the use of chemicals insecticides which van be in for of sprays or treated nets, and this method have been in use for many years and it is still in use (Caraballo, 2014). Many synthetic insecticides and naturally occurring chemical cues have been shown to influence mosquito oviposition (Geetha, *et al.*, 2003). Plant extracts have been screened and studied for their ovicidal activity against mosquitoes (Samuel *et al.*, 2011). Ovicidal compounds are able to interrupt embryo development, impair the survival of larva inside the egg or block egg hatching. Fresh eggs from control showed embryogenesis in progress while impairment of embryo development was detected in treated eggs, reflecting ovicidal activity (Govindarajan *et al.*, 2011; Madhiyazhagan *et al.*, 2012).

Biological control measures are a method used for the control of mosquitoes that involves the use of biological agents that shows no environmental contamination or mosquito resistance and their side effects on animals including humans are minimal, if not completely absent. Malaria has several serious complications which develop into respiratory distress syndrome in your children, 5-25% adults and up to 29% pregnant women (Taylor *et al.*, 2012) and also co-infection of human immunodeficiency virus (HIV) with malaria which increases mortality (Korenromp *et al.*, 2005). In pregnant women, it is an important cause of stillbirth, abortion, low birth weight and infant mortality (Williams *et al.*, 2010), particularly in *P. falciparum* infection and also *P. vivax* (Rijken *et al.*, 2012). Another clinical and public health concern is the proliferation of substantial antimalarial medicines resulting from inappropriate concentration of ingredients, poor stability and inadequate packaging (Caudron *et al.*, 2008). A 2012 study demonstrated that roughly one-third of the antimalarial medication in southern Asia and sub-Saharan Africa failed chemical analysis, or were falsified (Nayyar *et al.*, 2012). In 2015, there were 214 million cases of malaria resulting in an estimated 438,000 deaths, 90% of which occurred in Africa (WHO, 2016). Rates of diseases have decreased from 2014 to 2015 by 37%, (WHO, 2014). Malaria has a major negative effect on economic development (Gollin *et al.*, 2007). Therefore extensive studies are carried out to screen plants as insect growth control agents (Lakshmanan *et al.*, 2017). Mosquito transmits serious human diseases such as malaria, yellow fever elephantiasis, etc., which have been the





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cause of millions of deaths annually. The use of synthetic insecticides to control vector mosquitoes has developed physiological resistance in the mosquitoes and adverse environmental effect in addition to high operational cost. Insecticides of botanical origin have been reported as useful for the control of such mosquitoes. *Azadirachta indica* (Neem) and its derived products have shown a variety of insecticidal properties. This paper aims at the analysis of its extract pesticide efficacy on Larvicide on African malaria vector Anopheles *gambiae* (*Diptera Culicidae*) for the control of such mosquitoes.

# MATERIAL AND METHODS

#### Study Area and Preparation of Bark Sample

The study area was in the premises of the Yelwa Campus, Abubakar Tafawa Balewa University (ATBU), Bauchi, P.M.B 0248, Bauchi State. The collected plant bark were weighed and washed thoroughly using water, the plant material took twenty days to be dried to make sure it was thoroughly dried. Afterwards, it was grinded using a pestle and mortar. Afterwards the fine particles were separated using a sieve and then stored in a clean container before the extraction procedure.

#### **Neem Bark Extraction**

70 grams of *Azadirachta indica* powder was weighed and extracted with soxhlet extractor using the standard WHO procedure, while using distilled water as the solvent. The extract was kept in a water bath for three hours to evaporate the water. The extract was afterward weighed then the aqueous extract was further evaluated by phytochemical screening and larvicidal activity.

#### Methanol Extract of Azadirachta indica

70 grams of *Azadirachta indica* powder was weighed and extracted with soxhlet extractor using 500 milliletres of methanol as solvent. It was kept at room temperature for 24 hours. The mixture was stirred every hour using sterilized glass rod, then it was filtered through the Whatman No.1 filter paper. The extracting procedure was repeated once for total extraction of the active compounds. The filtrates gotten were combined and concentrated using the soxhlet apparatus. The solvent extract was used for evaluating the phytochemical screening and larvicidal activity.

#### **Phytochemical Screening**

According to Trease and Evans (1989), Sofowara (1993), and Harborne (1973); Different qualitative chemical tests can be performed on a filtrate to obtain its chemical composition using standard procedures.

#### **Test for Amino Acids and Proteins**

1 ml on ninhydrin solution with 2 milliletres of the extract was taken in a test tube then the mixture was subjected to heat at 50°C for one minute. A violet colour was gotten which indicates the presence of amino acid and protein.

#### **Test for Phenol**

1 millilitre of the extract was taken in a test tube and was mixed with 5 ml of Fehling's solution A. It was also subjected to 50°C heat for one minute. A red ppt was obtained which indicates that phenol is present.

#### **Test for Saponins**

2 ml of the *Azadirachta indica* was taken and combined with distilled water of 5 ml. This mixture was thoroughly shaken to get a stable persistent froth. Three drops of olive oil were dropped into the frothing and vigorously shaken after which an emulsion was formed.



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#### Test for Flavonoids

Concentrated H<sub>2</sub>SO<sub>4</sub> was mixed with dilute ammonia solution and 5 ml of the bark extract was mixed (not respectively). Flavonoid was observed by a yellow coloration in the test tube. This coloration disappeared after the mixture stood.-

#### **Test for Tannin**

20 ml of water was mixed with 0.5g of the bark extract then filtered, a few drops of 0.1% of ferric chloride was added then observed for light green, brown or blue-black coloration to indicate the presence of tannin.

#### **Test for Terpenoids**

5 millilitres of the neem extract was mixed with 2 ml of chloroform and then was filtered. To the filtrate,  $H_2SO_{4(conc)}$  was added carefully which formed a layer in the mixture. A reddish brown colour was observed at the interface to show positive result for the presence of terpenoid; this is Salkowski test.

#### **Test for Steroids**

10ml of the *Azadirachta indica* was dissolved with 3ml of chloroform then it was filtered. The filtrate was cautiously mixed with H<sub>2</sub>SO<sub>4(conc)</sub> which formed a layer at the lower part of the mixture. The test was positive because a reddish brown colour appeared.

#### Larvicidal Bioassay

Standard procedures according to WHO (2005) were followed when carrying out the bioassay test. 750ml of tap water was poured into a 1-litre beaker in a series. The test concentrations were made with the methanol extract of *Azaridachta indica,* different concentrations were made as 150mgml<sup>-</sup>, 200mgml<sup>-</sup>, 250mgml<sup>-</sup>, 300mgml<sup>-</sup>. Fourth instar larvae were used for this study and they fed on yeast powder and glucose from the surface of the water in which they were cultured in (Lakshmanan *et al.*,2017). 25 larvae per concentration were exposed to each dose. The number of dead larvae was recorded every day for four days after the treatment at room temperature. The larvae were considered dead when they became immobile and did not surface for oxygen over an unbearable period. The mortality data was analyzed by the chi-square using SPSS.

## **RESULTS AND DISCUSSION**

The larvae as usual moved by wriggling while they were placed in the beakers of the neem bark extract concentration. The larvae were observed to have taken a resting posture after they were left in the concentration for the fullness of the four days. This indicated their death consequently. Mortality began in the beakers, first of these was the beaker with the highest concentration that is; 300mgml-. Also, the rate of mortality was different due the difference in concentration. The table 1 and 2 give the data of the rate of the mortality of the anopheles' larvae and those alive at the various levels of concentration at the various time intervals as indicated above On the first day i.e. 24hours, the result showed the Pearson Chi-Square=11.000, where p=0.027. The value of p was less than the chosen significance level  $\alpha$ =0.05, the null hypothesis which shows that there is no correlation between the various levels of concentration and mortality rate of the anopheles' larvae is not acceptable while the hypothesis is accepted. Thus, this gives the conclusion that there is an association between the different level of concentration and the mortality level of the anopheles' larvae after the first day. Due the results, it can be said that: there was a statistically significant correlation between the different level of concentration and mortality rate of the anopheles' larvae after 24hours. (X<sup>2</sup>(4) =11.00, p<.05). At 2 days, the output presented shows the Pearson Chi-Square=35.519, where p=0.000. Since the p-value is less than the chosen significance level  $\alpha$ =0.05, the null hypothesis which postulates that there is no association between the different level of concentration and mortality rate of anopheles' larvae after 2 days is also rejected while the alternative hypothesis is accepted. Thus, it can be concluded that there is an association between





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the different level of concentration and mortality rate of the anopheles' larvae. Based on these readings, it can be stated that:

There was a significant statistical association between the different concentration levels and the rate of mortality of the anopheles' larvae after 2 days. (X<sup>2</sup>(4) =30.519, p<.05). At 3days, the output resulted shows the Pearson Chi-Square=73.162, where p=0.000.Since the p-value is less than the chosen significance level  $\alpha$ =0.05, the null hypothesis which postulates that there is no association between the different level of concentration and mortality rate of anopheles' larvae after 3 days is also rejected while the alternative hypothesis is accepted. Thus, it can be concluded that there is an association between the different level of concentration between the different level of concentration between the different concentration and mortality rate of the anopheles' larvae. Based on these readings, it can be stated that: There was a significant statistical association between the different concentration levels and the rate of mortality of the anopheles' larvae after 3 days. (X<sup>2</sup>(4) =73.162, p<.05). At 4<sup>th</sup> days, the output resulted shows the Pearson Chi-Square=114.135, where p=0.000.Since the p-value is less than the chosen significance level  $\alpha$ =0.05, the null hypothesis which postulates that there is no association between the different level of concentration and mortality rate of anopheles' larvae after 3 days. (X<sup>2</sup>(4) =73.162, p<.05). At 4<sup>th</sup> days, the output resulted shows the Pearson Chi-Square=114.135, where p=0.000.Since the p-value is less than the chosen significance level  $\alpha$ =0.05, the null hypothesis which postulates that there is no association between the different level of concentration and mortality rate of anopheles' larvae after 4<sup>th</sup> days is also rejected while the alternative hypothesis is accepted.

Thus, it can be concluded that there is an association between the different level of concentration and mortality rate of the anopheles' larvae. Based on these readings, it can be stated that: There was a significant statistical association between the different concentration levels and the result of the various tests carried out proves that *A. indica* has a serious larvicidal effect on Anopheles' larvae. This is very likely because of the phytochemical constituent in the bark of Neem. Steroids, tannin, alkaloid, saponin and flavonoid have been confirmed to be present in the Neem bark after the phytochemical screening. Mosquito borne diseases are one of the most public health problems in the third world countries of which Nigeria is popular in. There are various ways to control the malarial vector by causing larval mortality and death of the adult mosquitoes. The control of the disease carrying female adult is faced with serious challenge because of the rise or resistant vector mosquitoes to the various modern chemical insecticides. However, besides the general most common and well-advertised synthetic insecticides, better alternatives are being researched.

The fight against the killer insects needs not to cause any collateral damage in any way or cause more harm. These give rise to the trial of phytochemicals as good alternatives to the chemical insecticides in the nearest future. These alternatives are relatively safe, not expensive, are they are easily and readily available in the environment around us the world over today. The use of phytochemicals in the control of mosquito has been effective since the early 1900s. This was defeated after the discovery of such chemical compounds such as the DDT in 1939 which side tracked the application of phytochemicals in mosquito control programme. Attention is being redirected to the potential in phytochemicals since the side injurious side effect of the synthetics to nature. The biological chemicals are rather a better option as contrasted to the synthetic chemicals since the former be easily biodegradable and have no ill or adverse effects on non-target organisms. This is one quality that is will be well appreciated since we are trying at all cost and by all means to save Mother Nature and sustain our biological world. As at the time of this research, phytochemicals make up just about 1% of the world's product in pesticides. This trend can be envisaged to be changing in the nearest future.

## CONCLUSION

This study concludes that the presence of biological chemicals-phytochemicals in the Neem bark (*Azadirachta indica* A. Juss) such as tannin, flavonoid, alkaloid etc., could be the very possible for its larvicidal activity against Anopheles *gambiae* (*Diptera Culicidae*). The findings in this work indicates that the shrub could be studied more intently in its possible beneficial activity in the control of vector borne diseases could be used for better and safer human habitats health wisely. I verily recommend that further work should be done in research for the intent of isolating the efficacy of secondary metabolites contained in the bark of *Azadirachta indica* extract on the larvae of the mosquito anopheles. This research can be developed by further findings on the content of secondary metabolites in plant part varieties of







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the Neem plant by comparing extraction means and methods of different parts of the *Azadirachta indica* to check for the larvicidal effects of the isolation of secondary metabolites in the plant of case study.

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S.No	Number of Larvae	Concentration (Mgml)	24Hours	48 Hours	72 Hours	96 Hours	
1	25	150	4	10	18	25	
2	25	200	6	15	20	25	
3	25	250	6	15	23	25	
4	25	300	9	18	25	25	

#### Table 1. Mortality Rate of Anopheles' Larvae

S/N	No. of Larvae	Conc. mgml <sup>-</sup>	24 Hours		48 Hours		72 Hours		96 Hours	
			Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive
1	25	150	4	21	10	11	18	7	25	0
2	25	200	6	19	15	10	20	5	25	0
3	25	250	6	19	17	8	23	2	25	0
4	25	300	9	16	18	7	25	0	25	0
Total	100		25	75	60	35	86	14	100	0

