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AGORA 2022

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Sree Narayana College, Kollam
Affiliated to University of Kerala
NAAC 'A' Grade, ARIIA All India Rank II

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Chief Editor's Message

The 'AGORA National Seminar Series' is an annual event showcasing the social, scientific and technological activities of research and academic communities of all types of organizations and institutes across the country. The major purpose of this seminar series is to spread the knowledge in various subjects across different departments of the college so as to enrich the inter-disciplinary culture in the entire campus. AGORA series is being conducted by coordinating different departments of S. N. College, Kollam to disseminate knowledge to the entire academic community. AGORA 2022 has succeeded in bringing many luminaries in science and arts subjects with its research together with main focus within the college to deliberate and debate on the recent advances in various subjects. The proceedings of AGORA 2022 being published now will certainly go a long way to enlighten researches and teachers in their pursuit of knowledge. Let the outcome of these deliberations engender commendable results and kindle genuine spirit of enquiry and research.

Prof. Dr. Nisha J. Tharayil

(Principal, S. N. College, Kollam)

Editor's Message

It is our great pleasure to welcome you to this issue of the Proceedings of the Multi-disciplinary Seminar Series of Sree Narayana College, Kollam - AGORA 2022 which showcases the social, scientific and technological activities of research and academic communities of all types of organizations and institutes across the country. AGORA 2022 mainly focuses on the contributions from the research community in a multi-disciplinary and interdisciplinary aspect. The seminar brought together students, researchers and educators of varied domains to share their ideas, views and also to explore their technical abilities.

This issue contains papers accepted over single iterations of the review process. We would like to express my gratitude to the Chief Editor and other expert members for their sustained support to make the launch of this 'Proceedings' possible. We also acknowledge the authors themselves, without whose expert input there would have been no AGORA seminar series. Their efforts made a great contribution to its success.

Dr. P. Nikhil Chandra

(Assistant Professor, Chemistry)

Dr. S. Jisha

(Associate Professor, Zoology)

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ഡോ. പെട്രീഷ്യ ജോൺ

01

A review on bioplastics from natural resources: Processing methods, applications, and biodegradation

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Abstract: The current review focuses on the recent developments of bioplastics obtained from natural resources. Natural polymers have received enormous attention attributable to their ability to address the environmental threats resulting from petroleum-based polymers. This review describes the different classifications of natural polymers, their blends, properties, and applications. The review also focuses on different processing methods, and finally discusses the future trends in plastic production using natural polymers.

Keywords: Natural polymers, nanocomposites, processing, applications, biodegradation of natural polymers

1. Introduction

Plastics are becoming indispensable in our day-to-day life, primarily due to their extensive applications in different fields. Plastic materials are lightweight, flexible, moisture-resistant, durable, and relatively inexpensive. Due to the enormous demand for these materials, there is an exponential growth in the plastic production over the years and reached approximately 400 million tonnes per year as shown in Figure 1[1,2].

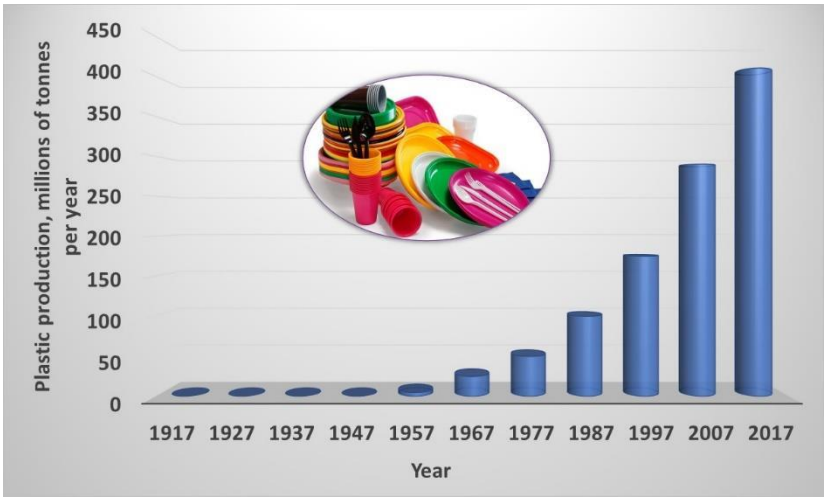

Figure 1. Global plastic production, mega tonnes, 1917 to 2017 [1,2].

The extensive production and consumption of plastic materials is a growing concern, as their waste management infrastructure often has not reached an appropriate processing rate to deal with their increasing levels of plastic waste. Shockingly, if the current trend of plastic production and waste management continues, the amount of plastic waste in the natural environment may reach approximately 12,000 million metric tons by 2050 [2]. In recent years the link between plastic waste, human health, and environment have been universally accepted, and there is a growing interest in tackling the environmental risks created by the fossil-based polymers. Micro plastics are another significant issue in plastic waste on ecosystems and human health due to their size [3,4]. Fossil-based plastic tends to degrade into micro-plastics over a period, and end up in our eco-system on both lands and in seas, by the action of UV light, acidity levels in land-fill, waves and winds.

Since fossil-based plastic materials may take ~ 500-1000 years to degrade [5], they remain as waste in the environment. Most plastics can act as an organic pollutants that may lead to food contamination and other serious health hazards. As a result, nondegradable plastic materials cause severe adverse impacts on the environment. The fragments and toxins released during photo-decomposition of such plastic debris can pollute the soil and water. It should be noted that only 14% of the total plastic packaging material is collected for recycling, whereas the remaining 86% is discarded into the natural environment. Apart from the pollution created by the nondegradability of such systems, the large scarcity of petroleum resources due to their extensive usage is also another serious concern. Most plastic waste, which leaches into the environment, finally ends up in the ocean carried via various water sources. A report launched at the 2016 World Economic Forum's annual meeting in Davos, highlighted that 95% of the value of plastic packaging material (worth $80-120 billion annually) is lost to the economy due to improper management and infrastructure for collection of plastic waste. On the current track, it is expected that the total weight of plastic waste could be higher than the total weight of fish in the ocean by 2050 [6]. According to another study conducted by Eriksen et al. in 2014, around 5.25 trillion plastic particles weighing 268,940 tons are floating at sea. The results obtained from their study are summarized in Table 1.

As already mentioned, global plastic production has increased twentyfold since 1960. It is expected that it may double again over the next 20 years. In Europe, about 1.5 million people are employed in the plastic industry and generated a turnover of EUR 340 billion in 2015 [7]. Even though plastics production in Europe has been stable in recent years, the possibility of reuse and recycling of plastics is very low. In Europe, every year around 25.8 million tonnes of plastic waste are generated. Of that 25.8 million tonnes, less than 30% is collected for recycling [7].

Recently Europe has adopted a strategy to address the challenges created by plastics. It involves the design and development of plastic materials by considering the importance of reuse and recycling. This approach should greatly help to reduce the adverse effect of plastic

materials on the environment. However, greater efforts and cooperation is required from the plastics producers to recyclers, retailers, and consumers for the successful implementation of the strategy. In 2017, the European Commission has decided to work towards the goal of making all plastic packaging recyclable by 2030 [7].

In recent years, the global socio-economic landscape has altered dramatically, making natural polymers worth consideration for many applications. The concern over the long-term availability of oil and environmental considerations forced us to consider alternative, especially renewable, sources of materials.

Table 1. Model results for the total particle count and weight of plastic floating in the world's oceans[8].

	Size (mm)	**North Pacific**	**North Atlantic**	**South Pacific**	**South Atlantic**	**Indian Ocean**	**Mediterranean Sea**	**Total**
Count	0.33–1.00	68.8	32.4	17.6	10.6	45.5	8.5	183.0
	1.01–4.75	116.0	53.2	26.9	16.7	74.9	14.6	302.0
	4.76–200	13.2	7.3	4.4	2.4	9.2	1.6	38.1
	>200	0.3	0.2	0.1	0.05	0.2	0.04	0.9
	Total	199.0	93.0	49.1	29.7	130.0	24.7	525.0
Weight	0.33-1.00	21.0	10.4	6.5	3.7	14.6	14.1	70.4
	1.01–4.75	100.0	42.1	16.9	11.7	60.1	53.8	285.0
	4.76–200	109.0	45.2	17.8	12.4	64.6	57.6	306.0
	>200	734.0	467.0	169.0	100.0	452.0	106.0	2028.0
	Total	964.0	564.7	210.2	127.8	591.3	231.5	2689.4

** Total count ($n\times10^{10}$ pieces), weight ($g\times10^{8}$ g; or $g\times10^{2}$ tons) of plastic in the ocean* [9].

Natural polymers, thanks to their environmentally friendly properties such as biodegradability, low toxicity, low disposal costs, and renewability, are now gaining massive attention as one of the best solutions as an effective alternative to petroleum-based polymers. Natural polymers are mainly derived from plants and animals. Cellulose, hemicellulose, starch, pectin, etc. are obtained from plants, whereas chitin, alginates, psyllium, etc. are derived from animal origins [10]. Figure 2 presents the classification of natural polymers from various sources.

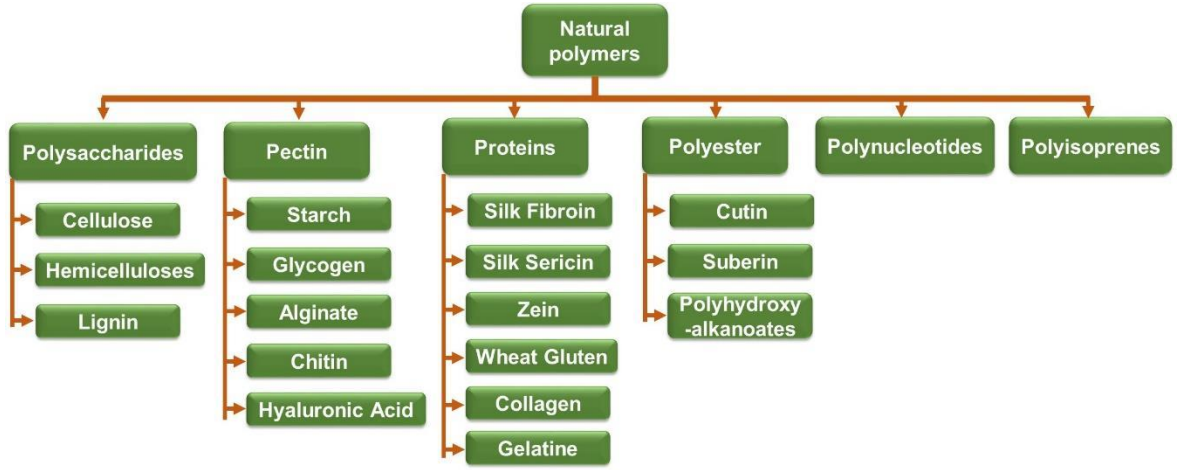

Figure 2. Classification of Natural polymers [11].

Natural polymers have found applications in several commercial sectors such as pharmaceuticals, chemical engineering, agriculture, biomedical, coatings, and food [10]. As observed in Figure 3, there is a significant increase in the number of total publications based on bioplastics in recent years, which highlights both the universal relevance of the topic and the increased funding in this field.

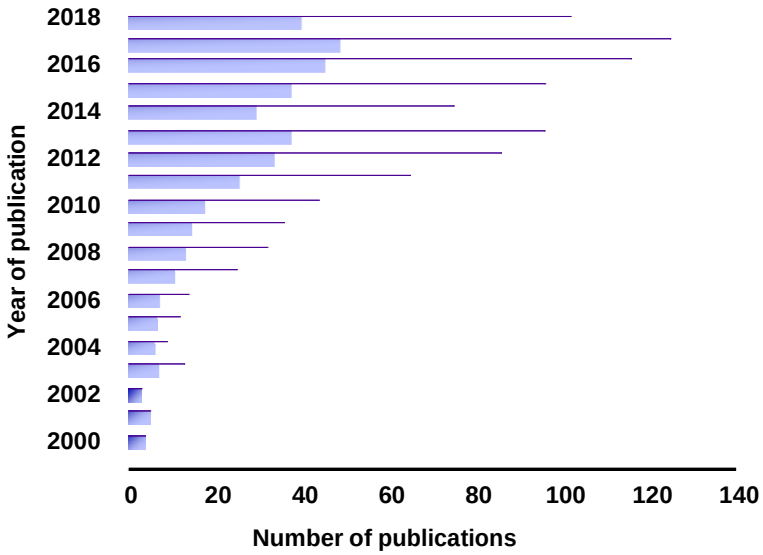

Figure 3. Total publications on bioplastics by year. (Source: Web of science)

Natural polymers have a history of more than century-much longer than fossil-based plastics. They are biodegradable and renewable, and thus environmentally friendly. At the end of their useful product life, they can be easily disposed of without harming the environment. The challenge with natural polymers being employed for large-scale replacement plastic production is primarily due to the strong interaction of functional

groups [12]. This prospective provides an overview of the various natural polymers, material properties, processing challenges, applications, and future trends.

2. Types of natural polymers including properties

2.1 Cellulose

Cellulose, the principal constituent of the plant cell wall, is considered as one of the most abundant molecules derived from biomass. It was discovered in 1838 by a French chemist Anselme Payen. Cellulose is mainly extracted from kenaf, jute, cotton, wood, etc. It is highly crystalline, with a high molecular weight polymer. The general formula for cellulose is $(C_6H_{10}O_5)_n$, consisting of a linear homopolymer of glucose residues with β (1→4) linked D-glucose units. Inter and intramolecular hydrogen bonding make cellulose rigid and water-insoluble. Even though the structure is similar to starch, cellulose exhibits different properties [13,14].

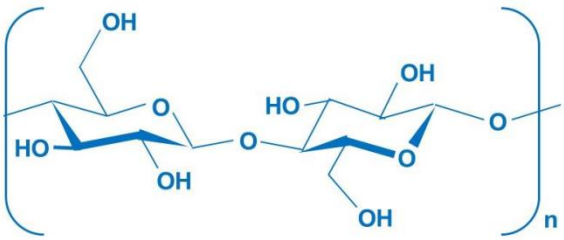

Figure 4. Repeating unit of cellulose.

2.2 Chitins

Chitin is a linear polysaccharide consisting of 2-acetamido-2-deoxy-β-D-glucopyranose units, with β (1→4) linkage [15,16]. It is present in the exoskeleton and internal structure of invertebrates. The structure is similar to cellulose, but with an acetamide group (□NHCOCH3) at the C□2 position instead of the hydroxyl group (Figure 5). Chitin is the supporting material of molluscs, crustaceans, insects, etc. Chitin exists in their different crystal structures: α, β, and γ. α-chitin, which has a more compact structure, is generally obtained from the shell of crabs and shrimps. β-Chitin is obtained from the pen of loligo and squid. γ-chitin is a mixture of both α and β-chitin [17,18]. It is biodegradable and biocompatible. Chitin exhibits poor solubility in common organic solvents, and diluted aqueous solvents, which limits its practical, commercial applications.

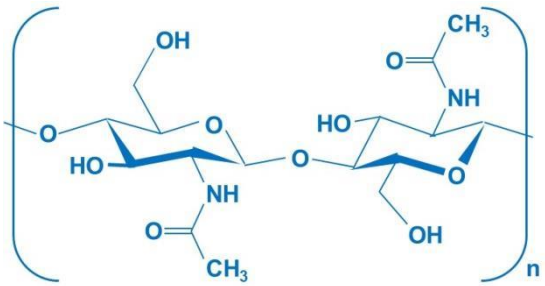

Figure 5. Structure of chitin

2.3 Starch

Starch is a polysaccharide, which contains glucose units joined together by glycosidic bonds. The natural abundance of starch is similar to that of cellulose and chitin. It mainly acts as the energy store in plants and is found in the roots, leaves, stems, etc. in granular forms with different shapes (spheres, polygon, ellipsoids, etc.). Rice, corn, wheat, sorghum, potato, etc. are some of the primary sources of starch. Generally, starch is composed of two molecules: amylose, which is the linear fraction, and its branched counterpart, amylopectin [19]. In amylose, glucose units are linked together by α-1-4 glycosidic bonds, whereas amylopectin has additional α-1-6 links [20,21]. The composition of amylose and amylopectin may vary depending on the type of starch. However, in general, the composition of amylose in starch is ~20-30% and amylopectin is ~70-80% [20,21]. The structure of amylose and amylopectin are shown in Figure 6. Some of the main industrial applications of starch involve adhesives, paper, and clothing. Starch is used for making packaging films, overwraps, flushable sanitary products, mulch films, etc.

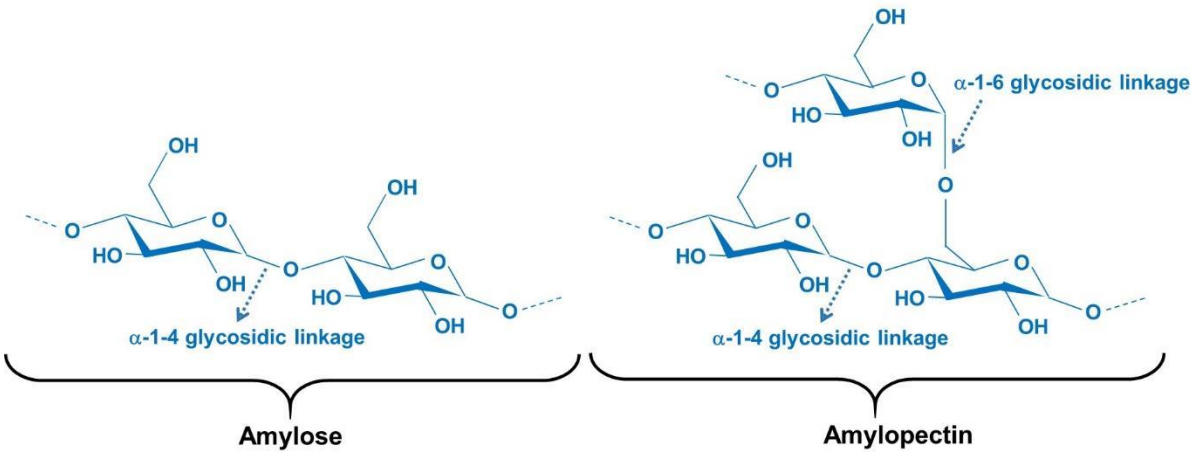

Figure 6. Structures of amylose and amylopectin (two components of starch)

2.4 Lignin

Lignin is also considered as one of the most abundant biopolymers. It is regarded as the primary source of aromatic structures on earth. It is one of the main components in the cell wall along with cellulose and hemicellulose. Lignin adds strength and structure to the cell walls of woody plants.[22] The structure of lignin is based on three different cinnamyl alcohol precursors (monolignols): p-coumaryl alcohol, coniferyl alcohol, and sinapyl alcohol (Figure. 7) [23,24]. The radical polymerization of monolignols results in the formation of a complex three-dimensional molecular structure with a great variety of bonds [25,26]. The majority will be the β-O-4 ether linkages (50%). Apart from that other linkages such as α-O-4, 4-O-5 also exist together with C–C bonds [27,28]. The reactivity and the degree of branching in the lignin are determined by the proportions of the three monomers [22].

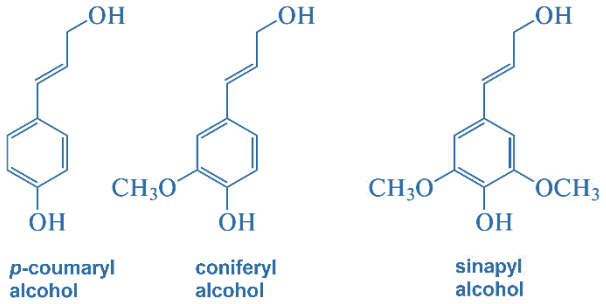

Figure 7. The three different alcohol precursors (monolignols) of lignin.

3. Modification of natural polymers

Natural polymers have received much more attention in recent years due to their environmental benefits. However, the performance of products made from the natural polymer is not similar to products produced from fossil-based counterparts due to the inherent properties of natural polymers. Some of the approaches to upgrade the properties and improve the processability of natural polymers are given below:

i) Blending of polymers ii) Chemical modification

iii) Grafting of functional groups iv) The addition of nanoadditives

Out of these methods, polymer blending and the creation of polymer nanocomposites by adding nanoadditives are the most preferred methods on an industrial scale mainly due to their adoptability on an industrial scale without invasive modification of current processing technologies.

3.1 Blends of natural polymers

3.1.1 Blends of Cellulose

Nishio et al. prepared cellulose/poly(viny1 alcohol) (PVA) blend films from mixed solutions in N, N-dimethylacetamide (DMAc)-lithium chloride (LiC1) by solution-coagulation method and analyzed using different characterization techniques. They noted that there is a significant decrease in the crystallinity of PVA with the addition of cellulose and no crystallization was observed when the cellulose content is above 70 wt. % [29]. The authors employed the same method to prepare the blends of cellulose with nylon 6 and poly(ε-caprolactone) (PCL) [30]. Similar to the result obtained in their previous study, the crystallinity of both nylon and PCL has been found to decrease with the increase in the cellulose content. However, the crystalline nature was retained even at a composition containing 90 wt. % cellulose. The level of miscibility of both the blends was found to be relatively low, but there was no indication of phase separation at any level above micrometer size. Miyamoto et al. prepared cellulose-starch blend films using the solution-coagulation method and investigated their structure and properties [31]. The blended films showed porous structures, and the average pore size was found to increase with increasing starch content. Such porous blend films displayed high water and oil absorbency. It was

observed that the oil absorbency of the blend film with 50 % starch was ten times higher than that of cellulose film.

3.1.2 Blends of Starch

Even though the compatibility of starch with synthetic polymers is weak, some efforts have been made to prepare starch/polymer blends, especially to improve the degradability of commonly used synthetic polymers. Modified starch was also used to enhance the miscibility and adhesion of starch in the blends [32]. Olivato et al. prepared starch/ poly(butylene adipate-co-terephthalate) blends with tartaric acid as an additive and investigated the mechanical, optical and structural properties. The result indicated that the addition of tartaric acid had improved the properties of the materials, which makes it suitable for food packaging applications [33]. It has been reported that the blending of commercial polyester Bionolle with starch has improved the rate of degradation of the Bionolle [34].

Tudorachi et al. investigated the biodegradation behavior of polyvinyl alcohol (PVA)/starch mixtures in the presence of some bacteria and fungi due to the better compatibility of PVA with starch. They observed that the microorganisms had consumed the starch along with the amorphous part of PVA [35].

Polyethylene is a commonly used thermoplastic polymer due to its wide range of applications. However, it is resistant to microbial breakdown [36]. It was reported that the addition of biodegradable compounds like starch could improve the degradation of polyethylene [37]. The degradation rate of starch/polyethylene blend was found to vary with the amount of starch as well as the environmental conditions [38]. To study the degradation of these starch/polyethylene blends in a natural environment, Johnson et al. investigated the chemical, photo, and biological degradation of 11 types of commercially produced degradable starch/polyethylene compost bags [39]. The oxygen tension on the surface of the film was found to have a substantial effect in controlling the degradation. The pro-oxidant additive (transition metal), has also played a significant role in controlling the degradation in the compost environment [39].

3.1.3 Blends of Chitin

Chitin is often blended with other polymers mainly to overcome its poor solubility and reactivity. Lee et al. reported that the blends of β-chitin and poly(vinyl alcohol) (PVA) showed improved mechanical properties [18]. Ramaprasad et al. used chitin–polyaniline blend for the construction of developing humidity sensors. They observed that the blends showed a significant improvement in the conductivity along with good thermal and environmental stability even after three years [40]. Mi et al developed chitin/poly(d,l-lactide-co-glycolide) and chitin/polylactide-based microspheres for protein delivery. They observed that the formulations of the blends might help in the controlled release of bovine serum albumin (BSA) [41]. Park et al. fabricated biodegradable nanostructured scaffolds

based on poly (glycolic acid) (PGA)/chitin blend for tissue engineering applications [42]. Based on the results, they concluded that the blend with 25% PGA and 75% chitin with bovine serum albumin coating could be used for making scaffolds for tissue engineering applications [42].

3.1.4 Blends of Lignin

Lignin is an aromatic biopolymer that represents the second most abundant natural polymer other than cellulose. The abundance and aromatic structure would make it an ideal polymer for blending with various natural polymers to improve their properties. Lignin has been evaluated with different natural polymers to improve their performance and properties for various applications [43,44]. It has been reported that the grafting of starch films with lignin can improve the water resistance, which is one of the main drawbacks of starch-based packaging films [45]. Kaewtatip et al. studied the mechanical properties and the resistance to water absorption of thermoplastic starch (TPS) in the presence of kraft lignin (KL) and esterified lignin (EL). Both the blends showed improved mechanical properties compared to that of pure TPS. [43] Huang et al. prepared the blends of soy protein, which got the attention mainly due to its low-cost and biodegradability, with alkaline lignin and investigated their properties with the help of different characterization techniques. The results indicated that the presence of alkaline lignin could enhance the thermal stability, tensile strength, Young's modulus and water resistivity of soy protein plastics, which helps in expanding their applications [46]. Mousavioun et al. investigated the thermal stability and miscibility of poly (hydroxybutyrate) and soda lignin blends. An improvement in the overall thermal stability was observed for the PHB/lignin blends compared to PHB over a wider temperature range [47]. Wu et al. studied the mechanical properties of bio- based composite films derived from cellulose, starch, and lignin. The mechanical properties of the composite films were found to improve significantly due to the combined effect of different components. Also, the thermal stability and gas permeability were found to be better for the composite films [48].

4. Natural Polymer Nanocomposites:

The increasing use of natural polymers can lead to entirely novel materials with enhanced performance compared with traditional plastics. In recent years, innovations in the development of plastic products from natural polymers increasing due to awareness of problems associated with fossil plastics and breakthroughs in processing technologies. Thus, the use of natural polymers will help to reduce the use of fossil-based raw materials, which in turn reduces the volume of plastic waste. This will also help in the protection of the climate through the reduction in carbon dioxide released. Apart from biodegradability, natural polymers show some excellent properties, which are comparable with that of commodity plastics [10]. However, some of the properties like high gas permeability, low melt viscosity, higher processing temperatures, etc. restrict the use of natural polymers in different applications. The physical and chemical properties of natural polymers and their

synthetic counterparts can be quite different. The processing and development of products based on natural polymers are not always easy and cost-effective. Therefore, in the applications, the main focus is to capitalize on inherent bio-degradability and other unique properties of natural polymers and not to compete with the properties of conventional plastics. Even though the modification of biodegradable polymers is a challenging task, the nano-reinforcement of pristine polymers to prepare nanocomposite has already proven to be an effective way to concurrently improve these properties [49,50]. Therefore, from the preparation to the processing of natural polymer-based nanocomposites, that is, 'green nanocomposites' is leading the future drive to deliver more environmentally friendly materials for future generations.

5. Polymer nanocomposite technology

Natural polymers in their native form are unsuitable to be used in the same way as fossil plastics, requiring chemical, and thermal modification, blending with other polymers or reinforced with nano fillers to gain the technological usefulness of these polymers. In recent years, the use of nano additives such as nanoclays, 2-dimensional nanomaterials and other class fillers as additives to enhance the polymer performance has been well established. Various nano-reinforcements currently under investigation include nano clay (layered silicates), graphene, boron nitride, cellulose nanofibers, and carbon nanotubes. Polymer nanocomposites are of keen interest due to their significant enhancement of a large number of physical properties, including barrier, mechanical, flammability resistance, thermal and environmental stability, solvent uptake, and rate of biodegradability, relative to unmodified polymer resins [51,52]. It was observed that the improvement in different properties was obtained at a lower filler content (<5 wt %). This improvement in the properties of polymer nanocomposites is attributed to the strong interfacial interactions between the polymer matrix and the filler at the lower filler loading. Nanofillers generally consist of layer thicknesses in the order of 1 nm, and very high aspect ratios (e.g., 10–1000). A few weight percent of nano additive properly dispersed throughout the matrix can create a much higher surface area for polymer-filler interactions than the conventional composites.

Very few studies have explored natural polymer nanocomposites. Starch attracted widespread attention among natural polymers due to its low cost and abundance for packaging applications [53-61]. The studies reported that the addition of various types of nano additives resulted in significant improvement in tensile strength, modulus, elongation and barrier properties. Very recently, Jabier et al. reported the preparation of starch and chitosan nanocomposites reinforced with montmorillonite and bamboo nanofibers [53,62,63]. The results showed an increase in both tensile strength (by 50%), and elongation break (by 66%) compared to starch and chitosan, due to strong hydrogen bonding between the fillers and polymers.

Cellulose acetate (CA), which is obtained by the esterification of cellulose, has attracted attention due to its biodegradable nature, optical clarity, chemical resistance, and high

toughness. Park et al. first reported the preparation of biodegradable plasticized CA/clay hybrid nanocomposites [64]. Melt processing via extrusion-injection moulding is adopted in fabricating the nanocomposites from CA powder, eco-friendly triethyl citrate (TEC) plasticizer and organoclay. The results showed that the addition of TEC plasticizer at 20 wt% exhibited the best intercalation and exfoliation of clays as well as the best physical and mechanical properties of the resulting nanocomposites. The tensile strength, modulus and heat deflection temperature were improved, and the water vapor permeability was reduced by a factor of two, but the impact strength was decreased. In their later work (Park et al., 2004a) [65], they investigated the effect of compatibilizer maleic anhydride grafted cellulose acetate butyrate (CAB-g-MA) on the nanostructure of the biodegradable CA/organoclay nanocomposites. They reported that nanocomposite systems with 5wt% compatibilizer contents displayed a better-exfoliated structure than the counterpart without compatibilizer hybrid. Chitosan, a non-toxic natural polysaccharide, is compatible with living tissue and finds applications in packaging, wound healing, production of artificial skin, food preservation, cosmetics, and wastewater treatment [66]. Chitosan-based nanocomposites prepared using various nano additives were reported by Rhim et al. [67]. The tensile strength of the composites was increased by 7-16%, and moisture resistance increased by 25-30% depending upon the type of nanoparticles evaluated. Especially chitosan-based composites with nano silver particles showed enhanced antimicrobial activity. Darder et al. reported chitosan-layered biopolymer clay nanocomposites for sensor applications and are useful for anionic detection in aqueous media [68].

Despite the huge possibilities to deploy natural polymer-based nanocomposite materials in various applications, the low level of production, property limitations and high production costs restrict their use in a wide range of applications. Therefore, new improved processing technologies and economies of scale are all indispensable to produce a more favorable, global adoption of natural polymer solutions.

6. Processing of natural polymers

Polymer processing involves the conversion of raw polymeric materials into finished products with desired shapes and properties. Different processing methods have been developed depending on the chemistry and properties of the polymer and the end-use of the final product. Some of the main polymer processing techniques are briefly described below.

6.1 Extrusion Moulding

Extrusion is mainly used for moulding thermoplastic materials. Some of the natural polymers like starch, gelatin, etc. can be processed via melt processing [10,69]. The typical melt extrusion involves the pumping of raw materials through a barrel with a rotating screw, where it will be subjected to heat and pressure to achieve a product with uniformity [70,71]. Unwanted particles are removed with the help of a breaker plate and screen, and retained between the barrel and die. The final product is obtained after both sizing and cooling. Everyday products such as pipes, straws, films for packaging, etc. are produced via

extrusion moulding. In the pharmaceutical industry, especially in the drug delivery systems, melt extrusion is preferred over the other methods [72-75].

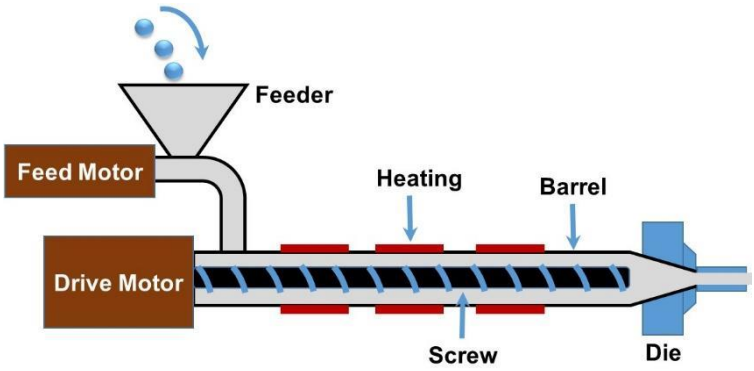

Figure 8. Schematic representation of an extruder.

Some of the natural polymers were also processed using the extrusion. Andreuccetti et al. used an extrusion process to prepare gelatin-based films and investigated the mechanical properties [69]. Starch, lipids, cellulose, etc. are some other examples of natural polymers, which were processed using extrusion [76-78].

6.2 Injection Moulding

Injection moulding is one of the main processing techniques used for the mass production of plastic parts. Some of the advantages of the process include the quick cycle of production, material and color flexibility, design flexibility, etc. In the injection moulding, the polymer material is fed into the machine in the form of pellets through a hopper. The pellets were heated within a heated barrel, and the polymer melt was injected into a suitable mould, which is cooled under pressure. Around 33% of all the processed polymeric materials are made using injection moulding [10,79,80]. Even though the machine is similar to the extruder, there is a difference in the screw operation. In injection moulding, along with the rotation, the screw moves forward and backward as per the steps of the molding cycle. Injection moulding is widely used for making automotive parts, bottle caps, parts for electronic applications, etc. It has also found applications in the biomedical area and the development of drug products [80,81]. Gomes et al. developed a new method based on the conventional injection moulding process to prepare biodegradable porous scaffolds from corn-starch- based polymers [81]. By following this method, they were able to prepare scaffolds with a porous core, which showed promising mechanical properties. In another report, native starch was processed in the presence of water using the injection molding [82]. Starch and gelatin capsules were also developed using the injection moulding process [83].

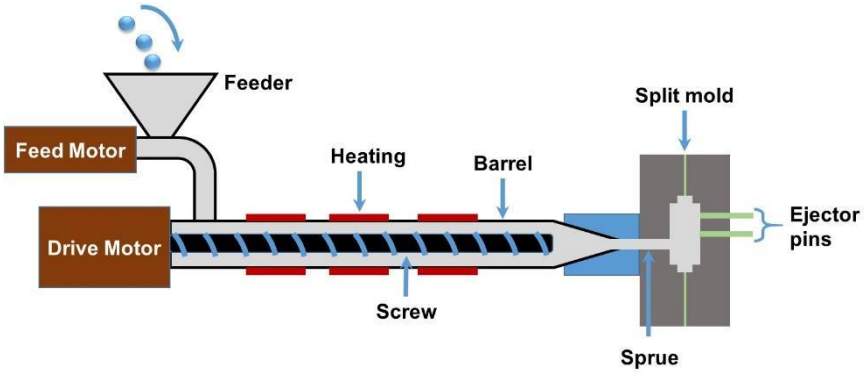

Figure 9. Schematic representation of an injection moulding.

6.3 Solvent Casting

Solvent casting is considered the oldest technology for making plastic films. This technique can be effectively used for making films with uniform thickness, superior optical purity, and mechanical properties. The process involves the dissolution or dispersion of the polymer in a suitable solvent, which is coated onto a substrate and the solvent is removed later by drying [10,84]. Santos et al. attempted to understand the effect of cellulose whiskers on the physical properties of glycerol-plasticized tilapia gelatin films, which are prepared using solvent casting technique from solutions with different concentrations [85].

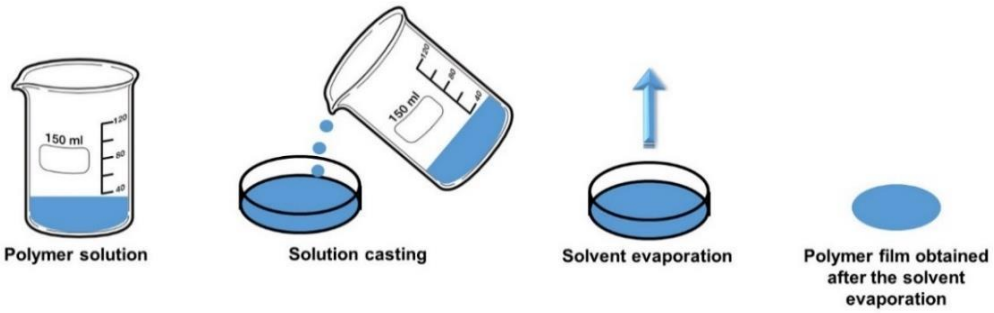

Figure 10. Different stages of solvent casting.

6.4 Electrospinning

In the electrospinning process, fine fibers from polymer solution are produced by using the electrostatic forces. The electrospinning setup consists of a high voltage power supply, a spinneret (e.g., a pipette tip) and a collecting plate. As shown in Figure 11, there are mainly two standard electrospinning setups: vertical and horizontal. Before the electrospinning process, the polymer is dissolved in a suitable solvent and then introduced into the capillary tube. Due to the surface tension of the polymer solution, it will be held at the end of the capillary, which is subjected to an electric field. Once the electric field reaches a critical value, it overcomes the surface tension, and the solution is electrically charged. The charged jet of solution is ejected from the capillary tip and fibres are formed on the collector plate after the evaporation of the solvent [86-88].

Different factors such as voltage, polymer fluid properties, flow rate, the distance between the capillary tip and the collector plate, and dimensions of the needle tip can tune the properties of the electrospun [89]. In some reports, the electrospinning process has been used to prepare fibers of natural polymers such as chitosan and silk fibroin [90,91].

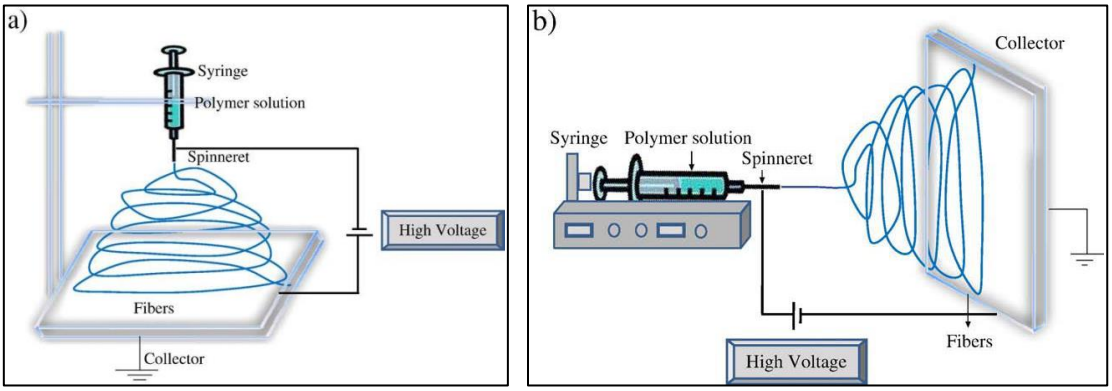

Figure 11. Schematic diagram of set up of electrospinning apparatus (a) typical vertical set up and (b) horizontal set up of electrospinning apparatus. [Reprinted with permission from ref [92]; Copyright © 2010 Elsevier Inc.]

7. Applications of Natural Polymers

Natural polymers have a wide range of applications in packaging, pharmaceuticals, textiles, cosmetics, adhesives, etc. Packaging materials made of natural polymers are of great interest since they can be degraded by the action of microorganisms. In the pharmaceutical industry, the natural polymers have been widely used for drug delivery applications. Two of the major applications of natural polymers are described below.

7.1 In Packaging

The packaging industry is considered one of the largest markets for the plastics due to their relatively low cost and ample availability [93,94]. Natural polymer-based packaging materials can enhance the food quality by preventing the external contamination and extending the shelf life. Derivatives of different natural polymers such as starch and cellulose have been used for making the packaging films [95-97]. Table 2 shows the various literature reports on the blends of natural polymers, mostly fossil-based polymers, which can be used in the packaging application.

Table 2. Literature reports on the potential source of natural polymer blends that can be used in the packaging application. [Adapted with the permission from ref [98]; Copyright © Springer International Publishing Switzerland 2016]

Title of paper	Polyolefins	Reference
Electret-thermal analysis to assess biodegradation of polymer composites	LDPE/starch blends	[99]
Effect of compatibilizer on the biodegradation and mechanical properties of high starch content/low-density polyethylene blends	LDPE/starch blends	[100]
Photo biodegradation of low-density polyethylene/banana starch films	LDPE/starch blends	[101]
Studies on biodegradability, morphology and thermo mechanical properties of LDPE/modified starch blends	LDPE/starch blends/starch phthalate	[102]
Soil burial of Polyethylene -g- (Maleic Anhydride) Compatibilized LLDPE/Soya powder blends	LDPE/soya powder blends	[103]
Thermal degradation of biodegradable blends of polyethylene with cellulose and ethylcellulose	LDPE/cellulose/ ethylcellulose	[104]
Linear low-density polyethylene/soya powder blends containing PE-g-MA copolymer as a compatibilizer	LDPE/soya powder blends	[105]
A new approach for morphology control of poly(butylene adipate-co-terephthalate) and soy protein blends	poly(butylene adipate- coterephthalate) (PBAT)/soy protein concentrate(SPC)	[106]

Even though LDPE, a fossil-based polymer, is often blended with starch to improve its properties for packaging applications, it has been reported that the addition of starch can improve the degradation of the LDPE/starch blends to some extent [107-109]. However, there is a growing interest in packaging materials made from natural polymers, mainly to tackle the environmental pollution created by petrochemical-based packaging materials [98,110,111].

7.2 In the Biomedical field:

Natural polymers have been widely used in the biomedical field due to their biocompatibility and biodegradability [10,112]. Modified alginate is regularly employed for drug delivery applications [113-117]. For example, alginate-based mesalazine tablets were used for intestinal drug delivery [118]. George et al. designed pH-sensitive alginate–guar gum hydrogel crosslinked with glutaraldehyde for the controlled delivery of protein drugs [116]. El-Sherbiny et al. developed a series of sodium alginate-based pH-responsive hydrogel microspheres encapsulating poly(d,l-lactic-co-glycolic acid) nanoparticles. Their results indicated that the prepared particles could be effectively used as biodegradable carriers

with desirable sustained release profiles of silymarin in addition to enhancing the overall dissolution of silymarin and its oral bioavailability [119].

Table 3. Natural polymers used in fast dissolving tablets [120].

Sl. no.	Natural polymer	Marketed drug	Disintegration time	Concentration used
1	Chitin and chitosan	Cinnarizine	60 sec	3% w/w
2	Guar gum	Glipizide	30 sec	1% w/w
3	Gum karaya	Amlodipine, granisetron hydrochloride	17.10 sec	4% w/w
4	Agar and treated agar	Theophylline	20 sec	1-2%w/w
5	Fenugreek seed mucilage	Metformin hydrochloride	15.6 sec	4%w/w
6	Soy polysaccharide	Lornoxicam	12 sec	8%w/w
7	Gellan gum	Metronidazole	155 sec	4% w/w
8	Mango peel pectin	Aceclofenac	11.59 sec	0.1–4%w/w
9	Lepidium sativum mucilage	Nimesulide	17 sec	5–15% w/w
10	Plantago ovata seed mucilage	Granisetron HCl	17.10 sec	5%w/w
11	Aegle marmelos gum	Aceclofenac	8–18 min	6% w/w
12	Locust bean gum	Nimesulide	13 sec	10% w/w
13	Lepidium sativum	Nimesulide	17 sec	10% w/w
14	Mangifera indica gum	Metformin HCL, paracetamol	3–8 min	6% w/w
15	Hibiscus rosa-sinensis mucilage	Aceclofenac	20 sec	6%w/w
16	Dehydrated banana powder	Ondansetron HCl/propranolol, gabapentin	15–36 sec	6%w/w

Modified chitosan has also found applications in the drug delivery systems [121,122]. Chitosan succinate and chitosan phthalate were found to have the potential to serve as oral insulin carriers [123]. N-trimethyl chitosan was found to show enhanced transdermal permeation with different degrees of quaternization [124]. It was reported that the fluoride anion-modified gelatin nanogel system could act as an effective therapeutic technology

platform for the controlled drug delivery system for cancer and other diseases [125]. Table 3 gives the details of natural polymers, which are used in fast-dissolving tablets.

8. Biodegradation of natural polymers

Biodegradation can be referred to as the chemical decomposition of polymers, which is triggered by the action of microorganisms. In the degradation process, first, the polymer is fragmented into lower molecular mass species by oxidation, photodegradation or hydrolysis, or biotic reactions, which is followed by the bioassimilation of polymer fragments by microorganisms and their mineralization. The decomposition of the polymer has a strong dependence on its chemical composition [126].

Several bacteria and fungi were reported to degrade cellulose. Cellulose can degrade under both aerobic and anaerobic conditions [127]. The β-1,4 glycosidic linkages in the cellulose are broken down by the enzyme called cellulase. Cellulases are divided into two classes: endoglucanases and cellobiohydrolases. Among these, endoglucanases hydrolyze the internal bonding and cellobiohydrolases act on the existing or endoglucanase-generated chain ends [127,128]. Even though the amorphous part of cellulose can be degraded by both endoglucanases and cellobiohydrolases, the crystalline portion is degraded only by the action of cellobiohydrolases. The degradation of lignin is very difficult mainly due to its structural complexity and insolubility. The degradation can be carried out by extracellular, oxidative, and unspecific enzymes. Lignin from the wood can be degraded in the presence of white-rot fungi [127,129]. The enzymes involved here are peroxidases and laccases, which act as low-molecular weight mediators to carry out the degradation. Another way of lignin degradation is alkaline-based solubilization [130].

9. Challenges and Future trends in plastic production using natural polymers

The natural polymer market is gaining growing attention majorly due to its medical and packaging applications. The growing demand for natural polymer-based materials has mainly arisen due to the concerns related to the environmental hazards created by the commonly used fossil-based plastic materials. However, a lack of information on the molecular properties of natural polymers and processing difficulties currently constrains the widespread use of natural polymers in various applications. For example, starch is an abundant natural polymer, but the molecular properties of the starch change from source to source and difficult to predict their molecular properties, which is critical for the processing and development of starch, based plastics. Therefore, there is a great need, and extensive investigation is required into the molecular structure of natural polymers for better materials design, processing, and property interpretation. Nevertheless, the penetration of natural polymer plastics into the market has been slow due to the high cost of composite materials. If the properties of natural polymers, such as strength, performance, and processability improve, our society will flourish with the uptake of products based on natural polymers. New applications for agricultural waste and byproducts of processing, as

well as recycling of natural polymers, promise to make more efficient use of our natural resources.

10. Summary

Natural polymer-based plastics are moving ever closer to commercial reality, and have great potential for diverse applications in many sectors. The commercialization of plastics based on natural polymers will continue to rise over the coming years, especially for single-use plastic items. However, there are number of challenges that remain to be addressed regarding processing technologies that have the potential to modify the properties of natural polymers in an efficient and environmentally friendly manner. It is critical that intensive, commercially focused research is given priority so that natural polymer-based plastics can finally compete economically with synthetic plastics.

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02

ACADEMIC MANAGEMENT SYSTEM

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Abstract:-

An academic management system is a software application that is specifically designed to assist with the organization and administration of educational institutions. This type of system can be used by schools, colleges, universities, and other educational organizations to manage a wide range of tasks and processes related to the operation of the institution. Some of the key features of an academic management system include student enrollment, class scheduling, grading, report generation, and communication tools for students and faculty. By providing a centralized platform for managing these and other tasks, an academic management system can greatly improve efficiency and productivity for educational institutions.

INTRODUCTION

Academic Institutions are moving toward IT in a faster manner. The academic management system is a comprehensive tool designed to streamline and optimize various processes and tasks related to the management of educational institutions. From scheduling and enrollment to grading and report generation, this system aims to provide a single, unified platform for all academic management needs. It is user-friendly and intuitive, making it easy for administrators, teachers, and students to access and utilize its various features. The system also includes robust security measures to protect sensitive information and data. Overall, the academic management system is a valuable resource for any educational institution looking to improve efficiency and productivity.

Better care is exercised to make sure that all the conventional modules in an academic environment like Admin, HOD, Faculty, Student etc. are also made available in this project.

The main advantage of this information system is that the students get academic updates on a regular manner. Consolidated reports are made possible in the tip of the finger.

Students will get academic schedules in a faster way. The prediction module is an extension of AI where historic data (Previous student‟s data) is fed to the system for forecasting. For this purpose Google‟s Deep Learning framework called „Google Colab‟ is utilized.

Academic alerts are always mandatory for students for timely submission of documents like online test, online assignment etc. These kinds of alerts are set by the faculty in their concerned modules. Publishing of results will get greater pace as the report module provide them in a nice presentation manner.

SYSTEM ANALYSIS

The basic objective of the analysis stage is to develop the logical model of the system victimization tools like information, flowchart and elementary data description of the elementary algorithmic program.

System analysis isn't an exact science. It is if truth be told a lot of associate art, power-assisted by scientific approach to search out definition and recording knowledge, gathering ancient structures is barely one a part of the system analysis, following step is to visualize the info, analyze the case and providing the alternatives.

Existing System:-

At present despite the fact that we tend to area unit flooded with innumerable tutorial system, they're not customizable to the requirement of an educational atmosphere. The various modules out there in these systems might not be necessary for all systems. Emerging technologies like Prediction, Graphical news etc. aren't out there to all or any such systems. Majority of the systems area unit developed in proprietary platforms. This poses nice licensing challenges. It puts additional burden upon the shoulder of the establishments through significant fee.

Proposed system:-

Proposed system bridges all problems connected with the present system. It provides custom-made modules applicable for an educational establishment. The computer code is developed in open supply technologies. Because the development is completed in PHP, there aren't any hidden prices within the method. Within the backend the system uses MySql information server.

Proposed system mainly focus on the below given modules

1. Admin
2. Student
3. Faculty
4. HOD

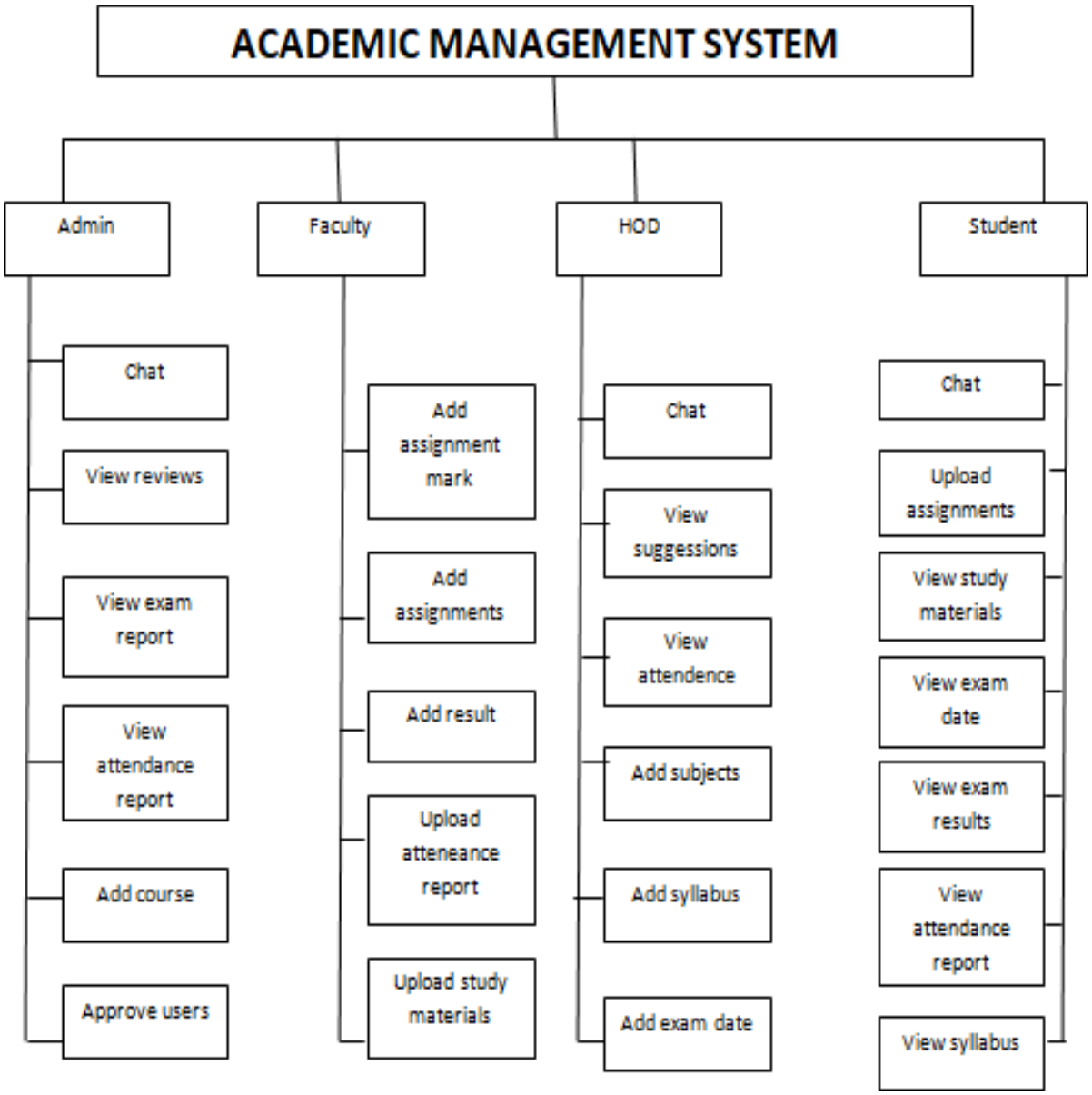

Figure 1: Structure Chart

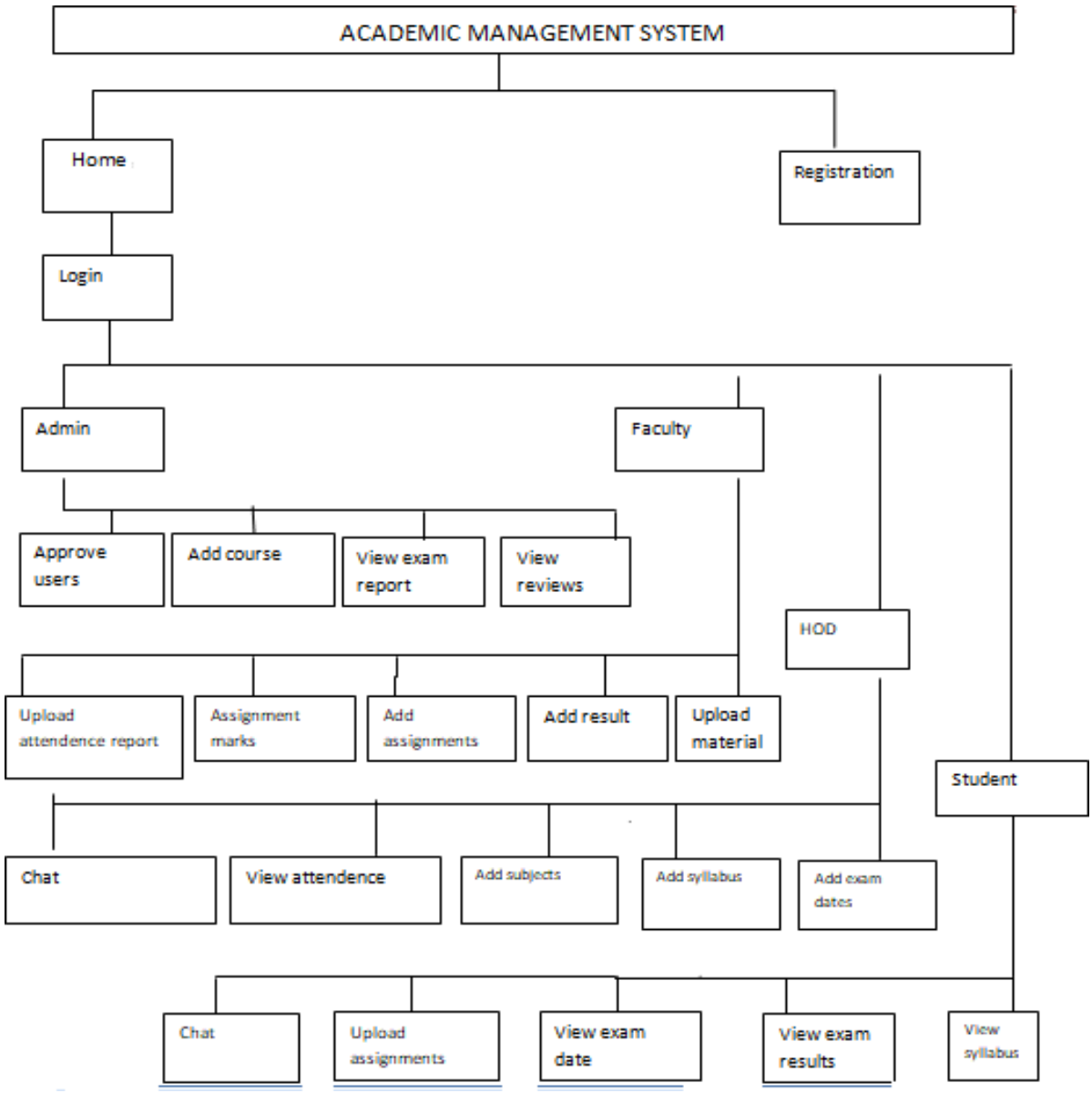

Figure 2: Menu Tree

SYSTEM IMPLEMENTATION

Implementation is the process of bringing developed system into operational use and turning it over to the user. Implementation includes all those activities that takes place to convert from old system to new one. Implementation is the phase, in which one has to be cautious, because the efforts undertaken during the project will be fruitful only if the software is properly implemented according to the plan made. The system implementation was carried out using five main aspects:

- Transition planning
- Training
- Security
- Protection
- Quality control

Implementation Planning:-

Implementation of a system involves people from different departments and system analyst are confronted with the practical problems of controlling the activities of people outside their own data processing departments prior to this point in the project system, system analyst has interviewed department staffs with the permission of their respective managers. The implementation coordination committee should be responsible for a successful implementation. There should be at least one representative of each department affected by the changes and other members should be opted for discussion of specific topics.

Training:-

Training section must aim to give user staff the specific skills required in their new jobs. The training will be more successful if conducted by the supervisor with the system analyst is attendance to sort out any queries, new methods gain acceptable more quickly in this way.

CONCLUSION

The software we developed meets all the necessary requirements specified by the user. We have tested and confirmed that all the programs in the "Academic management system with sentiment analysis" are functioning properly. The system has been designed to be user-friendly and includes thorough documentation to facilitate smooth operation. The system, which was developed using PHP, aims to enhance user interactivity and minimize errors. Its primary goal is to serve as an information system for educational purposes, and it has successfully been implemented and tested.

FUTURE ENHANCEMENT

Since every application should expand and it should provide a way for updating the system have been developed. Every module in this system have been developed carefully such that future enhancement do no affect the basic performance of the system. Through the current system in suitable the customer can be eager to use the most recent available development the system is faster and better than the existing once.

In future, we can incorporate "**ACADEMIC MANAGEMENT SYSTEM**" with newer facility. So as to make it more attractive and ease to be used by the client. These may include artificial intelligence-powered systems that can analyze data and make recommendations, or systems that use blockchain technology to securely store and manage student data. We can enhance these systems are more comprehensive and are used to manage all aspects of an educational institution, including finances, human resources, and operations.

RESULTS

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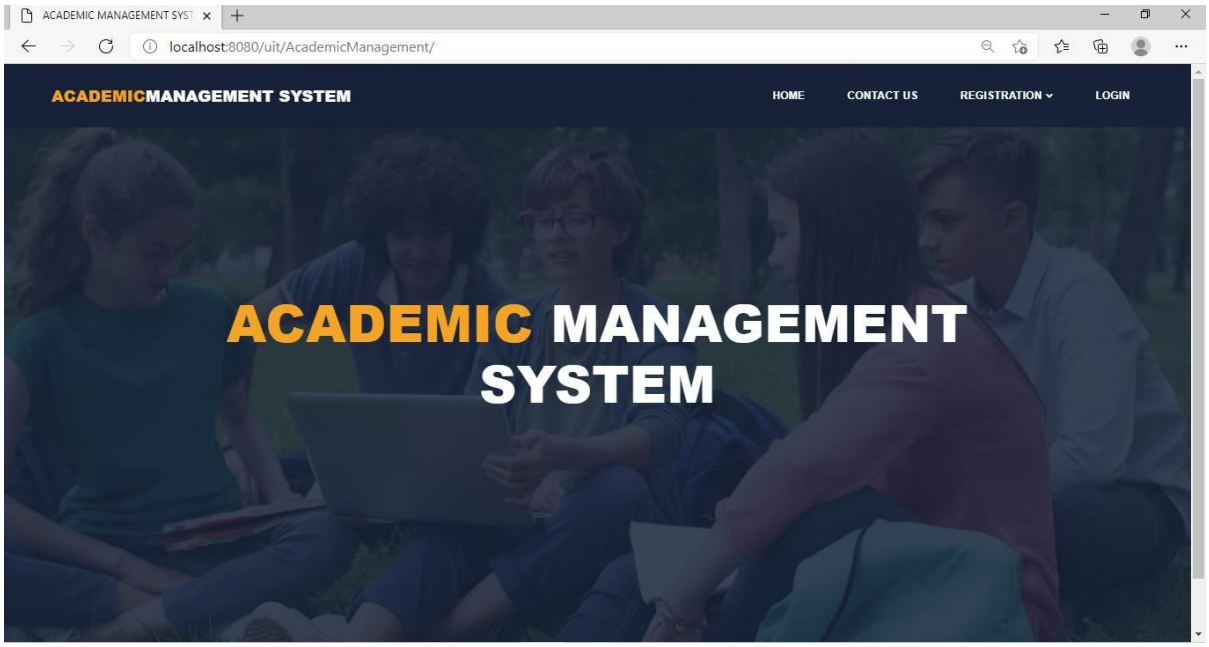

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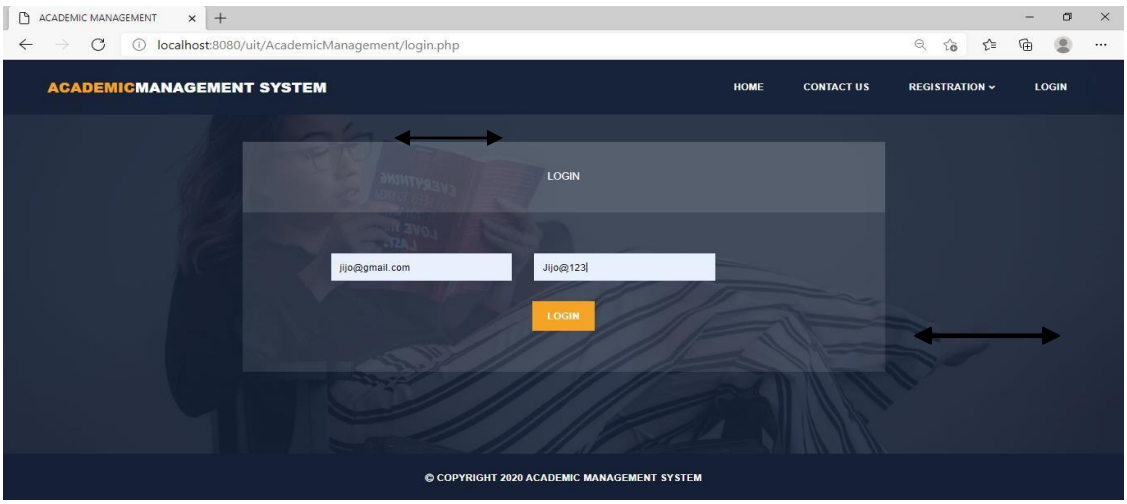

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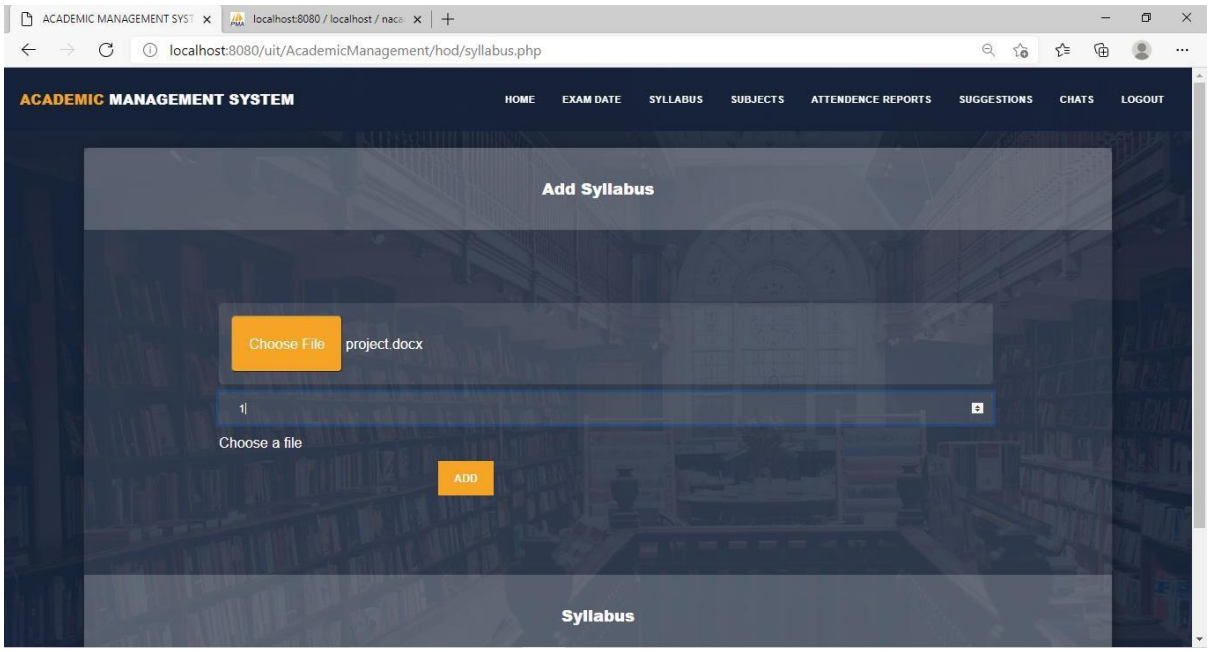

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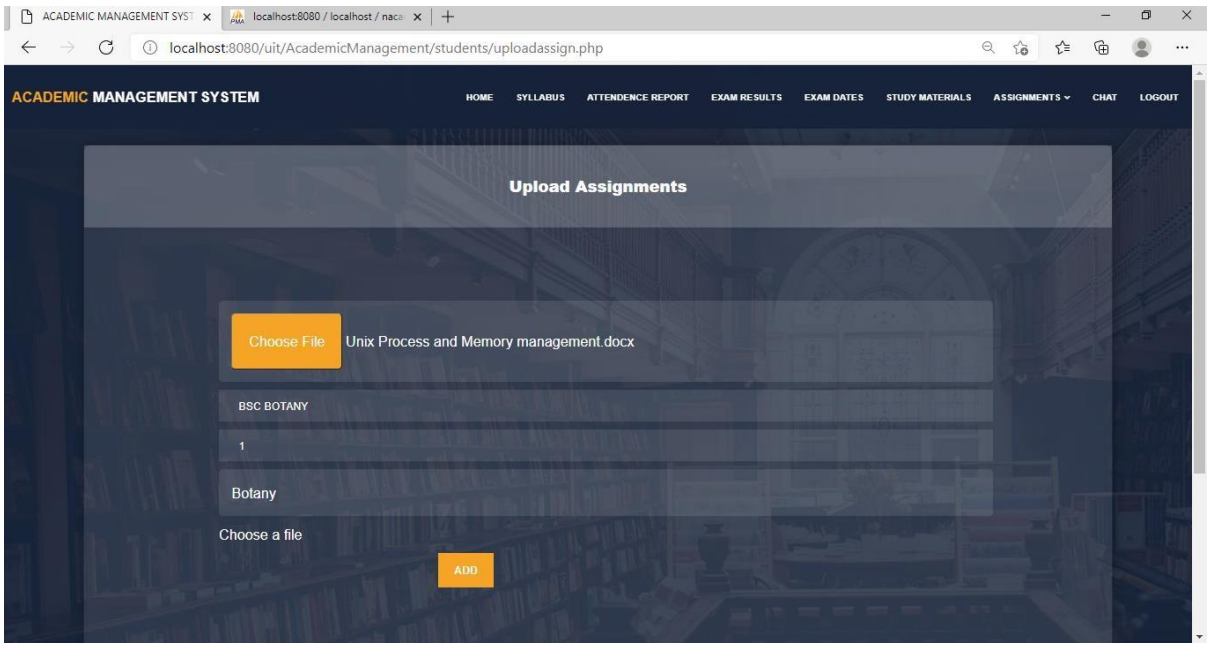

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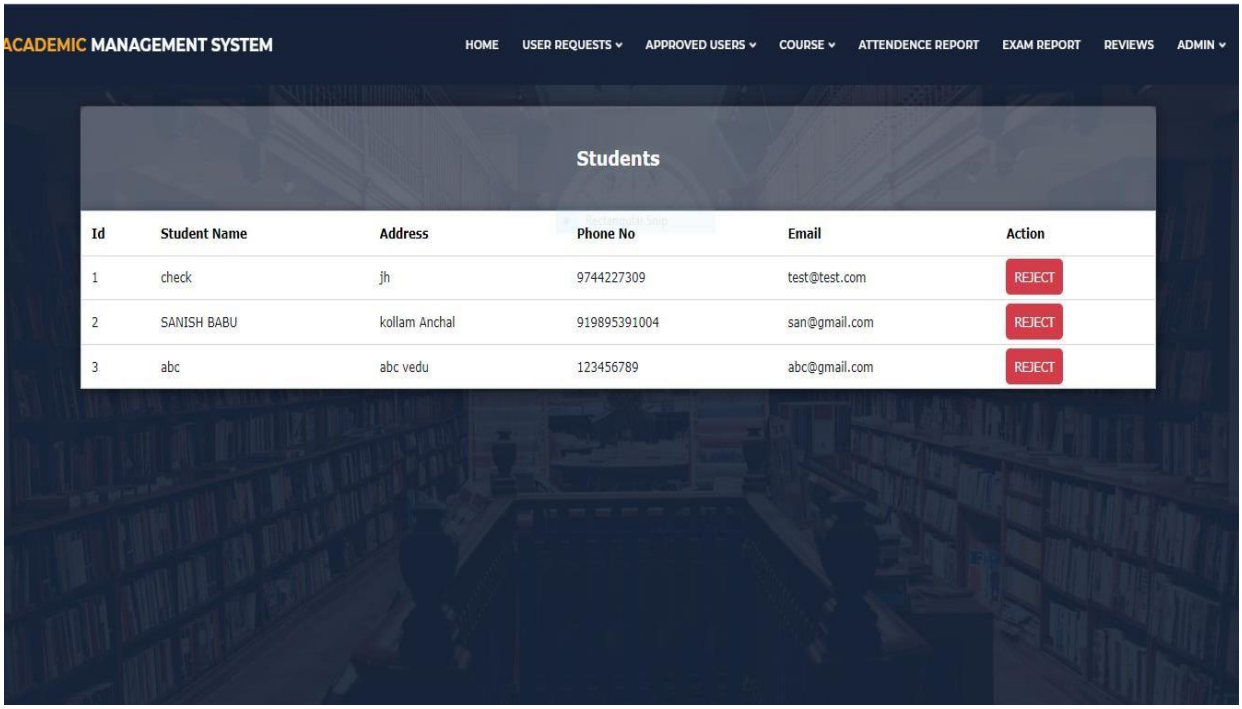

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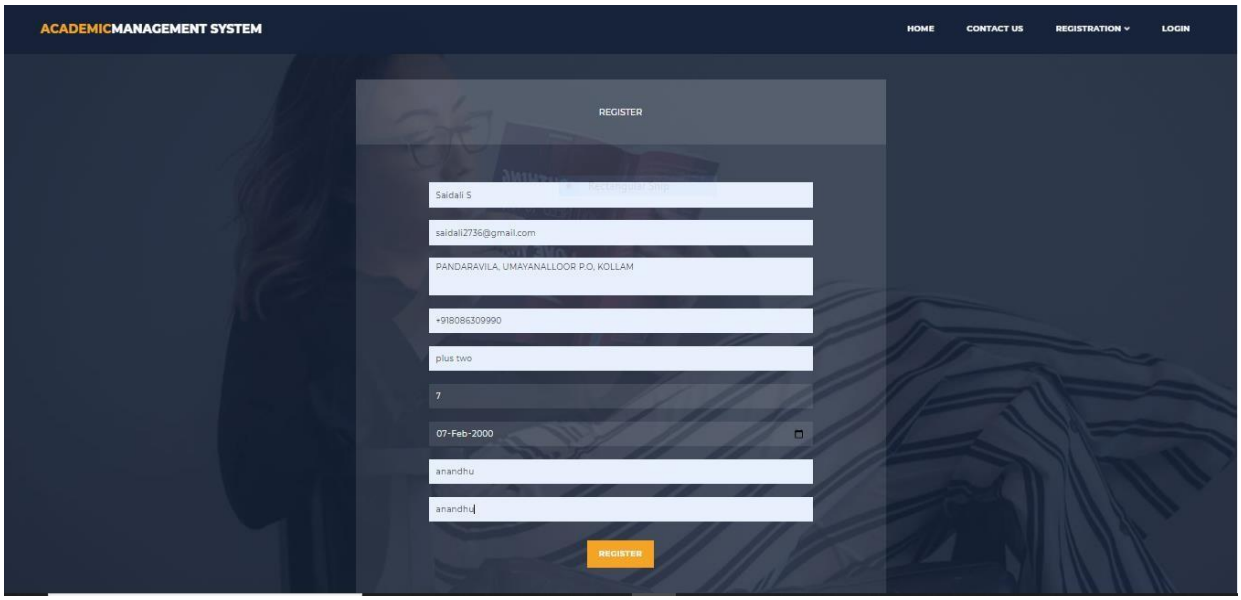

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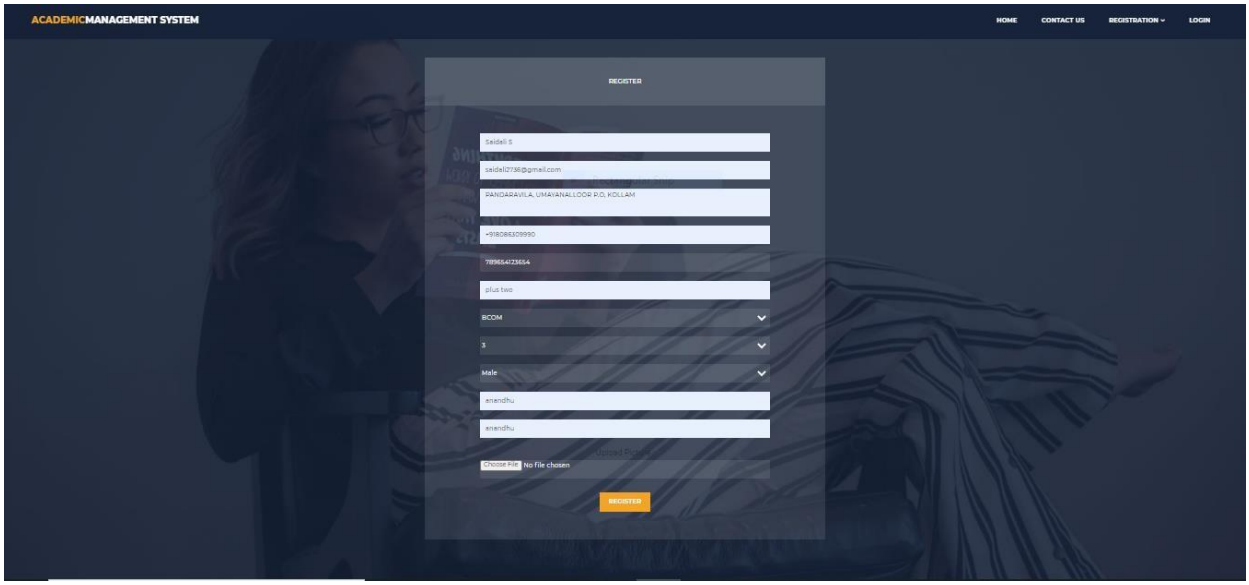

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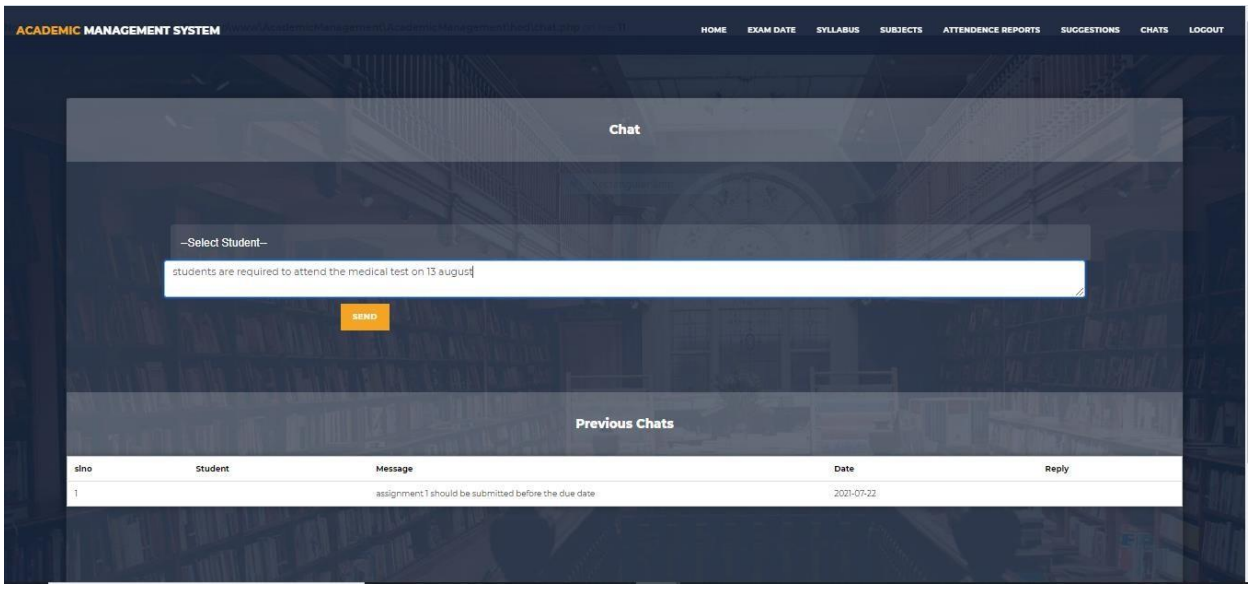

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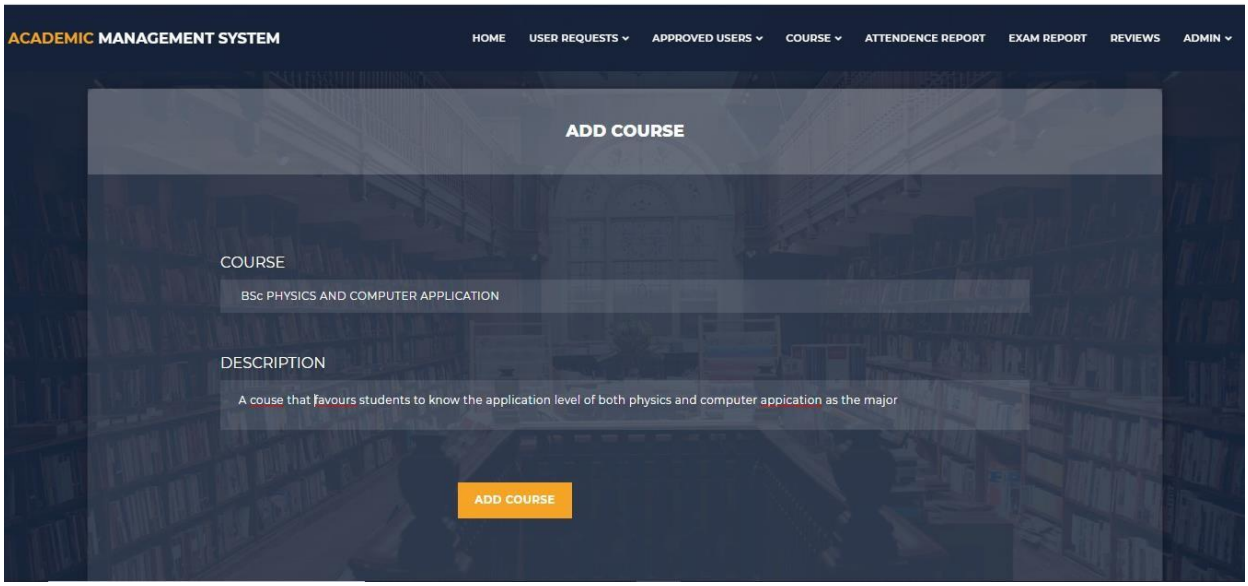

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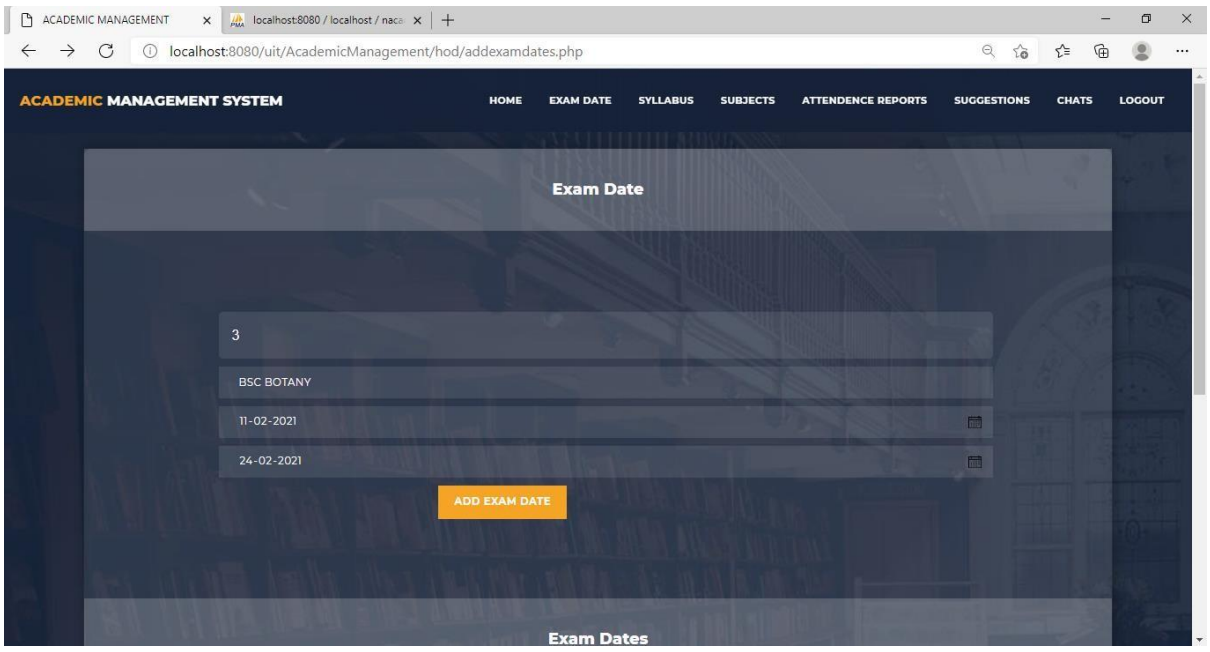

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03

Modelling of Micro Perforated Panels Using Maa's Theory

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Abstract

Passive and Active Methods of noise controlling are relevant in this particular modern world of fast industrial and technological developments. Noise and vibration produced as a result of these developments adversely affect the living and nonliving world simultaneously. Low frequency noise below 500Hz is being efficiently controlled by Active noise controlling methods. The passive acoustic absorbers are less efficient in this low frequency region. In this article modelling of Micro Perforated Panel based passed passive acoustic absorbers is being done based on Maa's theory. It is established through this modeling studies that they are efficient in controlling low frequency and high frequency noise simultaneously. The geometrical parameters of MPP plays a significant role in determining its performance. The main geometrical parameters of the MPP of importance are its peroration diameter, air cavity length, separation between the perforations and the thickness. The above parameters in suitable combination can be optimized for the efficient performance of the MPP in controlling the noise in the required frequency region of interest. Acoustic absorption coefficient close to 0.99 is achieved even at the very low frequency region close to 375Hz for the optimized values of geometrical parameters of the MPP. This modelling study clearly establishes that MPP can be used instead of the active noise controllers and the conventional porous acoustic absorbers. Thus the MPP absorber is a challenging candidate for addressing the noise controlling problem.

Key words: MPP,Passive Absorber,Activeabsorber,Acoustic Absorption Coefficient

04

A COMPARATIVE STUDY OF ANTIOXIDANT AND ANTIMICROBIAL ACTIVITY OF LEAVES AND FLOWER EXTRACTS OF *ANACARDIUM OCCIDENTALE* L. AND *MANGIFERA INDICA* L.

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ABSTRACT

This study was carried out to detect the antioxidant activity and antibacterial activity of ethanol extract of leaves and flower of the medicinal tree species, *A.occidentale* and *M.indica*. DPPH free radical scavenging method and agar well diffusion method was used to assess the antioxidant activity and antibacterial activity respectively. In comparison with other extracts, cashew leaves showed greater antioxidant potential. The antimicrobial activities of ethanolic extracts were also screened against some human pathogens such as *Bacillus cereus*; *Escherichia coli* and *Staphylococcus aureus.* Therefore ethanol extracts of various plant parts of *A.occidentale* and *M.indica* can be used as a new potential source of natural antioxidants instead of synthetic ones and antimicrobial agent for pharmaceutical industries.

Keywords: *Anacardium occidentale*, *Mangifera indica*, Antioxidant activity, Antibacterial activity, DPPH

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INTRODUCTION

Nowadays herbal medicine attained global importance both as medicinal and economical. *A.occidentale* is a tropical tree belongs to the member of the family Anacardiaceae, indigenous to Brazil, which is now widely grown in other tropical countries like India and is a multi-purpose plant (Togun, 1977). Many parts of this tree are used in traditional medicine. Commercially important two parts are cashew nut for diet and the liquid from nut shell (CNSL) for various industrial and medical applications (Joseph 1990; Pillai *et al.,* 1990). Anacardic acid is having very much demand in the international market (Rodrigues *et al.,* 2006). Apart from this, a large number of other phenolic compounds are founds in very small quantities in the shell (Miraliakbari and Shahidi 2008). Phenol is seen throughout the plant system though it is mainly concentrated in the nut shell. The mango (*Mangifera indica* L.) is one of the plantation crops of tropical and sub-tropical regions of the world, especially in Asia. Its popularity and importance can easily be realized by the fact that it is often referred as 'King of fruits' in the tropical world (Singh *et al.,* 1991). Mangiferin is one of the phenolic compounds present in mango leaves, bark, peels and kernels and is particularly seen high quantities in young leaves (Barreto *et al.,* 2008). Mangiferin is also having biological activities such as anticancer, antimicrobial, anti-allergenic, anti-inflammatory, analgesic, immunomodulatory and hypolipidemia, as well as antioxidant activity (Masibo and He 2008).

The various plant extracts can defend human and plant pathogenic bacteria, fungi and virus without any side effects and environmental hazards. In recent years, researches are going on to find out the plant products with antimicrobial properties intensified. Bacterial infections are the major reason for health problems, physical disabilities and mortalities around the world. The phytochemicals are more effective as compared to commercial antibiotics so that they are used as an alternate remedy for the treatment of various diseases. Alkaloids, tannins, flavonoids and phenolic compounds are the major bioactive constituents of plants. In view of the above, the present study has been made to investigate the antioxidant potential as well as the antimicrobial activities of a traditionally used medicinal tree plants such as *A.occidentale* L. and *M.indica* L.

Materials and Methods

Source of plant materials

Plant materials (young leaves and flower) of *A.occidentale* and *M.indica* were procured from the mother stock trees grown at the Sree Narayana College Campus, Kollam, Kerala.

Preparation of plant extracts

Powdered samples were extracted with ethanol by maceration and kept it for a period of 24 hrs at room temperature at a ratio of 1:100 (g:ml). Homogenized samples were centrifuged at 10,000 rpm for 15 minutes and supernatants were pooled. The extracts were

filtered using Whatman No.1 filter papers and each extract was concentrated in a rotary evaporator to remove ethanol. The residue thus obtained was dissolved in ethanol and stored at 4-8ºC in a refrigerator for further analysis (Kumarasamy *et al.,* 2007; Alzoreky and Nakahara 2003).

Determination of antioxidant activity using DPPH free radical

The 2,2-diphenyl-1-picryl-hydrazyl radical (DPPH) scavenging activity was measured (Bauer *et al.,* 1996). DPPH (20 mg) was dissolved in ethanol (250 ml) to obtain the concentration of 80 μg/ml. The plant extract was prepared in ethanol. Dilutions were made to obtain concentration of 20,40,60,80 and 100 μg/ml. Ascorbic acid was used as standard in 1-125 μg/ml concentration. 1 ml of the diluted plant extract was mixed with 1 ml of DPPH. After 30 minutes dark incubation at room temperature, spectrophotometric reading was taken at 517 nm.

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

IC_{50} value is the concentration of sample required to scavenge 50% of DPPH free radical and was calculated from the % inhibition versus concentration sigmoidal curve, using a non-linear regression analysis.

Determination of antibacterial activity

The antibacterial activity of the ethanol extracts was screened against some human pathogenic bacteria; *Bacillus cereus* (MTCC 2340); *Escherichia coli* (MTCC 56) and *Staphylococcus aureus* (MTCC 9760) obtained from the Microbiology Laboratory of the Department of Biotechnology, Sree Narayana College, Kollam, Kerala. Antibacterial activities of the different plant extracts were investigated by the agar well diffusion method (Zhao *et al.,* 2014; Jaiswal *et al.,* 2012) using Mueller- Hinton agar plates previously inoculated with 18 hour old nutrient broth culture for the bacteria. The zone of inhibitions produced by inhibitory action of different plant extracts and control were taken as the antibacterial activity.

Statistical analysis

Data were expressed as means ± standard deviation (SD) of three replicate determinations. All statistical analysis was carried out using a SPSS (Chicago, IL) statistical software package (SPSS for Windows, ver.17, 2008). To determine whether there were any differences among the means, one way analysis (ANOVA) and the Duncan's New Multiple range test were applied to the result at 0.05 level of significance (p<0.05).

Results and Discussion

Antioxidant activity

DPPH free radical scavenging activity of various ethanol extracts of *A.occidentale* and *M.indica* were determined. The results of the present study showed that all the plant extracts such leaves and flower had antioxidant activity.

It has been observed that the percentage of scavenging effect on the DPPH radical was increased with the increase in the concentration of all the extracts from 20 to 100 µg/ml. The ethanol extract of young leaves of *A.occidentale* showed the highest percent of inhibition from 43.44±0.58% at 20 µg/ml to 47.31±1.71% at 100 µg/ml while the flower extract of *M.indica* showed the least (13.6±0.54% at 20 µg/ml and 19.25±1.35% at 100 µg/ml), which is comparable to the free radical scavenging activity of standard ascorbic acid (46.88±0.36% at 20 µg/ml and 50.18±1.33% at 100 µg/ml) (Table1). Studies have clarified the radical scavenging activities of plant phenolic compounds and also verified the relationship between phenolic compounds and antioxidant activity (Tan *et al.,* 2014) and many researchers have affirmed that phenolic compounds are most adequate antioxidants in *A.occidentale* (Silva *et al.,* 2016, Samba *et al.,* 2018). Free radical scavenging activity of ethanol extract of flower, leaves and stem bark of *A.occidentale* were explored (Barreto *et al.,* 2016). The antioxidant activity of young leaves, barks, roots and kernels of *M.indica* were also studied (Chbisika *et al.,* 2014). Mangiferin is one of the major phenolics seen in mango leaves, bark, peels and kernels and is present in particularly high quantities in young leaves (Sujatha *et al.,* 2011).

Table 1: Free radical scavenging activities of various extracts of *A.occidentale* and *M.indica* measured using the DPPH assay

Test compound (Ethanol extract)		DPPH radical scavenging activity (%)				
		Concentration (µg/ml)				
		20	40	60	80	100
A.occidentale	Young leaves	43.44±0.58	44.11±1.34	45.97±1.23	46.96±0.91	47.31±1.71
	Flower	17.03±0.81	19.31±1.71	21.19±1.63	23.4±1.47	25.01±1.57
M.indica	Young leaves	32.31±0.63	33.5±1.79	34.3±0.87	35.31±1.74	36.91±1.23
	Flower	13.6±0.54	14.52±1.21	15.96±0.96	16.7±1.33	19.25±1.35
Control	Ascorbic acid	46.88±0.36	46.43±1.97	48.15±0.98	49.1±0.86	50.18±1.33

Results are expressed as means ± SD for triplicates

The antioxidant activity of different plant part extracts of *A.occidentale* and *M.indica* were also expressed in terms of IC_{50} (µg/ml) values (Table 2) and it ranged from 157.41±1.74µg/ml to 479.78±1.67µg/ml. The result revealed that flower of *M.indica* showed weak antioxidant activity, with IC_{50} value of 479.78±1.67µg/ml.. While the ethanol extract of young leaves of *A.occidentale* showed the highest antioxidant activity, with IC_{50} value of 157.41±1.74µg/ml. The IC_{50} value for standard ascorbic acid was 97.34±1.33 µg/ml. The IC_{50} value decreased with the increase of antioxidant activity of each explant type and vice versa. The result of the present study showed that the IC_{50} value differ significantly ($p < 0.05$) among the various extracts (Figure 1).

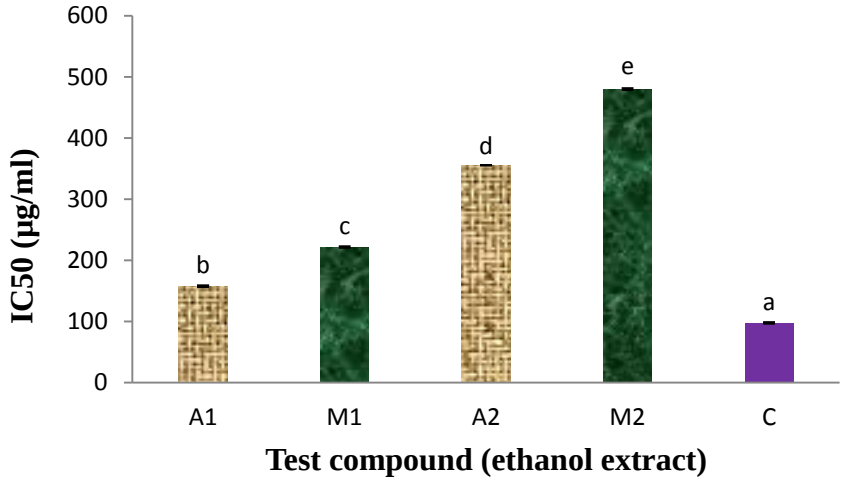

Fig.1: Antioxidant activity of investigated plant extracts of *A.occidentale* and *M.indica*

Values with different letters are significantly different by Duncan's multiple range test ($p < 0.05$),

(n=3, error bars represent standard deviation)

Young leaves (A1), Flower (A2) - *A.occidentale*

Young leaves (M1), Flower (M2) - *M.indica*

Control: Ascorbic acid

Antimicrobial activity

In the current study, various ethanol extracts of *A.occidentale* and *M. indica* were tested for its antibacterial activity against three human pathogenic bacterial strains of *Bacillus cereus* (MTCC 2340); *Escherichia coli* (MTCC 56) and *Staphylococcus aureus* (MTCC 9760)

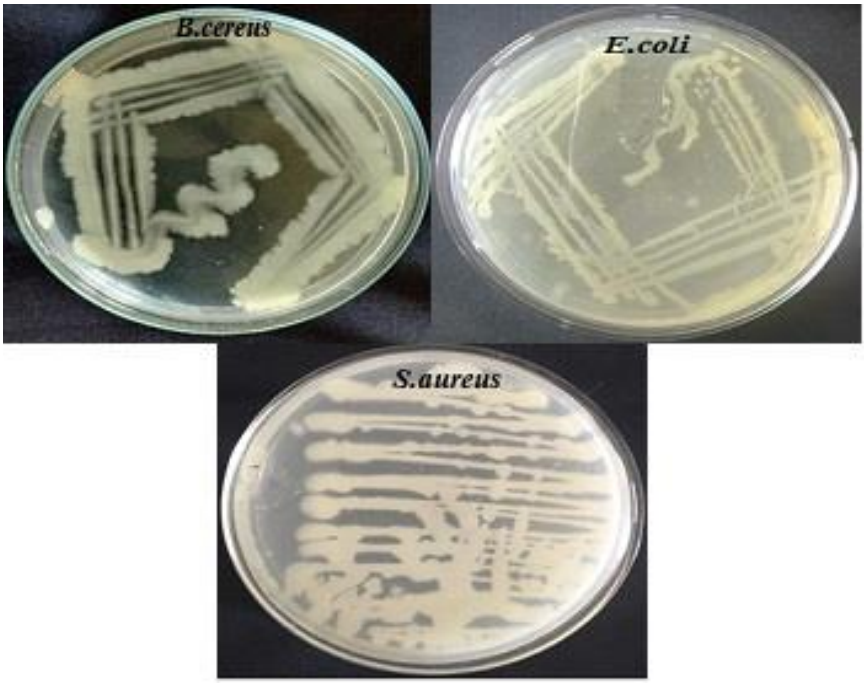

Fig.2: Pure cultures of *B.cereus; S.aureus and E.coli* on nutrient agar plate

All the plant extract of *A.occidentale* showed inhibitory action against *B.cereus* and *E.coli* whereas the ethanol extract of flower of *A.occidentale* and *M.indica* showed no inhibitory action against *S.aureus* as given in the Table 3. The control (ethanol) showed no zone of inhibition against three typical bacterial strains (Fig.3).

Table 3: Zones of inhibition produced by ethanol extracts of *A.occidentale* and *M.indica*

Test compound (Ethanol extract)		**Zone of inhibition (mm)**		
		Bacteria		
		B.cereus	***E.coli***	***S.aureus***
A.occidentale	Young leaves	19	19	21
	Flower	19	19	-
M.indica	Young leaves	17	23	22
	Flower	-	20	-

Young leaves (A1), Flower (A2) - *A.occidentale*

Young leaves (M1), Flower (M2) - *M.indica*

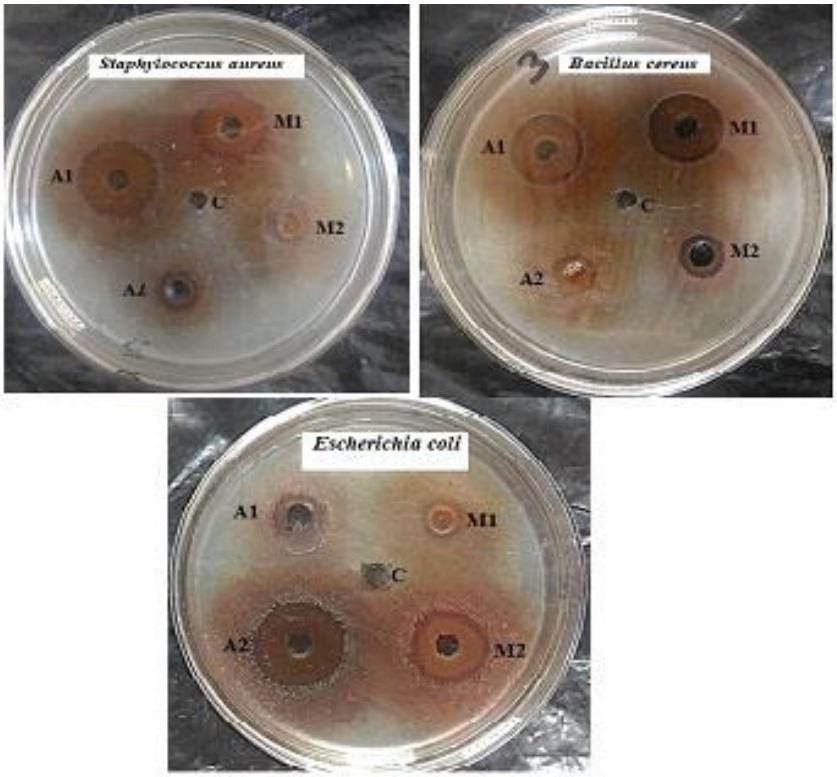

Fig.3: Zones of inhibitions revealed by various plant parts of *A.occidentale* and *M.indica* against *B.cereus, E.coli* and *S.aureus*

A1 (Young leaves), A2 (Flower) - *A.occidentale*

M1 (Young leaves), M2 (Flower) - *M.indica*: C-control

Among the two extracts of *A.occidentale* tested, flower showed maximum zone of inhibition (19mm) against *B.cereus* (Table 3 & Fig.3). It was observed that ethanol extract of young leaves showed the zone of inhibition of 12.5 mm and flower showed the zone of inhibition of 19 mm against *B.cereus* (Agedah *et al.,* 2010). Thus the present study is in compliance with early reports. The presence of a phenolic lipid known as anacardic acid and other chemical compounds such as tannins, flavonoids, phenols, alkaloids, saponins, steroids or triterpenes play a major role in the antibacterial activity of cashew tree (Sujatha *et al.,* 2011; Poongothai and Rajan 2013) .

Result of the present study also revealed that ethanol extract of young leaves and flower of *M.indica* showed zone of inhibition against *E.coli*. It also showed 22mm zone of inhibition against *S.aureus*, 17mm zone of inhibition against *B.cereus* (Table 3 & Fig.3).

It was also observed that young leaf extract of *M.indica* showed maximum zone of inhibition (23mm) against *E.coli* compared to the young leaf extract of *A.occidentale* (19mm) (Table 3 & Fig.3). Young leaf extract of *A.occidentlae* showed zone of inhibition (21mm) against *S.aureus* (Table 3 & Fig.3). This study was also supported by early study; there the antibacterial activity of young leaves of *M.indica* against *S.typhi* was investigated (Zakaria *et al.,* 2006). Antibacterial activities of plant extracts have the vast therapeutic potential to heal

many infectious diseases and are associated with lesser side effects compared to the synthetic drugs.

Acknowledgements

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05

Synthesis, Characterisation and Antibacterial Property of α-Mangostin-β-Cyclodextrin Inclusion Complex

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Abstract

Xanthone compounds in mangosteen (Garcinia mangostana Linn.) fruit have received great attention in the current research scenario due to its outstanding pharmacological properties. Of the various xanthones isolated from the pericarp of Garcinia mangostana Linn, α-Mangostin was found to be the major constituent. α-Mangostin, a xanthone derivative with two isoprenyl groups was known to possess several biological properties. The objective of this study was to synthesize an inclusion complex of α-mangostin with β-cyclodextrin (MN-CD). The complex was characterized by Fourier transform infrared (FTIR) spectroscopy and the antibacterial effect of MN-CD complex was assayed by using the agar disc diffusion method. The diameter of zone of inhibition was determined at concentrations of 10µl and 20µL of the samples and the formation of clear zone around the disc shows that MN-CD complex displayed an effective antibacterial activity against E coli.

Introduction

Plant based natural products have attained great interest in day today life owing to their numerous properties and applications in different areas [1,2,3]. They are highly diverse based on their chemical structure, composition, solubility and the methods by which they are synthesized[4]. Mangosteen (Garcinia mangostana Linn) is a tropical tree and cultivated for centuries in South East Asia rainforests and can be found in many countries worldwide. It is an erect slow growing tree with a pyramidal crown and can attain a height of 6–25 m. In India, Mangosteen was introduced in Nilgiri Hills, Tinnevelly district, Kanyakumari district and Kerala. The major bioactive compounds found in mangosteens are phenolic acid,

prenylated xanthone derivatives, anthocyanins and procyanidins. There is a renewed interest for the identification, isolation and utilization of the compound of natural products for several applications.

The pericarp of the mangosteen fruit contains large amounts of xanthones which are a group of oxygenated and heterocyclic compounds with a wide variety of pharmacological properties

& considerable amounts of other bioactive compounds such as terpenes, anthocyanins, tannins, flavonoids and polyphenols.[5] By far, the most studied xanthone in mangosteen tree is α-mangostin (MN) for which anti-oxidant, anti- proliferative, pro-apoptotic, anti-inflammatory, anti-carcinogenic, and anti-microbial activities have been reported[6]. Eventhough a plenty of reports are available for the biological applications of MN, studies related with the synthetic modifications and complexes of MN are limited. MN is a highly functionalized xanthone derivative with isoprenyl side chains, hydroxyl groups and methoxy group. Similar to curcumin, the molecule possess an enolic O, O- donor ligand. The reaction of enolic O, O-donor ligand in naturally occurring curcumin with different molecules resulted in the formation of various complexes and improved biological properties.

Samikannu Prabu *etal*[7] reported the formation of supramolecular complex between the curcumin and β-cyclodextrin (LC) and the complex formation was confirmed using absorption and emission spectroscopy. The binding properties of probe LC with cations in water were observed for the first time via absorption and emission spectroscopies. The selectivity and sensitivity of fluorescence chemosensors have been studied using probe. The probe showed selective binding to Hg^{2+} and afforded new absorbance and fluorescence peaks at 379 nm and 502 nm, additionally to the prevailing bands of LC at 432nm and 535 nm. It additionally showed apparent colour change from yellow to colourlessness and strong fluorescent to weak fluorescent owing to selective binding of Hg^{2+}ion, which was detected by naked eyes. No noticeable changes of colour and spectra were observed upon the addition of other metal cations such as [Ag^{+}, K^{+}, Na^{+}, Cs, $Ba^{2+,}$ Fe^{2+}, Mg^{2+}, Pb^{2+}, Mn^{2+}, Ni^{2+}, Cd^{2+}, CO^{2+}, $Cr^{3+,}$ Sn^{2+} and Zn^{2+}.

Owing to the resemblance in the ligand site of the curcumin, herein we have explored the synthesis and antibacterial property of the supramolecular complex between MN and β-cyclodextrin. (CD)

Materials and methods

Mangosteen is collected from one of the local market in our area. All reagents were procured from Aldrich, India. Deionised water was used throughout all experiments. The ^{1}H NMR spectra were recorded on a Brucker AV 400 MHz and ^{13}C NMR were recorded on a Brucker AV 100 MHz NMR system and chemical shift values are reported in parts per million (ppm) relative to tetramethylsilane (0.00 ppm). A diffused reflectance Fourier Transform Infrared

(FTIR) spectrum of the sample was taken on Perkin-Elmer Spectrum 100 FTIR spectrophotometer at room temperature.

Isolation of MN

Mangosteen pericarps collected were dried (1 Kg), cut in to small pieces and ground into powder form. Soxhlet extraction was carried out using ethyl acetate as the solvent. The extract was collected and purified by column chromatography on silica gel (60-120 mesh) with the n-hexane – ethyl acetate as the solvent system.MN is obtained as yellow crystalline solid with >98% purity was confirmed by ^{1}H and ^{13}C NMR. Characterization Data for MN: Yield 70%; Yellow solid; ^{1}H NMR (400 MHz, Acetone - d_6), δ 1.798 (s, 3H), 1.842 (s, 3H), 1.664, (s, 3H), 3.466 (d, J= 7 Hz, 2H), 4.144, (d, J= 7Hz, 2H), 5.28 (t, 1H) , 3.809 (s, 3H) 6.841 (s, OH), 9.675 (s, OH), 13.80 (s, OH). ^{13}C NMR(100 MHz, Acetone - d_6) δ 182.87, 162.98. 161.73, 157.39, 156.24, 155.74, 144.50, 138.14. 131.42, 124.76, 123.46, 112.03, 111.09, 103.65, 102.72, 93.17, 61.35, 30.35, 30.20, 25.91, 25.87,21.98, 18.27, 17.89.

Synthesis of MN-CD inclusion complex

The calculated amount of MN to be complexed was dissolved in a minimum volume of methanol at 60 °C and then added dropwise into the 2.5 equiv. of β-CD aqueous solution at 60 °C with continuous, intensive stirring. The mixture solution was refluxed with vigorous agitation at 70

°C for about 4 h. Then the reflux equipment was taken down and the solution was stirred for an additional hour at 70 °C to remove methanol. Then the system wascooled to room temperature. After stirring for 8 hour at ambient temperature, the reaction mixture was stored overnight at 4 °C and then filtered off on a sintered glass filter. The crystalline product was obtained and dried in a vacuum oven at an elevated temperature (50- 55 °C)

Antibacterial Assay: Disc Diffusion Method

The antibacterial effect of MN-CD complex was assayed by using the agar discdiffusion method described by Bauer *etal*.,1966 with some modifications.[15] Briefly, 100μL of a bacteria suspension was dispersed on Muller-Hington agar plates. Then, the sterilized paper disc (6mm in diameter) were impregnated with 20μL of the samples. The discs were placed on the surface of Muller-Hinton agar plates. Tetracycline and Chloramphenicol (10μL /disc) was used as a positive control. For diffusing the active compounds in the medium, the plates were kept at 4ºC for 2 hr. After that, all the plates were incubated at 37ºC for 24 hr. The antibacterial activity was then investigated by measuring the clear zones of inhibition to the nearest millimeter (mm).

Results and Discussion

The complex formation between MN and CD was confirmed by Fourier Transform Infrared (FTIR) spectroscopy. FTIR spectrum of the compound MN showed the characteristic absorption bands at 3400 (OH, broad), 1790 and 1735 cm^{-1} (carboxyl carbonyl groups) which confirms the xanthone skelton of MN. In the spectrum of the complex, the shifts in the peaks of MN-CD confirms the complex formation between MN and CD. (Fig 1)

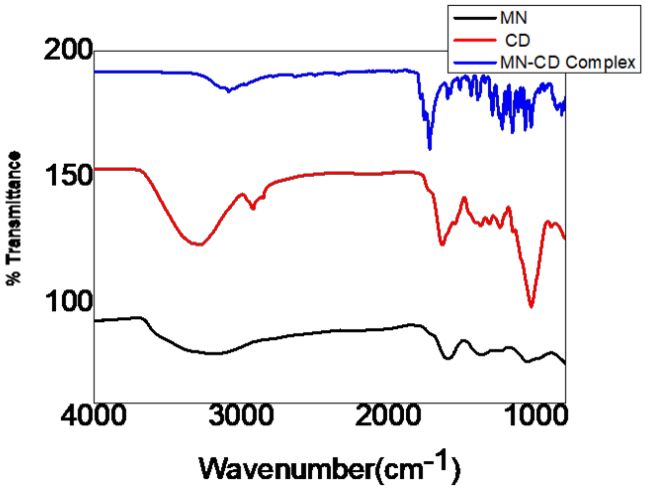

Fig. 1: FTIR spectrum of MN, CD and MN-CD complex

The synthesized MN-CD complex exhibit an effective antibacterial activity against gram-positive and gram-negative bacteria.The result suggests that the complex undergo an interaction with bacterial cell and displayed strong action against Escherichia coli. In this study different concentration of MN, CD and MN-CD complex was tested on Escherichia coli. The formation of clear zone around the disc is an indication of antibacterial activity. The diameter of zone of inhibition was determined at concentrations of 10µl and 20µL of the samples as shown in fig. 2 and table 1to

3. From the findings, it was observed that the MN-CD complex showed antibacterial activity. Therefore, the MN-CD complex can serve as an antibacterial agent.

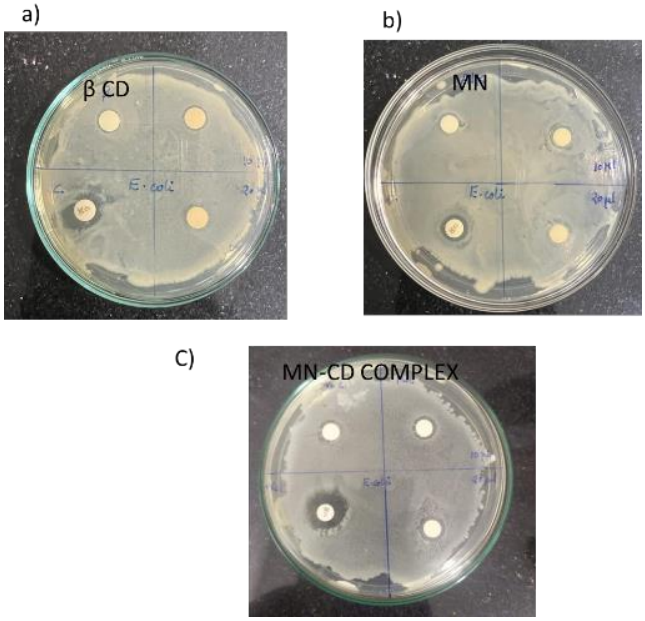

Fig .2: Antibacterial activity of a) MN b) CD and c) MN-CDcomplex on E coli bacteria

Table1: Antibacterial activity of MN

SL.NO	Name of Bacteria	Zone of inhibition in mm			
		Positive control	Negative control	MN (10µL)	MN (20µL)
1.	Escherichia coli	9mm	Nil	Nil	Nil

Table 2: Antibacterial activity of CD

SL.NO	Name ofBacteria	Zone of inhibition in mm			
		Positive control	Negative control	CD (10µL)	CD (20µL)
1.	Escherichia coli	10mm	Nil	Nil	Nil

Table 3: Antibacterial activity of MN-CD complex

SL.NO	Name of Bacteria	Zone of inhibition in mm			
		Positive control	Negative control	MN-CD Complex (10µL)	MN-CD Complex (20µL)
1.	Escherichia coli	10mm	Nil	4mm	6mm

Conclusion

α-Mangostin was isolated from the pericarp of mangosteen fruit and an inclusion complex of α-mangostin with β-cyclodextrin was synthesized. The complex was characterized by FTIR spectroscopy. On forming the inclusion complex, there occurs a shift in the peaks and the complex showed an excellent antibacterial property against E coli bacteria.

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06

CAA-NPR-NRC- A MYTH OR REALITY

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The Citizenship Amendment Act, 2019 (CAA) is an act that was passed in the Parliament on December 11, 2019. The 2019 CAA amended the Citizenship Act of 1955 allowing Indian citizenship for Hindu, Sikh, Buddhist, Jain, Parsi, and Christian religious minorities who fled from the neighbouring Muslim majority countries of Pakistan, Bangladesh and Afghanistan before December 2014 due to "religious persecution or fear of religious persecution". However, the Act excludes Muslims. Under CAA 2019 amendment, migrants who entered India by December 31, 2014, and had suffered "religious persecution or fear of religious persecution" in their country of origin, were made eligible for citizenship by the new law. These migrants, will be granted fast track Indian citizenship in six years. The amendment also relaxed the residence requirement for naturalization of these migrants from eleven years to five.

There arise widespread protests across the country including the national capital region and north-eastern states against the CAA amendment. The protest in Assam and other north-eastern states turned violent over fears that the move will cause a loss of their "political rights, culture and land rights" and motivate further migration from Bangladesh. The agitators say that new amendment in Citizenship Act discriminates against Muslims and violates the right to equality enshrined in the Constitution of the country. Sects like Shias and Ahmedis also face persecution in Muslim-majority countries like Pakistan but are not included in the CAA. Questions were also raised on the exclusion of persecuted religious minorities from other regions such as Tibet, Sri Lanka and Myanmar.

INDIAN CITIZENSHIP AMENDMENT-HISTORY

Routes to Indian Citizenship

The overall structure of India's citizenship laws denotes a shift from Jus soli to Jus sanguine. Before the 2004 amendment, any person born in India after 26 January 1950 was an Indian citizen, irrespective of whether one or both of her parents were illegal migrants. After the 2004 amendment, an individual born in India after 26 January 1950 but before 1 July 1987 is a citizen of India irrespective of whether one or both of her parents were illegal migrants. However, any person born in India on or after 1 July 1987 but before 3 December 2004 would be a citizen only if both her parents are Indian citizens, or, if one parent is an Indian

citizen and the other is not an illegal migrant at the time of that person's birth. The descent path to Indian citizenship is applicable to those who are not born in India. Complex rules regulate this path. Here, a person born outside India before 26 January 1950 can become a citizen if either of her parents was a citizen at the time of her birth. A person born outside India after 26 January 1950 but before 10 December 1992 is a citizen if her father was a citizen at the time of her birth. A person born outside India on or after 10 December 1992 can be regarded as a citizen if either of her parents was a citizen at the time of her birth. However, if the father or mother were Indian citizens by descent only, then either birth outside India had to be registered at an Indian consulate within a specific period of time or, the parent must have worked for the Indian government. After 3 December 2004 registration of a person as an Indian citizen by descent is not possible unless her birth is registered at an Indian consulate within a specified time.

In general, the path of citizenship by registration is intended for persons of Indian origin and the spouses or children of citizens of India. Citizenship by naturalization is a route meant for those who have no ancestral relation to India. Also, if a new territory is incorporated into India, the central government has the power to specify who shall be Indian citizens by virtue of their connection to such a newly incorporated territory, by way of an order notified in the official gazette.

It must also be noted that the 2004 amendment foreclosed any possibility of an 'illegal migrant' obtaining Indian citizenship by registration or naturalization. The term 'illegal migrant' has been defined to refer to a foreigner who enters or stays in India illegally, that is enters lacking valid travel documents or enters with valid travel documents but stays beyond the permitted time period. The CAA amends this complex legal regime on citizenship to carve out an exception for individuals belonging to select communities.

The 2019 Amendments

The CAA seeks to amend the parent Citizenship Act 1955 to pave the way for extending Indian citizenship to illegal migrants belonging to Hindu, Sikh, Buddhist, Jain, Parsi and Christian faiths (notably excluding Islam), who escaped persecution from Pakistan, Bangladesh and Afghanistan and entered India before 31 December 2014. Section 2 of the CAA amends Section 2(1)(b) of the Citizenship Act 1955 by holding that illegal migrants (as defined above) would not be considered illegal migrants for the purposes of the Citizenship Act 1955. Illegal migrants belonging to select faiths from selected jurisdictions can now seek Indian citizenship by registration or naturalization. Prior to the CAA, a person classified as an illegal migrant had no scope for legal conferment of citizenship. In fact, the Indian Supreme Court has held that in respect of illegal migrants, the Government of India has unfettered and absolute powers of expulsion. But, by virtue of Section 2, the covered class of illegal migrants is governed by a different legal regime contained within Sections 3, 5 and 6 of CAA. Section 6 of CAA reduces the residence requirement for Indian citizenship by naturalization. An applicant for citizenship by naturalization, generally,

must reside in India for a twelve-month period before the date of her application. In addition to that, she must reside in India for at least eleven out of the fourteen years prior to the twelve- month period. The CAA reduces this residence requirement from eleven to five years for individuals covered by Section 2. This substantially eases the citizenship requirements for individuals who belong to one of the enumerated faiths, fled from the three specified jurisdictions and have migrated to India before the cut-off date. As per the Government, this bestowal of legislative largess was actuated by the desire to provide much needed sacessor to victims of persecution who had suffered at the hands of oppressive theocracies.

The Constitutional Validity Dispute of the CAA

The framers of the Constitution aimed to codify the 'Indian dream' in the groundnorm; highlighting the features of the kind of social system they resolved to build. They did this by myriad ways including protection for equality rights, particularly pertinent in a community life with caste and class, based discrimination; by guaranteeing secularism in a nation fraught with communal antagonism and violence; and placing responsibility on the State to promote education in a country having a literacy rate of approximately 18 percent at the time of independence.

In light of that constitutional legacy, the CAA has been condemned for breaching the right to equality because of its use of invidious classifications and its assault on the secular character of Indian citizenship law. The strength of these claims can only be assessed with a clear picture of what the Constitution prescribes; it is imperative therefore, to probe the canons of equal protection and secularism, and then apply them to the CAA.

Article 14 of the Constitution synthesizes Dicey's conception of rule of law with the equal protection clause of the US. It guarantees every person in the territory of India the fundamental right of equality before law and equal protection of the law. This implies that non-citizens are entitled to rights under Article 14 if they are within Indian territory. A key component of this right is the entitlement of equal treatment for all those who are similarly situated; equals ought to be treated equally. Bearing that in mind, the Supreme Court has repeatedly held that judicial review of legislation and administrative action is a basic feature of the Constitution, including in the context of Fundamental Rights, it has developed a rich jurisprudence on the right to equality under Article 14 of the Constitution. As early as 1952, the Supreme Court started elucidating doctrinal tests for determining whether an impugned enactment survives the scrutiny of Article 14. It is now well settled that under Article 14, 'class legislation' is verboten, but 'reasonable classification' for the purpose of achieving specific ends is not In State of West Bengal v Anwar Ali Sarkar, the Supreme Court held that equality mandates two inquiries to determine whether a classification contemplated by an impugned statute is reasonable. First, the Court must assess the existence of an 'intelligible differentia' or a yardstick that separates elements within the class from those outside the class. And second, the Court will scrutinize the presence of a rational nexus between the

yardstick of differentiation and the object that the statute seeks to achieve. This 'nexus test' has been applied and reiterated in numerous cases over the years. In 1960, however, the Supreme Court observed that the repetition of the test has become mechanical and hackneyed. The Court even wondered if 'fanatical reverence' to the test would decimate the 'glorious content' of Article 14.

In response to academic criticism on the narrowness of the nexus tests, in Ajay Hasia v Khalid Mujib the Court enlarged the contours of Article 14 by holding that arbitrariness strikes at the very heart of the right to equality. Since then, 'protection against arbitrariness' has become a basic part of the equality doctrine under Article 14. But jurisprudential advancement on the determining factors of judicial review through Article 14 did not cease. Two changes in recent history are a watershed in the development of constitutional equality. First, the Supreme Court in Nagpur Improvement Trust v Vithal Rao, held that establishing a rational nexus between the 'differentia' and the 'object' would not fetch judicial imprimatur if the object of the classification is itself discriminatory. This explicitly expanded the scope of Article 14's enquiry beyond a mere nexus assessment to adjudicating on the constitutional repugnance of the legislature's objective in enacting a law. Second, in Navtej Singh Johar v Union of India, the Supreme Court added yet another caveat to the nexus tests. In this case, the Court was determining the constitutionality of Section 377 which criminalized sexual intercourse between consenting homosexuals. The Court rejected such criminalization and reasoned that a law that discriminates on the basis of an 'intrinsic and core trait of an individual' cannot be said to represent 'reasonable classification'.50 By this logic, the Court examined the 'constitutional relevance' or 'reasonableness' of a yardstick of classification, which in that case was sexual orientation, thereby holding that in case the yardstick is itself unreasonable, the impugned law would be contra legal. These two landmark developments signify an expansion in the scope of Article 14's enquiry in the nature of widening the reach of the scrutiny from determining mere intelligibility of the classification, whether its yardstick is discernible/understandable, to reasonableness, an analysis of which also requires a determination of whether the basis of the classification is just as per Navtej. This doctrinal evolution has transformed Article 14 into a bulwark against governmental iniquitousness.

The CAA's framework of granting privileges is predicated on two explicit classifications: the faith classification, only illegal migrants belonging to the six faiths enumerated earlier are worthy of protection via the citizenship path; and the nation classification, an illegal migrant only from Afghanistan, Pakistan or Bangladesh can benefit from the CAA. Albeit, the government has tried to defend these classifications per its counter affidavit filed before the Supreme Court in response to the petitions challenging the law, but considered alongside the implicit premises of the CAA's structure, a cogent argument against its incongruence with Article 14's standards can be made.

Granting citizenship in a secular nation, like India, therefore, is supposed to be a secular affair. When scrutinized against this backdrop, it is apparent that the CAA has perverted the secular character of India's citizenship law. First, it has elevated religious persecution, out of a pool of myriad forms of persecution, to the pedestal of the only type of persecution that would be grave enough to warrant a claim to citizenship for an illegal migrant. This creates a classification where individuals who are persecuted on grounds other than religious beliefs are excluded. This implies that in the eyes of Indian law, persons who are persecuted on account of their political views, sexual orientation, race or ethnicity are less deserving of citizenship rights.

Citizenship by descent

Section 4 of the Citizenship Act divides citizenship by descent (jus sanguinis) into three categories: persons born outside India between 26 January 1950 and 10 December 1992 if the father was an Indian citizen at the time of birth; persons born outside India between 10 December 1992 and 7 January 2004, if either of the parents is an Indian citizen at the time of birth; and children born after 7 January 2004 if either of the parents is an Indian citizen and the birth is registered at an Indian consulate within one year. Section 4 also requires births to be registered at an Indian consulate within one year and that the minor does not hold another nationality. This is aligned with Article 4 of the 1961 Convention, which requires states to grant nationality to persons born outside the country of his/her parents nationality, if (s)he would otherwise be stateless. In comparison to citizenship by descent described above, it becomes clear that Indian laws make it is easier for persons of Indian descent born outside of India to gain Indian citizenship than for persons born in India.

CONCLUSION

It is perhaps a first time in independent India's political history. The protest against citizenship Amendment Act 2019 was spread to every corner of the country, yet the reasons of the protest vary with geography. Some are protesting because the CAA allegedly violates the secular identity of the nation while other fear that it will endanger their linguistic and cultural identity. Yet others believe that the CAA itself is innocuous, combined with the proposed nationwide National register of citizens (NRC), an exercise that runs in the controversy in Assam, it will become a tool to exclude Muslim population of the country. That the union government has been hit hard by this allegation is evident from the fact that Prime Minister Narendra Modi has publicly contradicted Home minister Amit Shah's assertion that A nationwide NRC will be prepared by 2024.

According to the citizenship Amendment Act 2019, Hindu, Christian, Buddhist, Jain, Sikh and Parsi migrants who have entered India illegally that is without a visa- on before December 31, 2014 from the Muslim majority countries of Pakistan, Afghanistan and Bangladesh and have stayed in the country for 5 years are eligible to apply for Indian citizenship. The union government claims that the people of these, six faith have faced persecution in these three Islamic countries Muslims haven't. It is therefore India's moral

obligation to provide them shelter. The government says that this is a time bound provision to provide relief to immigrants who have suffered in Islamic countries because India got divided on religious lines. India has from time to time provide at citizenship to immigrants of religions from different countries. Sri Lankan Tamil Hindus to where given citizenship in the 1970 and 80s.

The Indian Constitution embeds the principle of secularism and send it entitles every person in India, not only citizens, to the equal protection of the law. Basic fundamental constitutional principles that any Indian law has to comply with. The principle of equal protection and treatment of law prohibits the government from distinguishing between two groups of people unless the distinction is reasonable and in non-arbitrary, and a clear purpose can be provided by the government for making the classification. The citizenship Amendment Act painfully contradicts this important constitutional principle. While certain groups of people from three countries are granted immunity from being deemed illegal migrants, and are given fast track to Indian citizenship, another group of from these countries will continue to be prosecuted as illegal migrants.

In response to any potential challenges to the law before Indian Supreme Court, it is unclear what constitutionally adequate rationale the government will provide for treating the illegal migrants differently based on their religion.

There is another dimension to the protesters across India – its implication for Indian citizens. Most centrally, protestors are worried about the combined effects of the CAA and governments controversial plant to create a national register of citizens (NRC). The basis for the NRC comes from both a 2003 amendment to the 1955 citizenship act and the rules issued in 2003 to operationalize the amendment. The NRC require every individual across India to demonstrate that they are Indian citizens through certain specified documents., the individuals will have to show proof of their residence and date and place of birth as well as citizenship of their and ancestors, going back to a cutoff date specified by the government. In large parts of India, the people are poor and illiterate and lack the kind of documents that will be required to prove citizenship. Those who are from poor and marginalized communities will disproportionately bear the burden of the implementation of the NRC. While there is no official link between the CAA and NRC there are concerns that the government is cloaking the CAA empathetic and inclusive legislation protecting those illegal migrants who have faced religious persecution but that it will in fact be strategic Lee used domestically to protect individuals from 10 vi non- Muslim religious who may be excluded from the Indian citizenship under the NRC.

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ദലിത് സ്വത്വാവിഷ്കാരം - പുതുരാമായണത്തിൽ

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ദലിത സ്വത്വാവിഷ്കാരം - പുതുരാമായണത്തിൽ

സമകാല മലയാള സാഹിത്യത്തിൽ സ്വന്തമായൊരിടം നേടിയ ചിന്താപദ്ധതിയാണ് ദലിതെഴുത്ത്. അടിച്ചമർത്തപ്പെടുന്നവനുവേണ്ടി, അധിനിവേശകനെതിരെ നിലകൊള്ളുന്ന പ്രസ്ഥാനമാണിത്. എന്താണ് ദലിതെഴുത്ത്/ ദലിത് സാഹിത്യം എന്നതിനെ സംബന്ധിച്ച് വ്യത്യസ്ത അഭിപ്രായങ്ങൾ നിലനില്ക്കുന്നുണ്ട്. അവയിൽ പ്രധാനമായും മൂന്ന് അഭിപ്രായങ്ങളാണ് ഇന്ന് പരക്കെ അംഗീകരിച്ചിട്ടുള്ളത്.

1. ദലിതർ അംഗീകരിച്ചിട്ടുള്ളത്
2. ദലിതരെക്കുറിച്ച് ദലിതരല്ലാത്തവർ എഴുതുന്നത്
3. ദലിതർക്കുവേണ്ടി ദലിതർ എഴുതുന്നത്

അതായത് മുഖ്യമായും ദലിതരിൽ ഊന്നുന്നതും ദലിതരുമായി ഐക്യപ്പെടുന്നതും മുഴുവൻ ചൂഷിത വിഭാഗത്തെയും ഉൾക്കൊള്ളാൻ വ്യാപ്തിയുള്ളതുമായ സാഹിത്യമാണ് ദലിത് സാഹിത്യം. ദലിതർ എഴുതുക എന്നതുകൊണ്ട് അനുഭവമുള്ളയാൾ എഴുതുക എന്നാണർത്ഥം. മറിച്ച് അത് ജാതി സാഹിത്യമല്ല. ദലിതനായി ജനിച്ചതുകൊണ്ട് ഒരാൾ ദലിത് എഴുത്തുകാരൻ ആകുന്നുമില്ല. 'ദലിത്' അവബോധം ഉണ്ടാക്കുക എന്നതാണ് സർവ പ്രധാനമായിട്ടുള്ളത്. ഇന്ന് എല്ലാ മർദ്ദിത ജനവിഭാഗത്തെയും കുറിക്കാൻ 'ദലിത്' ശബ്ദം പ്രയോഗിക്കുന്നുണ്ട്.

ആധിപത്യത്തിനെതിരെ പ്രതികരിക്കുന്ന അടിച്ചമർത്തപ്പെട്ടവന്റെ ശബ്ദമാണ് ദലിതെഴുത്തിൽ നാം കേൾക്കുന്നത്. അതാകട്ടെ, അവന്റെ സ്വത്വത്തെക്കുറിച്ചുള്ള തിരിച്ചറിവാണ്. ജാതീയമോ വിഭാഗീയമോ ആയ ആത്മ ബോധമല്ല ദലിത് സ്വത്വം. അത് ചരിത്രപരമായ തിരിച്ചറിവാണ്. ഇങ്ങനെ കീഴാള സംസ്കാരത്തിന്റെ ആത്മാഭിമാന ബോധത്തിൽ നിന്നും പാരമ്പര്യത്തിൽ നിന്നും രൂപംകൊണ്ട പുത്തനുണർവിന്റെ സ്വാംശീകരണമാണ് ദലിത് സ്വത്വത്തെ നിർണ്ണയിക്കുന്നത്. കീഴാളവർഗം എന്നും പ്രകൃതിയോടും സമൂഹത്തോടും ഇണങ്ങി ജീവിയ്ക്കാനാണ് ശ്രമിച്ചത്. അതിനാൽ ചൂഷണാധിഷ്ഠിതമായ എല്ലാത്തരം വ്യവസ്ഥിതിയെയും അവർ എതിർക്കും. ദലിത് സാഹിത്യത്തിന്റെ കേന്ദ്രം തന്നെ മനുഷ്യ

നാണ്. അവർ അവന്റെ സന്തോഷത്തിലും സങ്കടത്തിലും പങ്കുചേരുകയും അവനെ വിപ്ലവ ത്തിലേക്ക് നയിക്കുകയും ചെയ്യുന്നു. എന്നാൽ മനുഷ്യകേന്ദ്രിതമായ ആവാസവ്യവസ്ഥ എന്ന സങ്കല്പം ദലിത് ജീവിതത്തിലില്ല. കാരണം പ്രകൃതിയുടെ സുരക്ഷിതത്വവുമായി അഭേദ്യമായി ബന്ധപ്പെട്ടതാണ് അവരുടെ ജീവിതരീതി. ആർഷസംസ്കാരത്തിന്റെ യഥാർത്ഥ അവകാശികൾ തന്നെ ദലിതരാണ്.

സാറാജോസഫിന്റെ 'പുതുരാമായണ'ത്തിൽ അധികാരവർഗത്താൽ, പുരുഷാധിപത്യ ത്താൽ, ആര്യമേധാവിത്വത്താൽ ചവിട്ടിയരയ്ക്കപ്പെടുന്ന ദലിതരുടെ ജീവിത ചിത്രീകരണ മാണ് നമുക്ക് കാണാൻ കഴിയുന്നത്. ഇതിഹാസ കഥാപാത്രങ്ങൾ പൊളിച്ചെഴുതപ്പെടു മ്പോൾ കീഴാള സ്വത്വത്തിന്റെ അടിച്ചമർത്തലുകളാണ് വെളിപ്പെടുന്നത്. 'ഭൂമിരാ ക്ഷസ'ത്തിൽ ഇക്ഷ്വാകുപുത്രനായ ദണ്ഡകനാൽ ബലാത്സംഗം ചെയ്യപ്പെടുന്ന ശുക്രാ ചാര്യ പുത്രി അരജയും ജേതാവിനാൽ ലങ്കയിലെ മണ്ണിൽ ക്രൂരമായി വലിച്ചെറിയപ്പെടുന്ന 'അശോക'യിലെ സീതയും കീഴാള വർഗത്തിന്റെ പ്രതിനിധികളാണ്. ഗുരുപുത്രിയെന്ന പരി ഗണനഅരജയ്ക്കോ ധർമ്മപത്നിയെന്ന പരിഗണന സീതയ്ക്കോ ലഭിക്കുന്നില്ല. അധികാരി യുടെ കൈയ്യൂക്കും അഹമ്മതിയും ഇരുവരുടേയും ജീവതത്തെ തർകർത്തെറിഞ്ഞപ്പോൾ പ്രകൃതിയാണ് അവരോട് പകരം വീട്ടിയത്. ദണ്ഡകന്റെ സാമ്രാജ്യത്തിൽ മൺമഴപെയ്യു കയും അനേകായിരം വർഷങ്ങൾ പുല്ലുപോലും മുളയ്ക്കാതെയും കിടന്നു. ജേതാവിനാൽ പിടിച്ചടക്കപ്പെട്ട ലങ്കയുടെ സ്ഥിതിയും മറിച്ചല്ല. അധികാരത്തിനുവേണ്ടി ജ്യേഷ്ഠനെ ഒറ്റി കൊടുത്ത വിഭീഷണന, കരിയും ചാരവും കനലും മാംസക്കഷ്ണങ്ങളും ബലിക്കാക്ക കളും വിധവകളുടെ വിലാപങ്ങളും നിറഞ്ഞ ഊഷരമായ ലങ്കയാണ് രാമന കാഴ്ചവെ യ്ക്കാൻ കഴിഞ്ഞത്. 'അശോക'യിൽ പരാജിതനായി ചിത്രീകരിക്കപ്പെടുന്ന രാവണൻ കീഴാള രാജാവാണ്. ഏതു ദുരിതവും നേരിട്ട് അദ്ദേഹം സ്വപ്രയത്നത്താൽ കെട്ടിയു യർത്തിയ കീഴാള സാമ്രാജ്യത്തെയാണ് വിഭീഷണന്റെ അധികാര മോഹവും രാമന്റെ ആര്യ മേധാവിത്വവും തകർത്തെറിഞ്ഞത്. 'തായ്കുല'ത്തിലെ ശൂർപ്പണഖയും കീഴാളപ്പെൺകൊ ടിയാണ്. അവൾ സ്ത്രീത്വത്തിന്റെയും മാതൃത്വത്തിന്റെയും പ്രതിരൂപമാണ. വനചാരിയും വൃക്ഷപ്രേമിയുമാണ്. കാടും ഭൂമിയുമായുള്ള അവളുടെ ആസക്തി നിറഞ്ഞ ആഭിമുഖ്യവും കരിങ്കാളിയുടെ നിറവുമെല്ലാം അതാണ് സൂചിപ്പിക്കുന്നത്. അവളുടെ കാതൽ വനമായ പഞ്ചവടിയിൽ ആധിപത്യം സ്ഥാപിച്ചത് രാമനും കൂട്ടരുമാണ്. അവിടെകണ്ട പുരുഷനോട് പ്രണയം തോന്നിയത് സ്വാഭാവികം മാത്രം. പക്ഷേ അധികാരവർഗം അവന്റെ സ്വച്ഛന്ദവിഹാ രകേന്ദ്രം കൈയേറുകയും അവന്റെ പെണ്ണിന്റെ അവയവങ്ങൾ ഛേദിക്കുകയും ചെയ്തു. വരുംതലമുറയ്ക്കായി കാത്തുസൂക്ഷിച്ച അവളിലെ പെണ്മയെ, മാതൃത്വത്തെയാണ് അവർ തകർത്തെറിഞ്ഞത്. 'കറുത്ത തുളകളിലെ മന്ഥരയും അധികാര വർഗത്തിനുവേണ്ടി ബലി യാടാകുന്ന കീഴാള സ്ത്രീയാണ്. അവളുടെ കൂനിനെ 'കറുത്ത പാറയായാണ്' കഥാകാരി ചിത്രീകരിക്കുന്നത്. ഇവിടെ അവൾ രാജസ്ഥാപനത്തോട് പ്രതികാരം ചെയ്യുന്നുണ്ട്. ബാലി യുടെ വധത്തിനു കാരണമായതും ഈ നാഗരിക നിയമമാണ്. കാലാകാലങ്ങളായി അടി ച്ചേൽപ്പിക്കപ്പെട്ട സനാതനധർമ്മമാണ്. സുഗ്രീവനുവേണ്ടി രാമൻ ബാലിയെ വധിച്ച വാർത്ത നടുക്കത്തോടെയാണ് വാനരസംഘം കേട്ടത്. പക്ഷെ ആരും പ്രതികരിച്ചില്ല. ബാലിയുടെ നെഞ്ചു തകർത്ത അമ്പുകളാണ് അവരുടെ വായടപ്പിച്ചത്. ദേഹം തുളച്ച് മറുവശത്തേക്കു പായുന്ന അവ ലളിതമായി മനുഷ്യരെ കൊല്ലുന്നു. ശംബൂകനെ കൊന്നതും അവന്റെ കുട്ടി

കളെ അനാഥരാക്കിയതും ഈ അധികാരഗർവുതന്നെയാണ്. മേലാളർ സ്ഥാപിച്ച നിയമങ്ങൾ കീഴാളരുടെമേൽ അടിച്ചേല്പിക്കുകയാണുണ്ടായത്. ആ അടിച്ചമർത്തലുകളുടെ നാറുന്ന കഥകളും അവയോട് കീഴാള സ്വത്വത്തിന്റെ പലതരത്തിലുള്ള ചെറുത്തുനില്പുമാണ് നമുക്ക് ഈ കഥകളിൽ വായിച്ചെടുക്കാൻ കഴിയുന്നത്.

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08

Design And Characterisation of Poly Electrolyte Membrane's (PEM's) for Industrial Application

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Abstract

Poly electrolyte membrane's, PEM have a wide range of application over chemical, petrochemical industries, fuel cells, electrodialysis, ultrafiltration etc. This work is focusing on the design of polyelectrolyte membrane using Polyallylamine Hydrochloride, PAH and Polystyrene Sulphonate, PSS with Nylon 6,6 as supporting membrane by means of layer by layer,LBL method and characterisation of the multilayers with the assistance of analytical tools such as Scanning Electron Microscopy(SEM),Atomic Force Microscopy(AFM) , Fourier Transform Infrared spectroscopy(FTIR) and UV- Visible spectroscopy.

Keywords: PAH – polyallylamine hydrochloride, PSS – Polystyrene Sulphonate, LBL method -Layer by Layer method, PEM – Polyelectrolyte multilayer membrane

1. Introduction

Polyelectrolyte multi layer membranes can be prepared from a wide range of applicable substrates using layer-by-layer deposition method. These PEM's are obtained by the self assembly method of cationic and anionic polyelectrolytes which undergo layer-by-layer deposition in the aqueous solution. PEM's have many applications in the fields like bio optics, water purification, petrochemical industries, bio sensors, electrodialysis and so on. We are going to construct the polyelectrolyte multilayer membrane from Poly Allylamine Hydrochloride (PAH) and Poly Styrene Sulfonate using Nylon 6,6 as supporting membrane.

PEMs are used in Tissue Engineering due to their ability to interact with the biological molecules such as proteins or nucleic acid and also their sensitivity to external stimuli. HUMIC ACID, CS, Sodium Alginate etc are natural PEMs used for this purpose. Khademhosseini et.al developed a bio compatible support based on PLL and HA. Multilayer consisting of two polyelectrolyte was deposited on a glass support and this was used to grow and differentiate two cell types like stem cells and fibroblasts. The result obtained showed that the cells were stable for about five days and also the viability of the support for the cell.

The surface modified PEM's show a wide range of application in the field of tissue engineering, bio sensors, removal of water pollution, environmental remediation. The modern energy conservation and storage systems are relying on these PEM's. Due to their

long term stability and high performance other commercially available membranes were ruled out from the market. The objectives of the present styudy involves : Selection of appropriate supporting polymeric membrane for PEM, Selection of the promising polyelectrolyte for designing and developing PEM's, Utilization of LBL method for the deposition of PEM's, Characterization of newly designed PEM using analytical instruments, Proposal of the applications of newly designed and developed PEM's.

2. Materials and Methods

2.1. Materials

PAH, molecular weigt=65000 g/mol (0.5M), was purchased from Aldrich CO. and used without purification. PSS ,MW=70000 g/mol (0.5M), 30 weight percentage in water, purchased from Sigma Aldrich. 1M HCl to regulate pH, deionized water for rinsing and diluting the membrane, 250 mL beaker, spatula , Nylon-6,6 (no.4) as supporting membrane, 250 mL standard flask, glass rod, a pH meter.

2.2.Method

0.125g of PAH is weighed approximately then transferred to a 250 ml standard flask and made upto the mark. In another 250 mL standard flask 0.125g of PSS is made upto the mark. PAHbeing a weak electrolyte, it is pH dependent.1 M HCl is prepared to regulate the pH. 50 mL ofeach solution is transferred into 250mL beakers. A pH meter is immersed in PAH solution and its pH is adjusted to 6 by the addition of acid. The Nylon membrane is dipped in deionized water and keep it for 5 minutes. Then the membrane is dipped in the cationic electrolyte PAH for 15 minutes and then rinsed with deionized water. The washed membrane is then dipped into the anionic electrolyte PSS for 15 minutes and rinse it with deionized water. This procedure is repeated twice for 2 bilayers, 4 times for 4 bilayers, 6 times for 6 bilayers and 8times for 8 bilayers.

2.3.Film Characterization

For the characterization of the bare membrane and the multilayer deposited membranes we use the analytical techniques IR ,UV-Visible, AFM and SEM.

3. Result And Discussion

Successfully fabricated 2,4,6 and 8 bilayers of PAH/PSS polyelectrolyte membrane via LbL method. The membranes are characterized and the fabrication is confirmed by using microscopic analytical tools such as ATR-FTIR, UV-Visible Spectroscopy, AFM and SEM.The results of the bilayers are compared with the bare membrane results and between the membranes.

3.1ATR-FTIR Analysis

IR is a simple and effective technique for characterization. The IR of sulphonate peak made on the Nylon 6 6 membrane is shown in the figure. The absorbance of bare membrane is

shownin 0.00 cm^{-1}. The sulphonate group shows peaks at a range of 1020-1040cm^{-1} over pH range of

6. It is evident from the spectrum that the height of sulphonate peaks increases with increase in number of layers. The absorbance is exactly at 1034 cm^{-1} for the 8 bilayer membrane. The symmetric and antisymmetric deformation of NH^{3+} is usually shown in the region 1400-1700cm^{-1}.

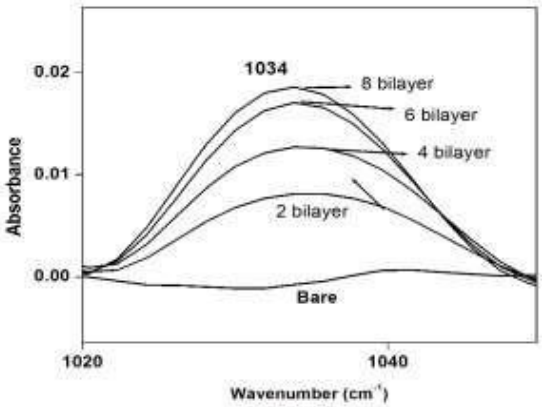


Figure 3.1 IR of sulphonate peak

3.2. UV-Visible Analysis

The growth of multilayers are analysed using uv-visible spectroscopy. The absorption of films increases linearly with the number of bilayers which means that the amount of material absorbed are same are same in each deposition step.

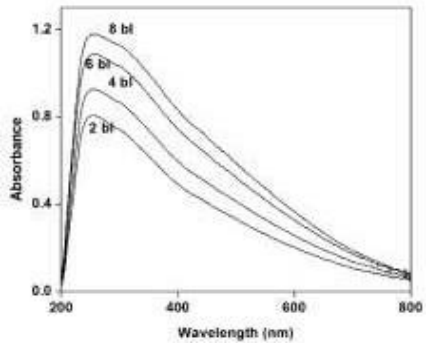


Figure 3.2 UV-Visible spectrum of synthesized bilayers

3.3.AFM Analysis

AFM gives globular morphological information and thickness of the bilayers on the surface of supporting membrane. All films present very smooth surface with root mean square roughness varying from 0.89 to 1.9 μm. The average thickness of PAH/PSS bilayers were found to be 2 μm. Usually is both are weak electrolyte, the bilayers are expected to be fully charged. But here PAH is weak and PSS is strong, so PAH is expected to be fully charged and pH dependent. AFM gives 3D image of the bilayers where the morphology

turns to be more and more globular and crowded when the number of bilayers are increased.

Figure 3.3 AFM of bare layer

(a)

(b)

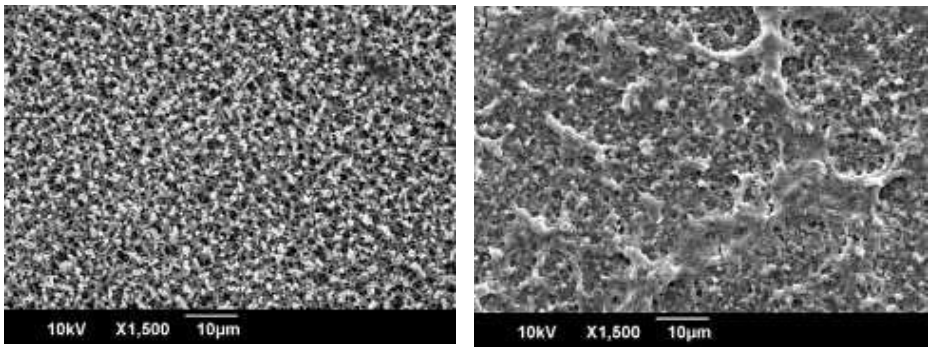
(b)

(d)

Figure 3.4 AFM of (a) 2 bilayer (b) 4 bilayer (c) 6 bilayer and (d) 8 bilayer membranes

3.4. SEM Analysis

The formation of multilayers on the surface of Nylon 6,6 supporting membrane has been investigated using SEM. Figure 3.4.1 is the bare membrane surface and figure 3.4.2 is the surface of 8 bilayer membrane. On examining the results we can see there is a slight decreasein the porous size of 8 bilayer membrane than the bare membrane. Which means as the number of bilayers increase , the sizes of the pores decreases proportionally.



(c) **(b)**

Figure 3.5 SEM of (a) bare membrane (b) 8 bilayer membrane

The fabricated PEM's were effectively characterized and the designing was confirmed using the above characterization tools. This work can be extend for industrial applications such as tissue engineering, waste removal from water, bio sensing application and so on.

4. Conclusion

Successfully synthesized PEM membranes consisting various bilayers such as 2,4,6 and 8 using LBL method by the alternate deposition of PAH and PSS on Nylon 6,6. The developed bilayers were characterized by UV-Visible spectroscopy, ATR FTIR spectroscopy, AFM and SEM. The analysis result shows the surface modification has become more selective by the addition of bilayers and offers meaningful industrial applications like tissue engineering, bio sensing, waste disposal, chemical cleaning.

09

FIRE FORCE MANAGEMENT WITH FIRE ALARM USING MACHINE LEARNING TECHNIQUES

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Abstract:

The role of the Fire Force Management System with Fire Alarm is to take action depending on the anticipated fire scenario, building and use type, number and type of occupants, and criticality of Contents and mission, these systems can provide several main functions. First, they provide a means to identify a developing fire through either manual or automatic methods and second, they provide alerts and notifications. Another Common function is the transmission of an alarm notification Signal to the fire department of other emergency response organization.

The first step to halt a fire is to properly recognize the incident, uplift the inhabitant alarm, after that notify accidents response professionals. This is often the function of the fire detection and alarm Systems. Here Artificial Intelligence and Machine learning are implemented for the scientist user. This user deals with the detection of fire based on the images generated with surveillance camera set across the state. The whole functionality is split to five users such as Admin, Fire Officer, Data Scientist, Public and Surveillance Camera.

Keywords:- DFD,CFD, SURVEILLANCE CAMERA,MENU TREE

INTRODUCTION

A key aspect of fire force management system with fire alarms using Machine Learning techniques is to identify and develop fire emergencies in a timely manner, and to alert the fire emergency organizations. This is the role of the fire force management system with the fire alarm system. First, they Provide a means to identify a developing fire through either manual or automatic methods and second, they Provide alerts and notifications. Another Common function is the transmission of an alarm notification Signal to the fire department of other emergency response organization. They may also shut down electrical, air handling equipment or special process *operati*ons, and they may be used to initiate automatic Suppression systems. This s*ection* will describe the Basic aspects of fire detection and alarm system

The first step to halt a fire is to properly recognize the incident, uplift the inhabitant alarm, after that notify accidents response professionals. This is often the function of the fire detection and alarm Systems. The public can register and add issues related to this department. Admin will be taking care of the overall administrations. Here Artificial Intelligence and Machine learning are implemented for the scientist user. This user deals with the detection of fire based on the images generated with surveillance camera set across the state. This proposed System ensures maximum security through various advanced methods in Artificial Intelligence. Admin, & Fire officer, Public, Data Scientist and Surveillance camera are the modules included in this work.

Existing System:-

The existing system is a manual entry for each user. so here each user needs to carried out in the hand written registers. It will be tedious job to maintain the record for the users. The human effort is more here. The retrievals of the information are not as easy as the records are maintained in the hand written registers. This application requires correct feed on input into the respective field suppose the wrong inputs are entered, the application resist to work. So, the user finds it if any error occurred.

Proposed System:-

To overcome limitation of this existing system, the proposed system is evolved. This project aims to reduce the paper work and saving time to generate accurate results for each user. The system provides good user interface. The best results can be generated by using this proposed system. As the development is done in PHP and Python there are no hidden costsin the process. In the backend the systems use MySQL database server.

Context Level DFD (Level 0)

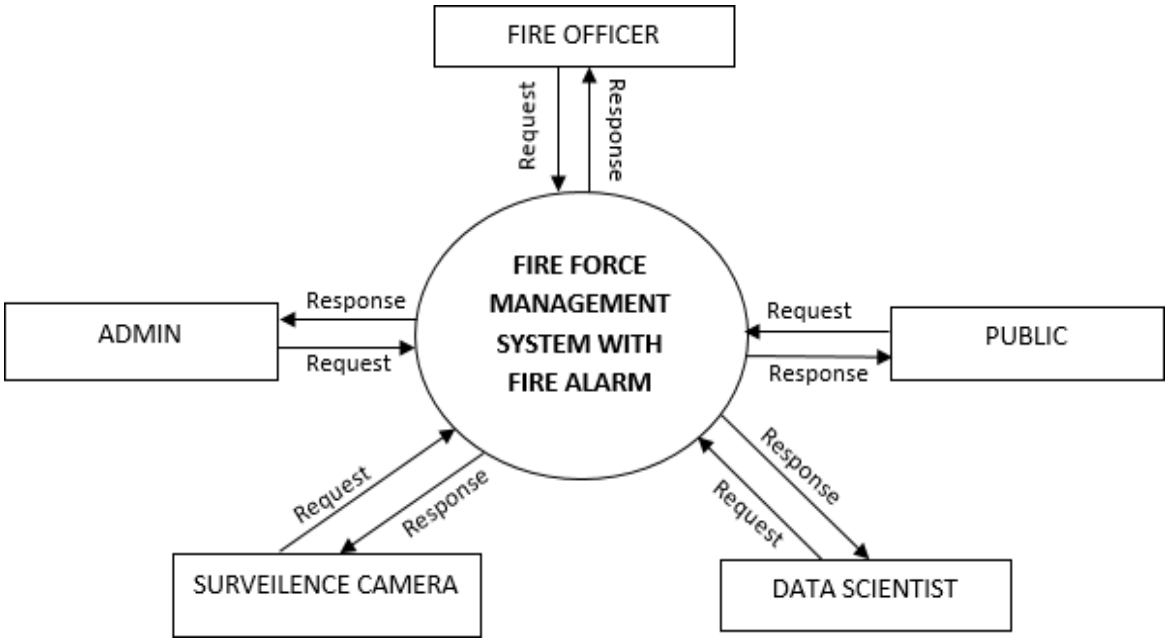


Figure.1 Context Flow Diagram

Level 1 DFD – ADMIN

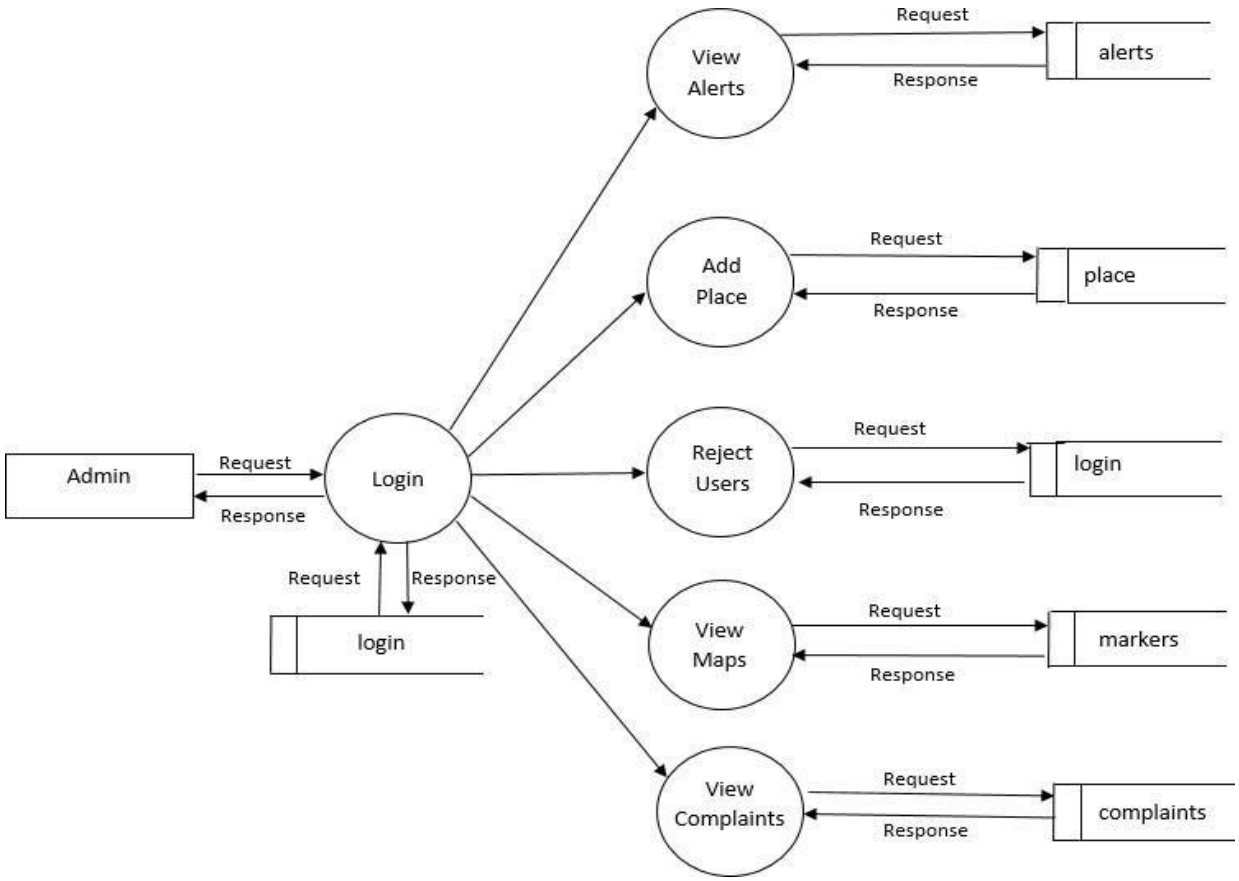


Figure .2: Data Flow Diagram for Admin

Level 1 DFD – DATA SCIENTIST

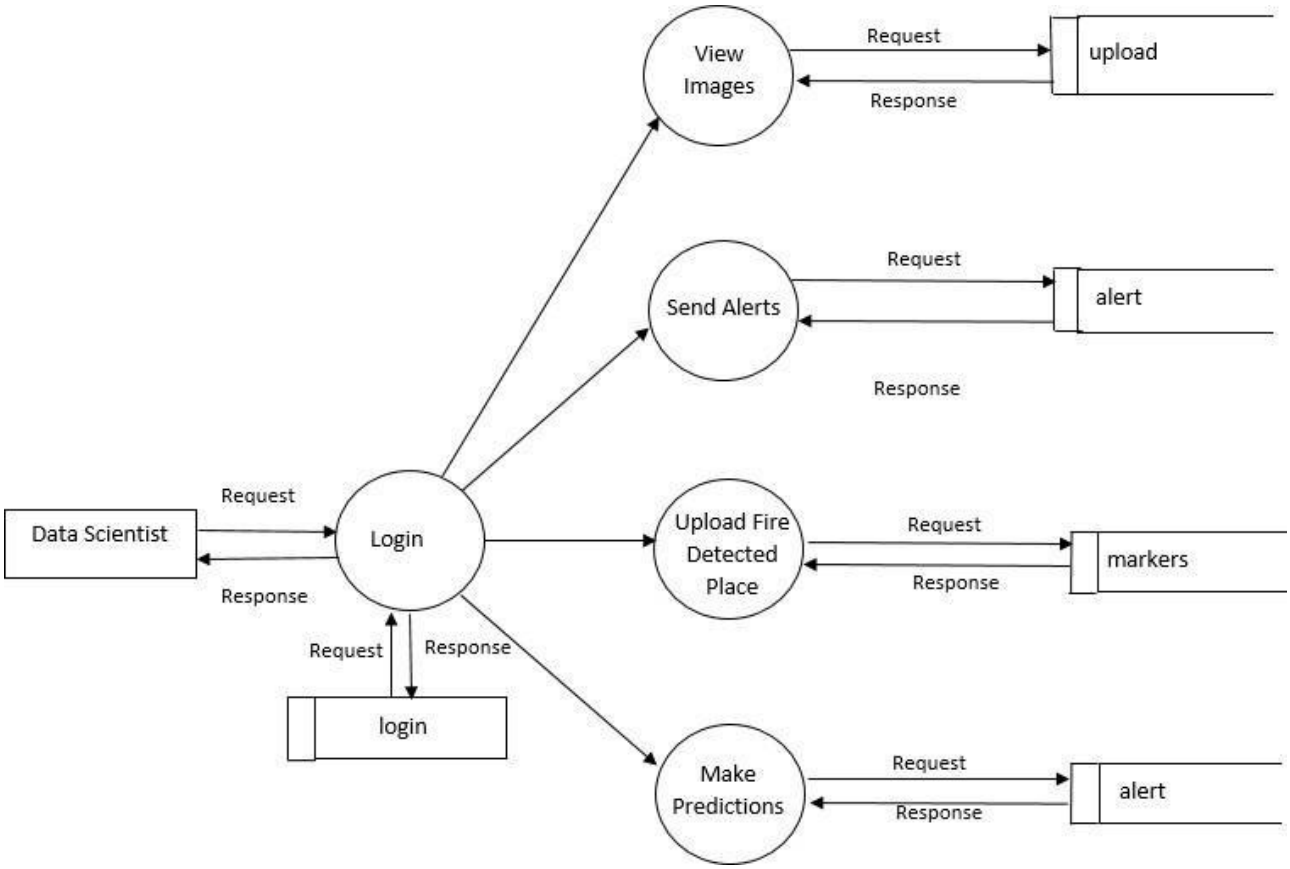


Figure 3: Data Flow Diagram for Data Scientist

Level 1 DFD–FIRE OFFICER

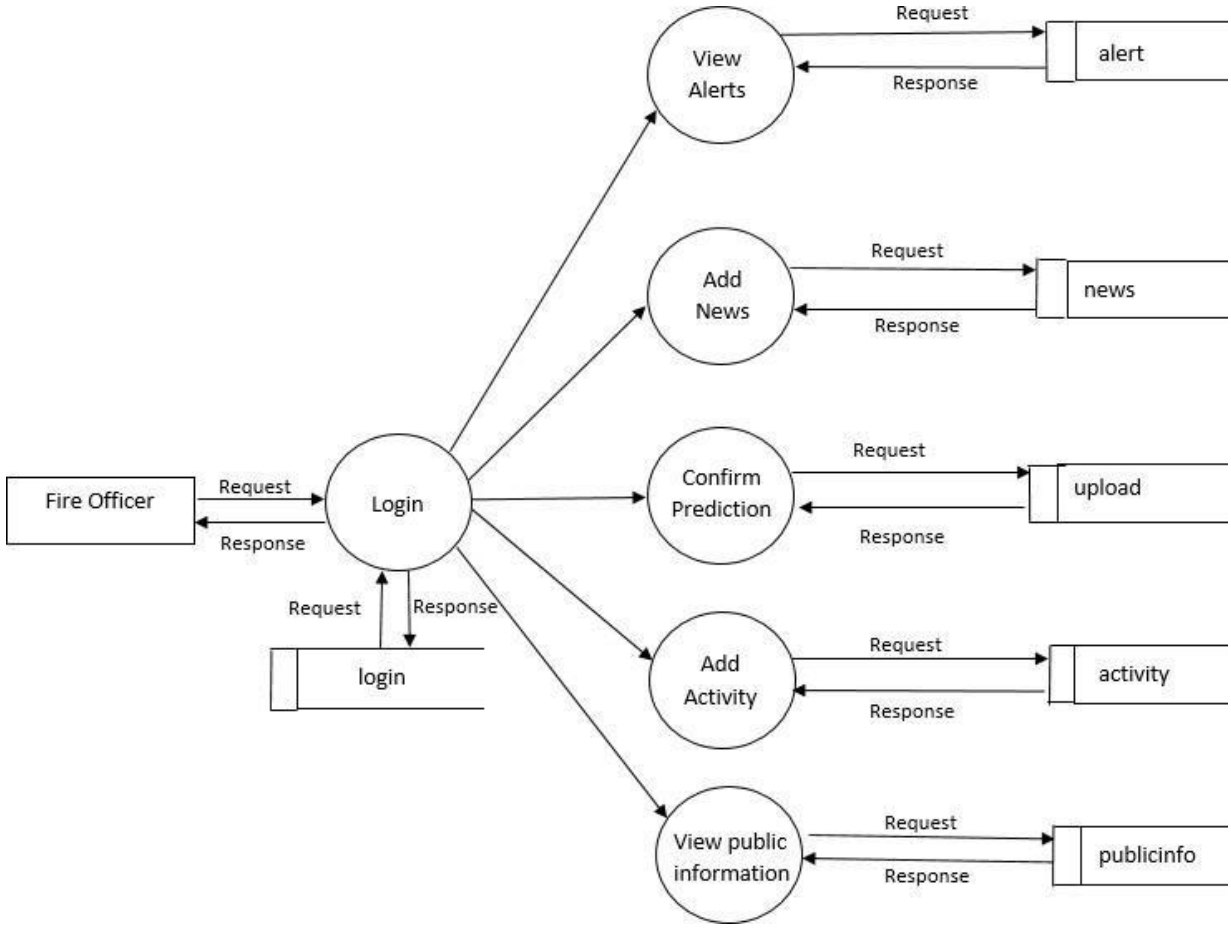


Figure 4: Data Flow Diagram for Fire Officer

Level 1 DFD – PUBLIC

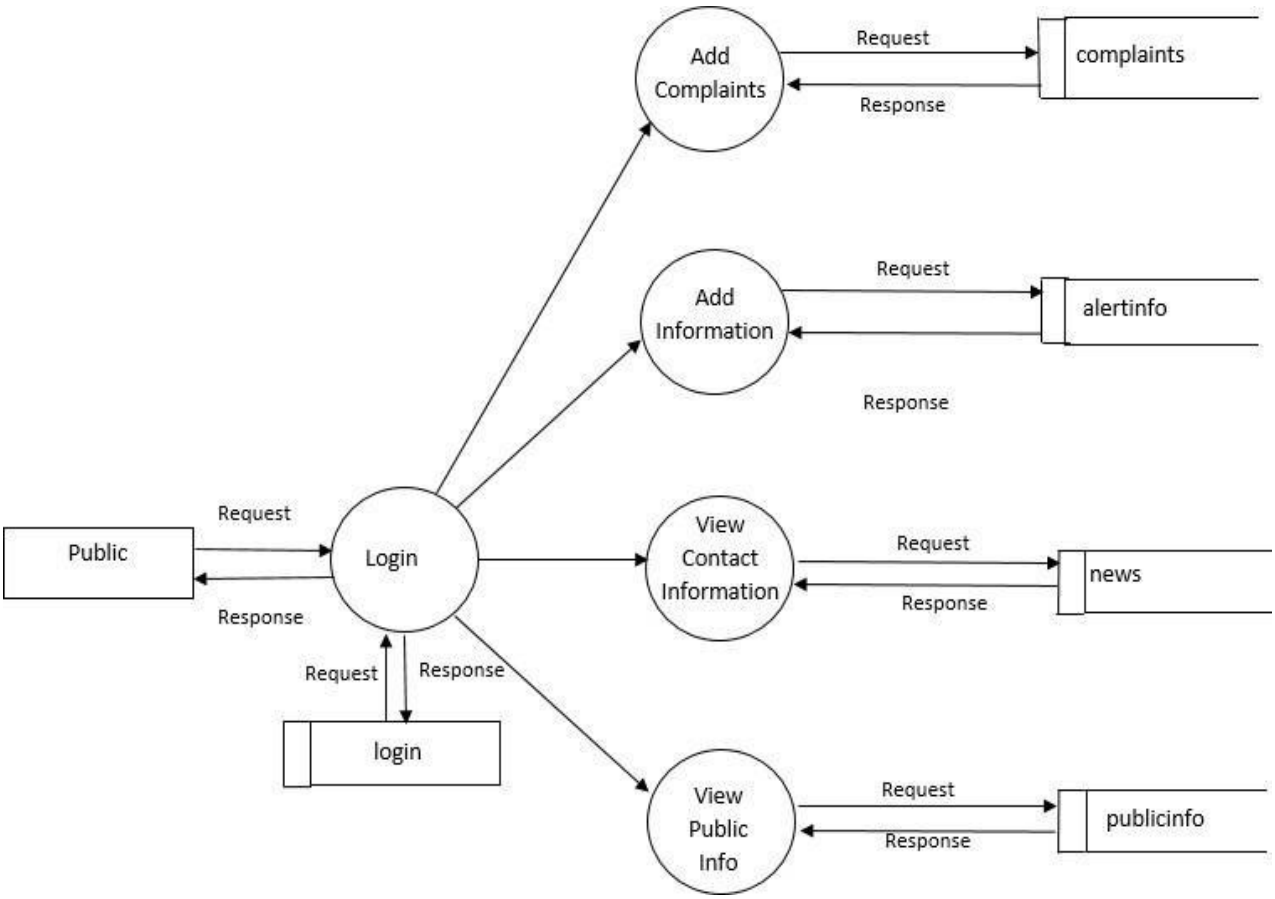


Figure 5: Data Flow Diagram for Public

Level 1 DFD – SURVEILLANCE CAMERA

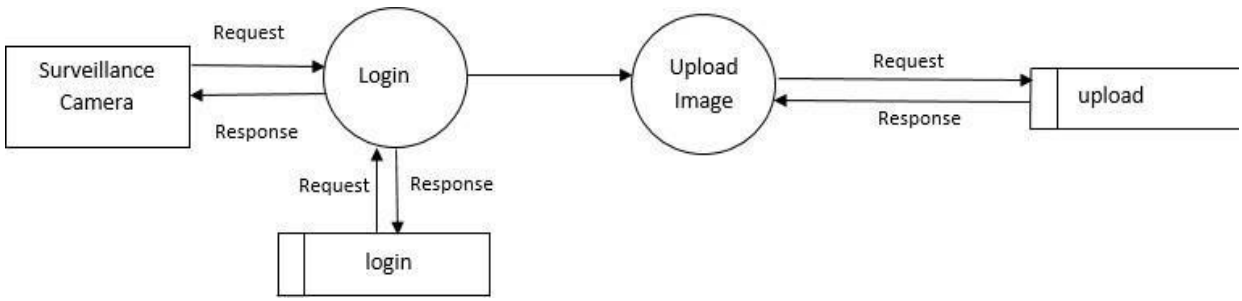


Figure 6: Data Flow Diagram for surveillance camera

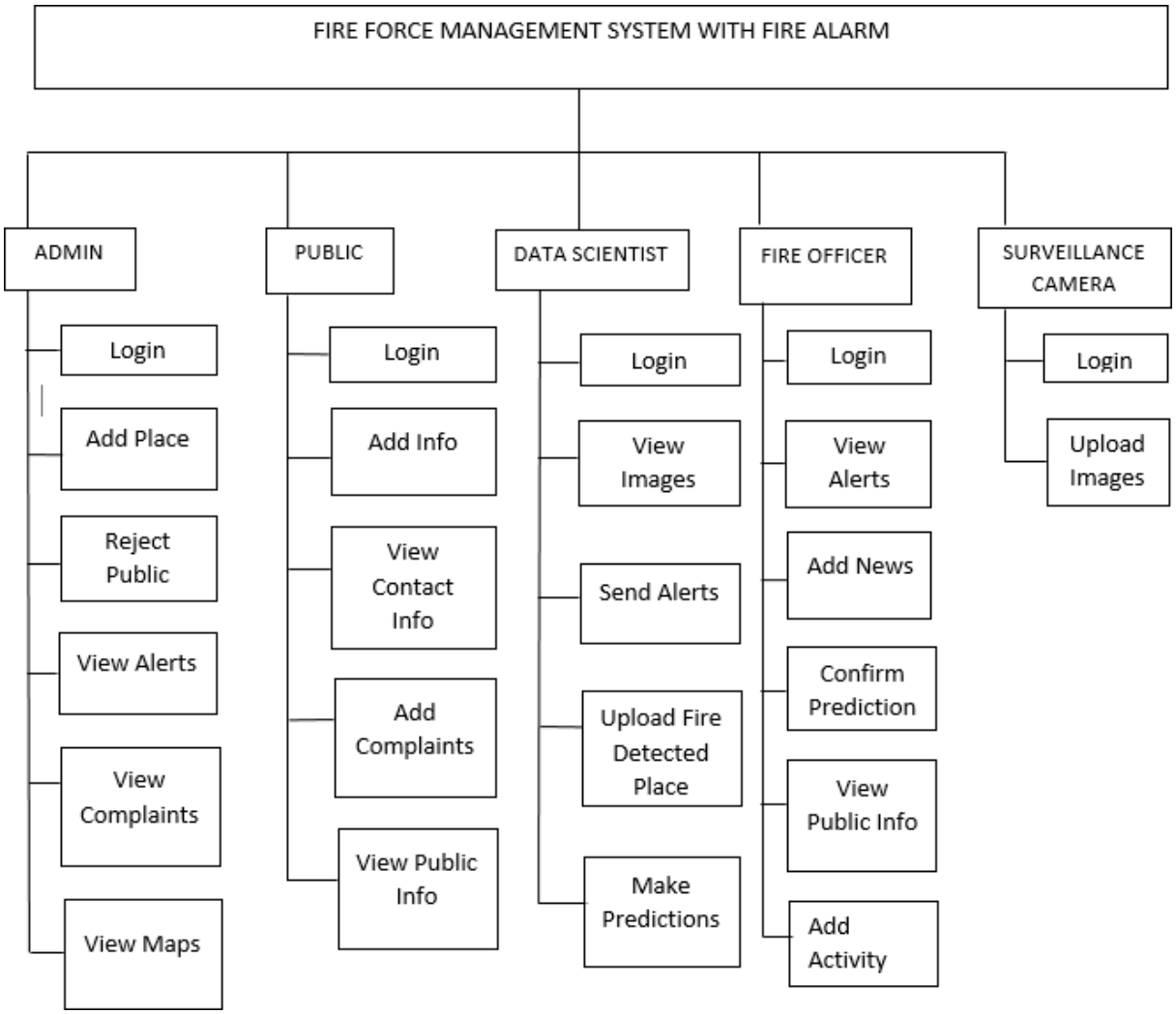


Figure 7: Structure Chart

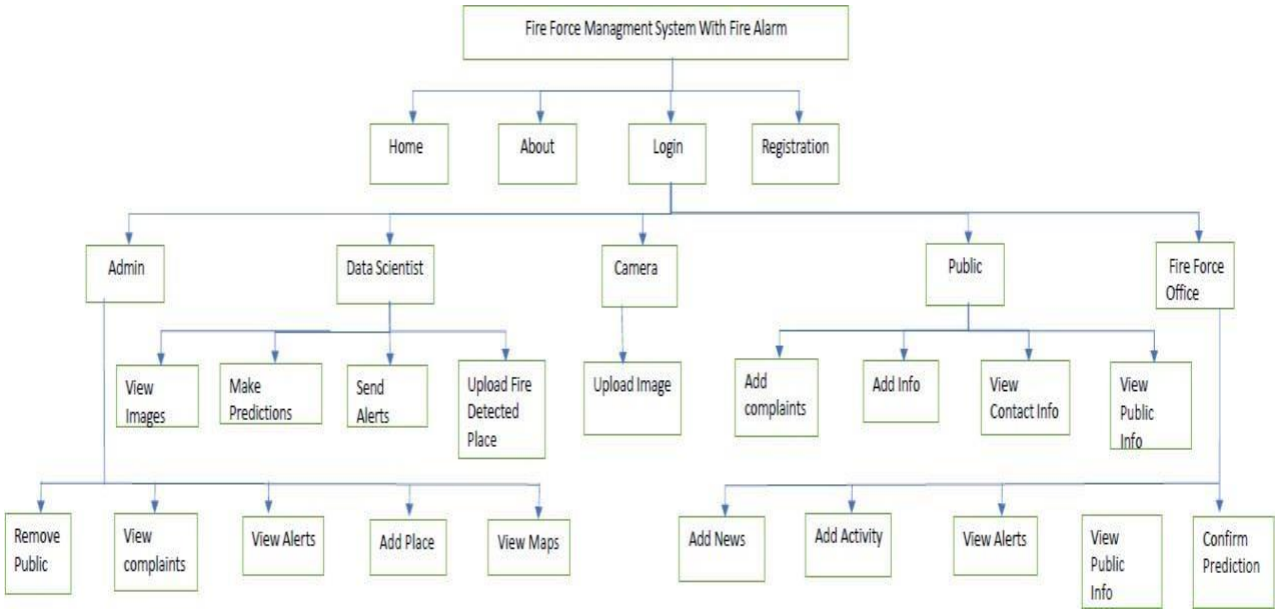


Figure 8: Menu Tree

MODULE DESCRIPTION

Modules

The Fire force management system with fire alarm is divided into 5 modules. The 5 modules included in this system are

1. Admin Module
2. Fire Officer Module
3. Data Scientist Module
4. Public Module
5. Surveillance camera Module

Each module specifies the functional requirement of the system:

1. ***Admin Module***
   - Add Place
   - Reject Public
   - View Alerts
   - View Complaints
   - View Maps
2. ***Fire Officer Module***
   - View Alerts
   - Add News
   - Confirm Prediction
   - View Public Information
   - Add Activity
3. ***Data Scientist Module***
   - Send Alerts
   - View Images
   - Send & view student complaints
   - Upload Fire Detected Place
   - Make Predictions
4. ***Public Module***
   - Add Information
   - View Contact Information
   - Add Complaints
   - View Public Information
5. ***Surveillance Camera Module***
   - Upload Images

CONCLUSION

This work has been developed with much care and free of errors and at the same time it is efficient and less time consuming. The purpose of this work was to develop a web application for making fire force management easier and detecting fire in a faster and more efficient way.

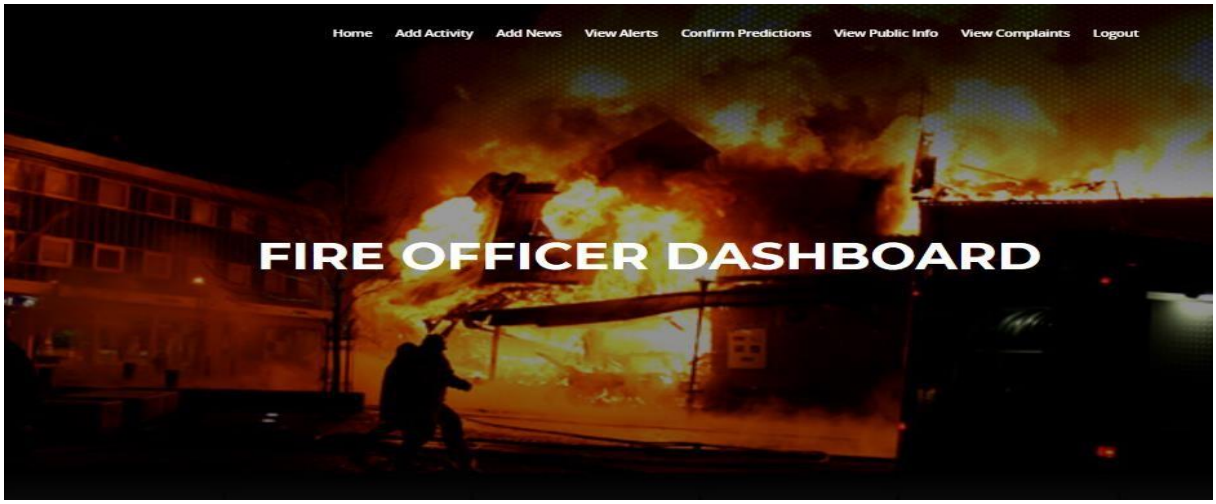
This work helped me in gaining valuable information and practical knowledge on several topics like designing web pages using html and CSS, usage of responsive templates and management of database using My SQL. The entire system is secured. Also, the work helped me understanding about the development phases of a software and the software development life cycle.

There is a scope for further development in this work to a great extent. A number of features can be added to this system like real time monitoring of fire engines in an area.

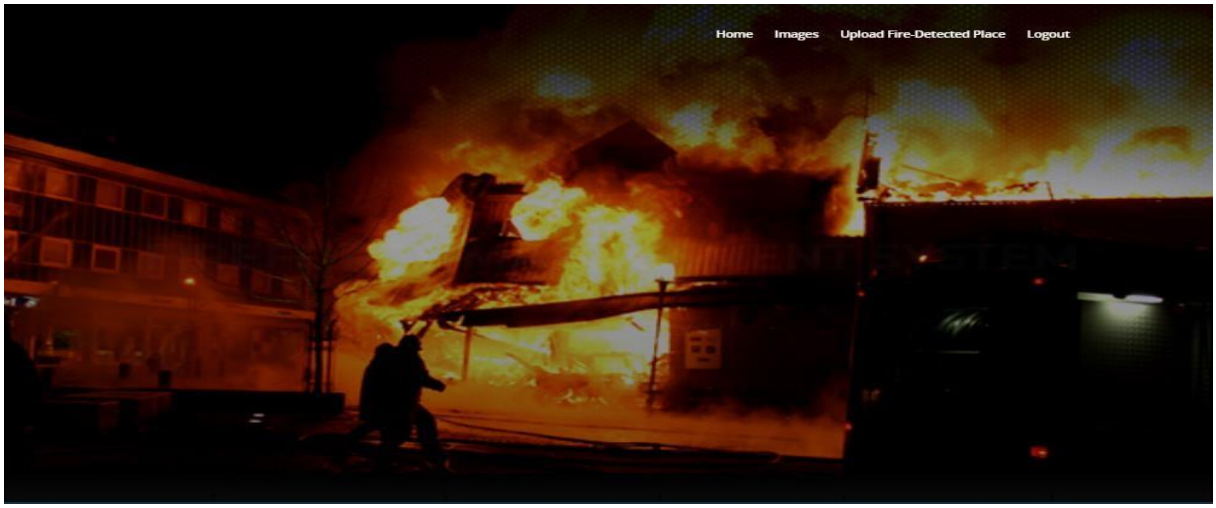
FUTURE ENHANCEMENT

This website involves almost all the features needed for a fire force management system with fire alarm. The system is designed in such a way that future expansion or modification can be easily implemented. The future implementation will be providing a fire engine tracker which will be available all over the state.

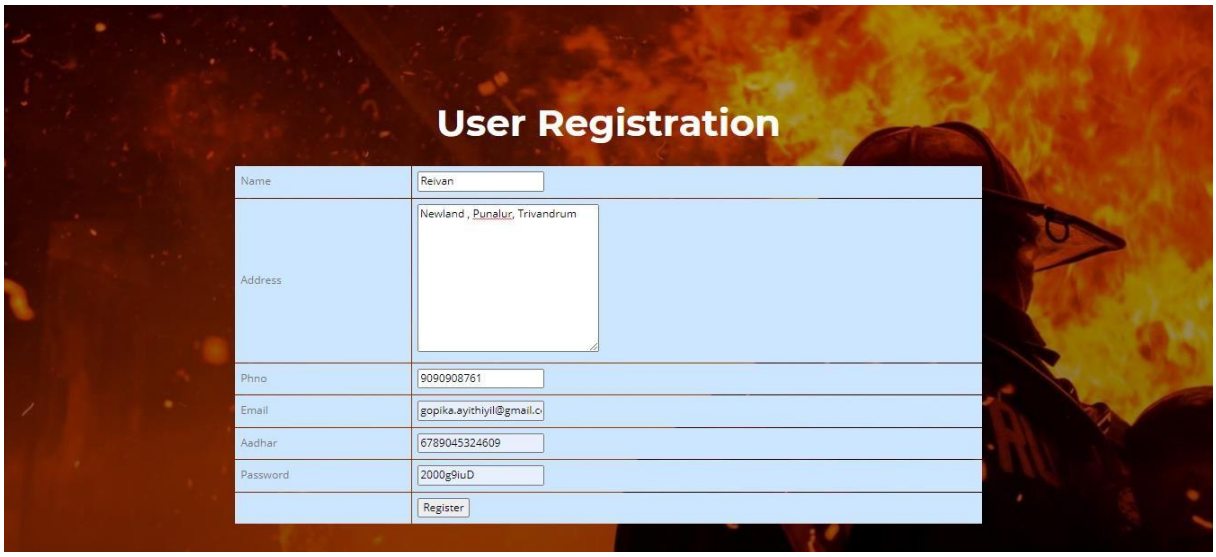
Camera Page



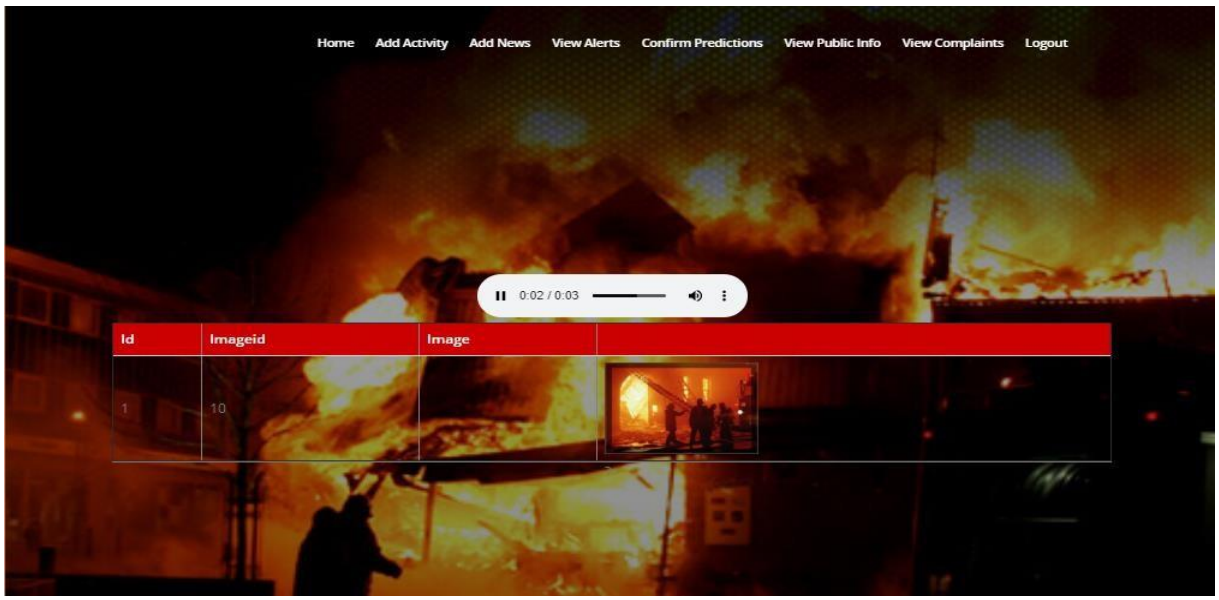
Officer page



Scientist Page



User Registration



Fire Alert

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10

"LIFE STYLE & CHRONIC DISEASES"

Studies on the chemical components & Antioxidant properties of *Ceratopteris thalictroides* (L.) *Brongniart*

Fathimabeevi.S, Ambili S

Ferns are much neglected group of plants, even though it is used for various purposes such as medicine, food, shelter and ornamentals. *Ceratopteris* species are aquatic pteridophytic ferns, generally found in tropical regions. It is a potential underwater plant used to treat wounds and is also used as a vegetable in certain parts of the world. In The present study the medico-potentiality and chemical profile of this aquatic fern was looked into. On GC-MS analysis, nine compounds comprising 81.8% of the total volatile constituents were identified from the hexane extract of *Ceratoptersis thalictroides*. The plant possesses a characteristic odour and the rare aroma compounds mesitylene and trimenal may be the volatile compounds responsible for the peculiar odour of the plant. On phytochemical screening, it is found that, both methanolic as well as hexane extract contains steroids and not flavanoids and alkaloids. The *in vitro* antioxidant assay of methanolic extract of *Ceratopteris thalictroides* showed a dose dependent activity. Total phenolic content of methanolic extract of *Ceratopteris thalictroides* was studied. The plant contains 13.3497mg/g extract of phenolic compound in it. A TLC profile of the methanolic extract was also done. The study shows that this plant is a good candidate for carrying out further work for its medicinal properties.

11

Species composition of mosquitoes in the rubber plantation sectors of Kerala

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Abstract

Mosquitoes are the most important vector among arthropods that transmit diseases such as Malaria, Filariasis, Chikungunya (CG), Dengue Fever (DF), Yellow Fever, Japanese Encephalitis (JE) etc. Forest fringe associated rubber plantation areas are more prone to the spread of zoonotic diseases to rural and urban areas. In view of this, a study was conducted to assess the species composition and density of mosquitoes in the urban and rural areas of rubber plantation sectors of Kottayam district. Two villages from forest fringe associated rubber plantation areas and two wards from urban areas of Kottayam district were selected for the study. Immature and adult mosquitoes were collected based on WHO standard procedures. A total of 14 mosquito species were recorded in the present study in which five species belong to the Aedeine group. *Aedes albopictus* was the predominant vector species in the study areas. *Aedes albopictus* was found to be abundant in the urban areas while *Armigeres subalbatus* was recorded as the prevalent species in the rural areas. Per man hour density of mosquitoes were found maximum during June and July and density of *Aedes albopictus* found maximum during the month of May. Water storage containers were observed to be the major breeding habitat for *Ae.albopictus* in urban areas and discarded or unused rubber latex collection containers were found to be the main breeding source for *Ae. albopictus* in rural areas. Since *Aedes* transmitted diseases such as dengue and chikungunya are being reported in the study area entomological surveillance and its significance can be used to halt the outbreak as shown in this study.

Key words: **Rubber plantations, vector mosquitoes, *Ae.albopictus*, Dengue, Chikungunya**

1. Introduction

Among arthropod vectors, mosquitoes are the most important vector that transmit diseases such as Malaria, Filariasis, Chikungunya (CG), Dengue Fever (DF), Yellow Fever, Japanese Encephalitis (JE) etc. Rubber plantations are very much similar to manmade forests with lower temperatures and higher humidity under the canopy which provide suitable conditions for the mosquito vectors of dengue, chikungunya, malaria etc. Kerala state has the largest rubber plantations in the country to the tune of about 5.45 lakh ha. In Kerala, the forest fringe associated rubber plantations are located at the foothills of Western Ghats on the western coast of India. Forest fringe areas and associated rubber plantations are more

prone to zoonotic diseases from where it spread to rural and urban areas[1]. During 2007 Chikungunya outbreak in India, 55.8% of suspected cases were reported from Kerala and was the worst affected state in the country[2]. In Kerala, Kottayam and Pathanamthitta were the worst affected districts contributing 44.33% and 14.37% of the total CHIKV cases, respectively[2].Also dengue fever cases has shown an increasing trend in Kerala since 2006. More than 13.1% of dengue cases were reported from Kerala during the dengue outbreak happened in India during the year 2017. All the four serotypes of dengue virus (DENV-1, DENV-2, DENV-3 and DENV-4) were reported in Kerala[3].The first case of dengue in Kerala was reported during 1997 from the forest fringe areas of Kottayam District[4] and continues to contribute the maximum number of dengue cases next to Trivandrum District in the state every year.

Topographically, Kottayam district has abundant rubber plantations (109, 582 ha) which support profuse breeding of *Aedes albopictus*, the main vector of Dengue and Chikungunya infection. Rainwater that accumulates in the latex collection containers during the monsoon season are the major breeding habitat of this species[2,4]. Massive deforestation, development of human settlements along forest fringe areas, transportation through different modes are the important human activity related to the spread of this vector species in Kerala[5]. As the cases of mosquito borne diseases are being reported frequently in Kottayam district a preliminary survey was carried out to understand the species composition and prevalence rate of mosquitoes in the urban and rural areas of Kottayam district.

2. Materials and Methods

Two villages in the forest fringe associated rubber plantation areas, Kootikal and Koruthode of Kanjirappally taluk and two wards in urban areas, Pallom (ward 13) and Puthuppally (ward 22) of Kottayam district were selected(Fig.1.1). Fortnightly survey were carried out in the 4 areas from May 2021 to November 2021. Larvae were collected using WHO standard methods. Outdoor resting mosquitoes were collected using sweep nets on man hour basis[6]. For larval survey all breeding sources or sites in and around 10 households covering an area of about 0.5Sq.Km were enlisted and checked for vector breeding both in urban and rural areas. Immatures collected from the positive sites were kept for emergence in the laboratory and emerged species were identified using Keys[7,8].

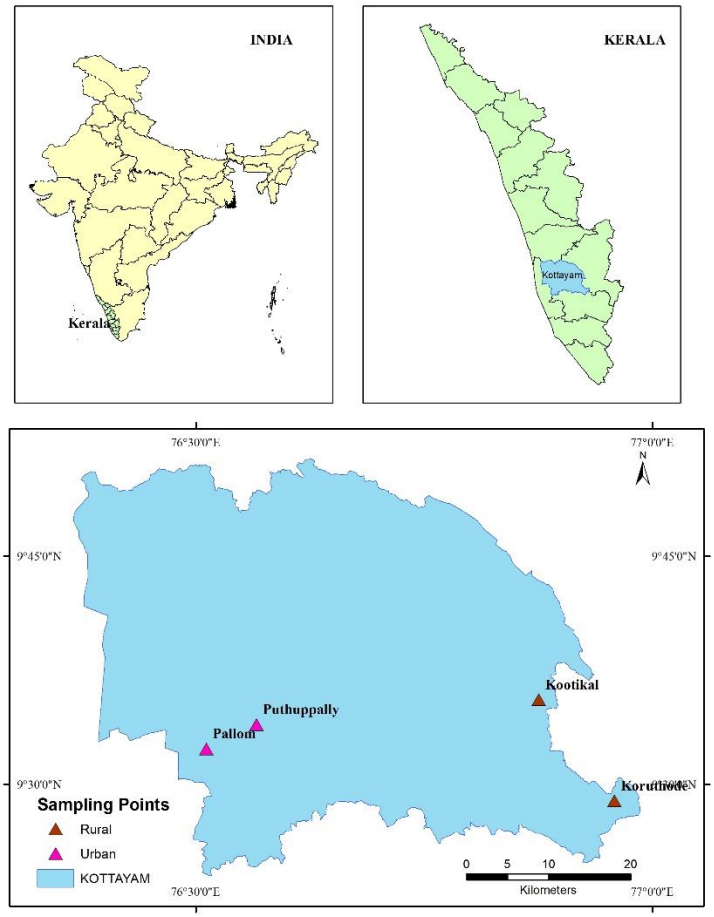

Fig.1.1 Study area showing sampling stations

3. Results

In the present study a total of 14 species of mosquitoes were recorded in the urban and rural areas of Kottayam district (Table 1.1). Five species belong to the genus *Aedes* have been recorded. *Aedes albopictus*, the secondary vector of dengue virus were found to be abundant in both urban and rural areas. Other non-vector species recorded under *Aedes* include *Aedes crysolineatus*, *Aedes vittatus*, *Aedes pseudotaeniatus* and *Aedes cogilli*. Under the genus *Culex* 3 species were recorded *Culex uniformis*, *Culex quinquefasciatus* and *Culex gelidus*. *Anopheles stephansi* and *Anopheles subpictus* are the species recorded under genus A*nopheles*. Non vector species such as *Armigeres subalbatus*, *Toxorhynchites splendens*, *Heizmannia discrepens* were also collected from the study sites.

Table 1.1 Species composition and prevalence rate of mosquitoes in the study areas

Sl. no	Species	Kootikal (Rural)		Koruthode (Rural)		Pallom (Urban)		Puthuppally (Urban)	
		N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
1	*Aedes albopictus*	443	27.6	565	36.0	791	80.5	983	78.50
2	*Aedes chrysolineatus*	259	16.1	212	13.51	5	0.5	23	1.84
3	*Aedes vittatus*	0	0	4	0.25	3	0.3	21	1.67
4	*Aedes cogilli*	3	0.2	11	0.70	0	0	1	0.1
5	*Aedes pseudotaeniatus*	7	0.43	3	0.20	0	0	0	0
6	*Culex uniformis*	195	12.1	183	11.7	13	1.32	50	4.0
7	*Culex gelidus*	8	0.46	0	0	0	0	2	0.12
8	*Culex quinquefasciatus*	2	0.12	0	0	4	0.4	5	0.40
9	*Anopheles subpictus*	0	0	0	0	1	0.1	3	0.24
10	*Anopheles stephensi*	0	0	0	0	0	0	2	0.12
11	*Heizmannia discrepens*	0	0	3	0.2	0	0	1	0.1
12	*Mansonia uniformis*	0	0	0	0	1	0.1	1	0.1
13	*Toxorhynchites splendens*	2	0.12	2	0.12	0	0	1	0.1
14	*Armigeres subalbatus*	686	42.8	587	37.4	165	16.8	160	12.8
	Total	**1605**	**100**	**1570**	**100**	**983**	**100**	**1253**	**100**

N=Number of mosquitoes collected

Most prevalent species in both urban and rural area was *Aedes albopictus* and *Armigeres subalbatus*. Other species recorded were not much prevalent in both areas. In the rural areas of Kootikal and Koruthode, the most prevalent species recorded was *Armigeres subalbatus* (37.4% to 42.8%) followed by *Aedes albopictus* (27.6 % to 36.0%), *Ae. crysolineatus* (13.51% to 16.1%) and *Cx. uniformis* (11.7%to12.1%) (fig1.2and 1.3). In the urban areas of Pallom and puthuppally the most prevalent species recorded was *Aedes albopictus* (78.50% to 80.5%) followed by *Armigeres subalbatus* (12.8% to 16.8%), *Culex uniformis* (1.32% to 4.0%) and so on (fig.1.4 and 1.5).

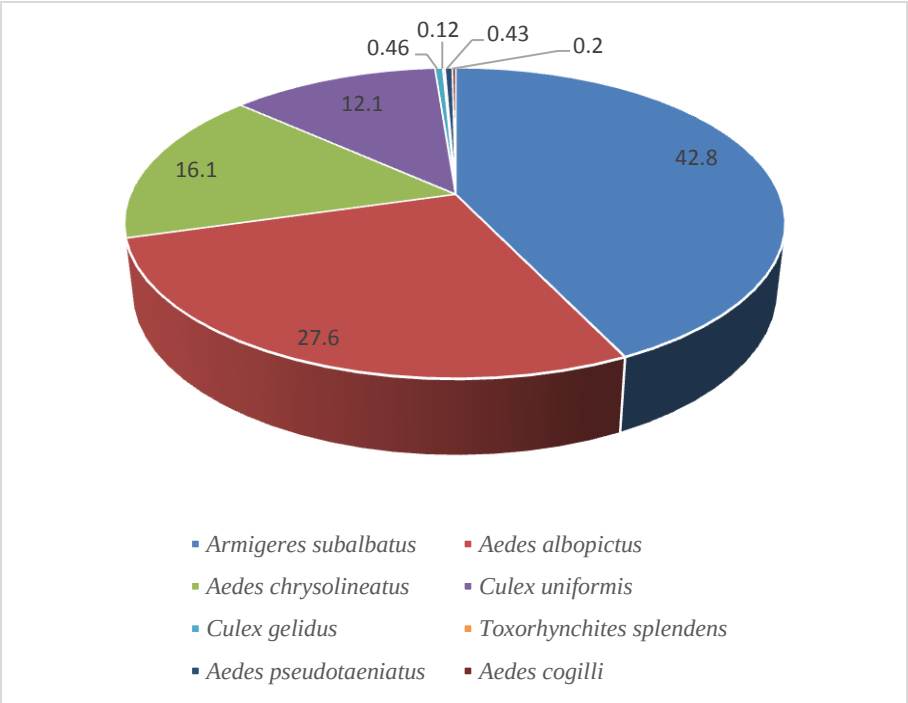

Fig.1.2 Species composition of mosquitoes in Rural areas of Kootikal

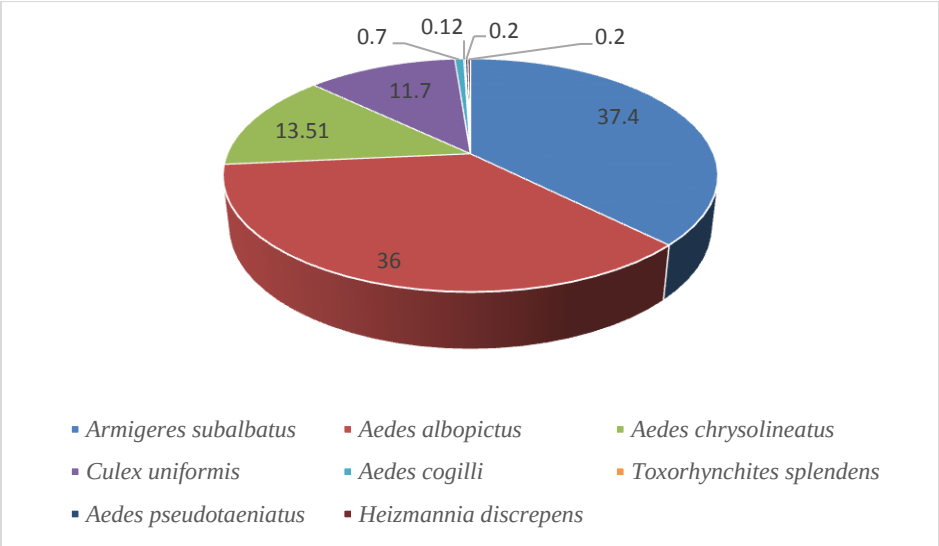

Fig.1.3 Species composition of mosquitoes in Rural areas of Koruthode

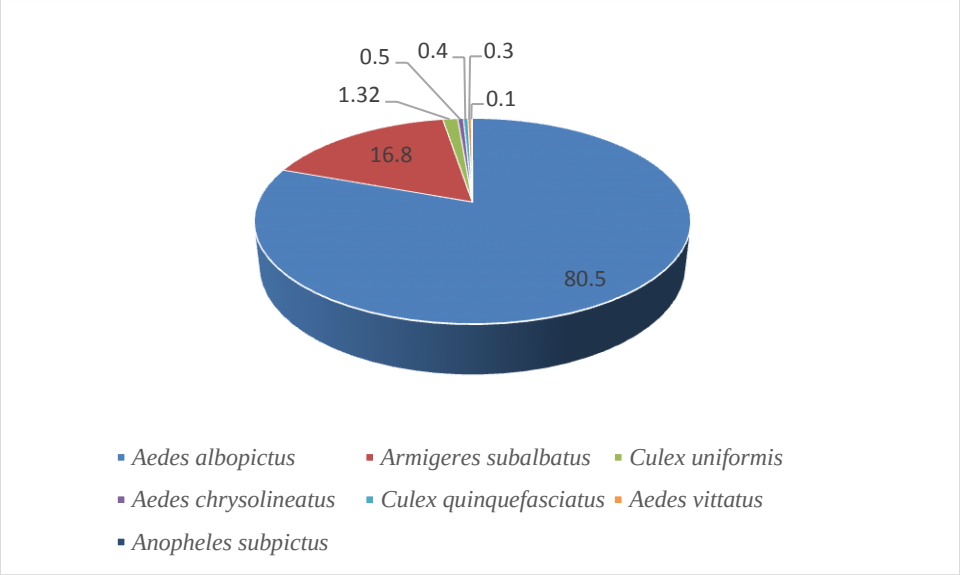

Fig. 1.4 Species composition of mosquitoes in urban areas of Pallom

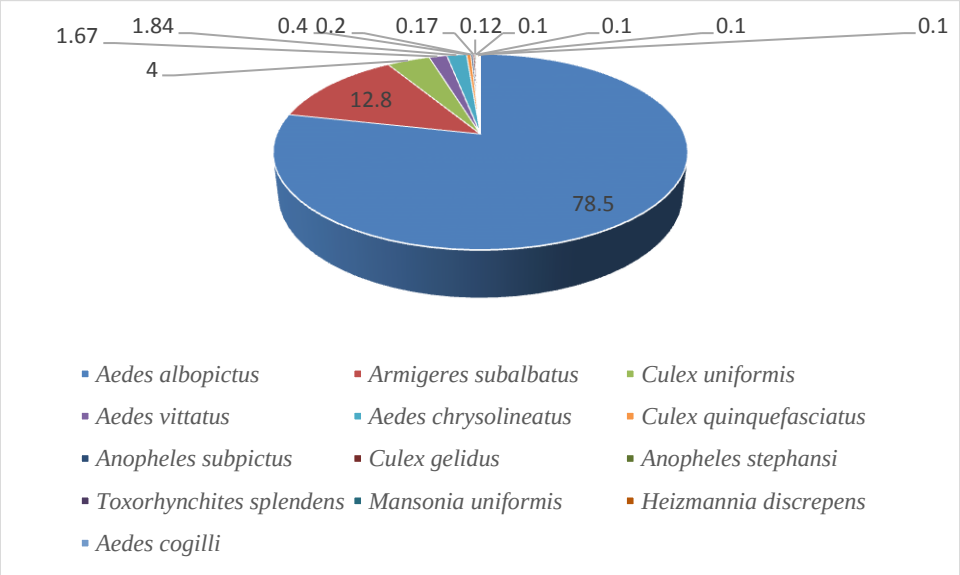

Fig. 1.5 Species composition of mosquitoes in urban areas of Puthuppally

Man hour density of total mosquitoes vary in different months both in rural and urban areas (fig.1.6 and 1.7). However there is no significant difference observed in the per man hour density of mosquitoes between rural and urban areas (t=1.43, p=0.178).When comparing different months total mosquito density was found to be high during the month of June and July while density of *Aedes albopictus* was found to be high during the month of May both in urban areas and rural areas. Also man hour density of *Ae. albopictus* was found to be high in urban areas compared to rural areas.

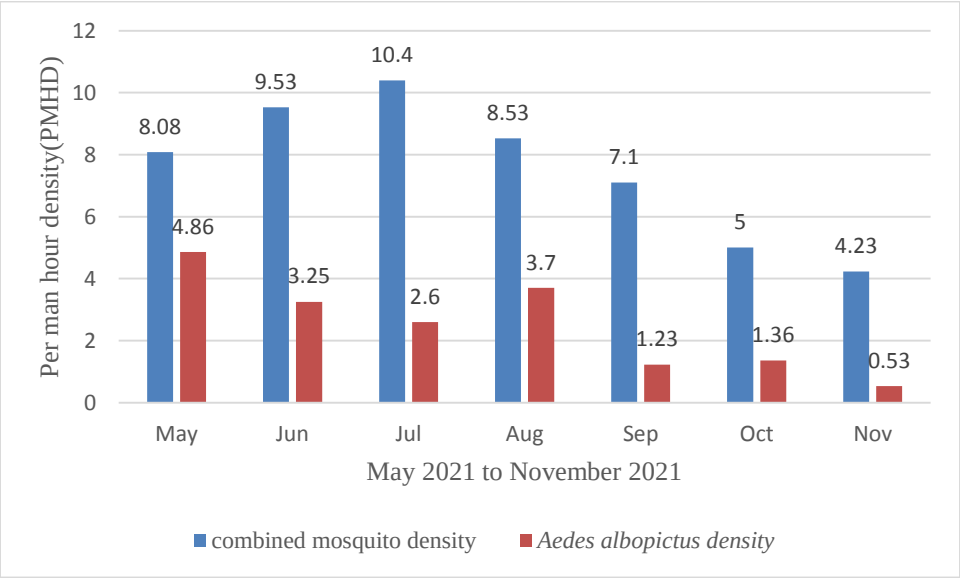

Fig. 1.6 Per man hour density of mosquitoes in the rural areas of Kottayam district

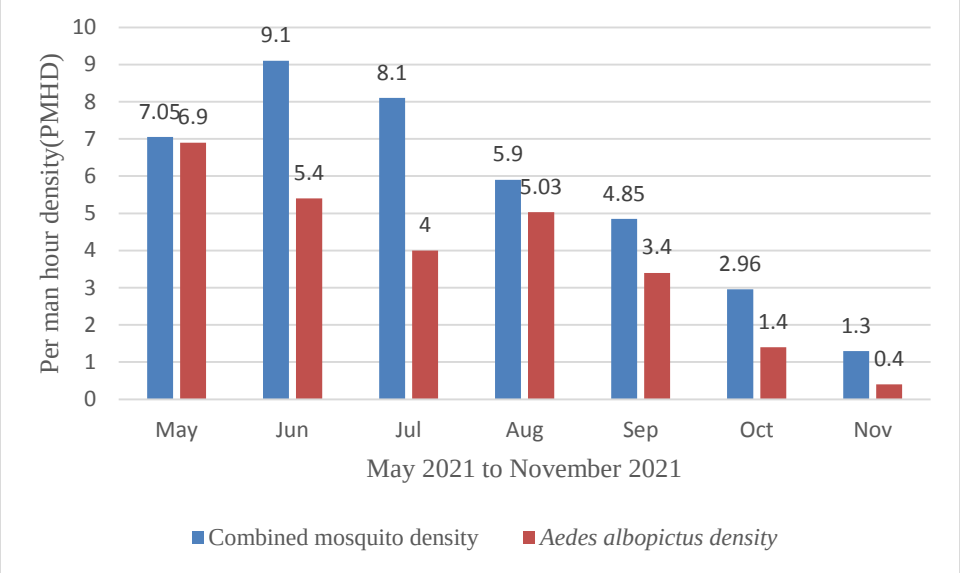

Fig. 1.7 Per man hour density of mosquitoes in the urban areas of Kottayam district

4. Discussion

Mosquito fauna of 14 species belonging to 7 genera were recorded in the study area and all the species were already reported from different parts of Kerala[9,10].Out of the 14 species of mosquitoes recorded in the present study, 8 were reported as vectors of various diseases in different parts of the world. Among the *Aedes* species collected from the study area *Aedes albopictus* was reported as the secondary vector of dengue and chikungunya[11]. The primary vector *Aedes aegypti* was not reported in any of the study area in the present study. *Ae. aegypti* was reported in urban areas of Thiruvananthapuram district of Kerala in an earlier study[12]. In the absence of the principal vector *Ae. aegypti, Aedes albopictus* is effectively transmitting dengue virus in the study area. In several south-east Asian countries *Aedes*

albopictus has incriminated with dengue virus[13]. In Kerala *Ae. albopictus* was recognized as the primary vector for the transmission of Dengue and Chikungunya [14,15]. The prevalence of *Ae. albopictus* was maximum in urban areas compared to rural areas. Peridomestic water storage containers were found to be the major breeding source for *Ae. albopictus* in urban areas. Cement tanks, Plastic drums and cisterns were used to store water in these areas. Significant presence of unused or discarded latex collection containers were responsible for the profuse breeding of *Ae. albopictus* in rural areas. Man hour density of total mosquitoes were found to be maximum during the monsoon month of June and July as rainfall positively influence the density mosquitoes[16]. However density of *Ae. albopictus* were found to be maximum during the premonsoon month of May as the intermittent rainfall during the month of May provide water filled peridomestic containers suitable for breeding of this species. Heavy and continuous rainfall during the monsoon months cause flooding of containers which prevent the breeding of immatures in containers[12].

Armigeres subalbatus was found to be the most prevalent species in the rural areas of Kottayam district. This species is commonly found close to human dwellings with potential breeding habitat of poor sanitation that include polluted water such as septic tanks[17] and has been reported to be a vector of Japanese encephalitis virus[18]. In India, it has also been reported to be a vector of filarial worm *Wuchereria bancrofti*[19]. *Ae. vittatus* was identified as the main vector of yellow fever in many parts of the world[20]. *Ae. crysolineatus*, *Ae. psudotaeniatus* and *Ae. cogilli* have no vector status. Of the three *Culex* species collected from the study sites *Cx. quinquifasciatus* is primary vector of bancroftian filariasis and suspected vector of Japanese encephalitis[21].*Cx. gelidus* is also incriminated as vector of JE and *Cx. uniformis* is a non-vector mosquito species. Genus *Mansonia* was represented by only one species, *Mn. uniformis* and was incriminated as secondary vector of JE in Kerala[22,23]and also have been implicated as vector of Brugian filariasis[24].Of the two *Anopheles* species collected *An.stephensi* is the primary vector of Malaria and *An.subpictus* is a suspected vector of Malaria in India. Also Japanese encephalitis virus was isolated from *An. subpictus* during the JE outbreak in Kerala in the year 1996[22].Species such as *Hz.discripens, Tx.splendens* are generally considered as non-vector species.

Species such as *Ae. albopictus, Ar. subalbatus, Cx. crysolineatus, Cx. uniformis* constituted more than 75% of the total mosquito species collected from the study area. Species such as *Anopheles stephensi, Anopheles subpictus, Mansonia uniformis* were least abundant one as only few specimens were obtained during the study. In forest fringe areas rubber plantation associated latex collection containers and peridomestic discarded containers were found to be the key breeding habitat for *Ae.albopictus.* During rainy season rainwater collected in the latex collection cup forms the main breeding habitat for *Ae.albopictus*[4]. Small and large scale rubber plantation is common and interspersed in the forest fringe areas.

5. Conclusion

Even though different vector and non-vector mosquito species were being reported in the forest fringe areas of Kottayam district, the most prevalent species recorded was *Ae. albopictus* especially in the urban areas. Extensive cultivation of rubber plants provide suitable situation for proliferation of *Aedes albopictus*. Since *Aedes* transmitted diseases such as dengue and chikungunya are being reported in the study area entomological surveillance and its significance can be used to halt the outbreak as shown in this study.

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SYNTHESIS OF CERIUM DIOXIDE NANOPARTICLES USING SIMPLE SOL-GEL METHOD

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Abstract

Cerium dioxide (CeO_2) nanoparticles have gained huge attention owing to their use in diverse applications. Current synthesis methods for CeO_2 nanoparticles including hydrothermal and chemical precipitation are time-consuming and require chemical organic reagents. In order to minimize the reaction time and avoid the use of organic reagents, a new method for CeO_2 nanoparticles were used, which provided an easy, efficient, and continuous bulk phase synthesis at room temperature. In the present study, ammonium cerium nitrate and ammonium hydroxide were used as precursors, and nitric acid was added as a stabilizer to separate the nucleation and growth processes of the nanoparticles to prevent their aggregation. The products were characterized by X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), transmission electron microscopy (TEM), scanning electron microscopy (SEM), and UV-Vis spectrophotometer. XRD pattern showed the cubic fluorite structure of the cerium oxide nanoparticles. The surface morphological studies from SEM and TEM depicted non homogeneous agglomerated spherical nanoparticles and the sizes of as synthesized CeO_2 NPs are between 20±5. The sharp peaks in FTIR spectrum determined the existence of Ce-O stretching vibration and the absorbance peak of UV-Vis spectrum showed the bandgap energy of 3.02 eV.

Keywords: Cerium oxide, Nanoparticles, bulk phase method, simple sol -gel synthesis, Spherical particles.

Introduction

Nanomaterial's have attracted extensive interest worldwide for their unique size and shape dependent chemical and physical properties[1] compared to bulk materials, owing to the enhanced surface area to volume ratio[2], quantum confinement, as well as their potential self-assembly for device applications[3]. Cerium dioxide based materials have been extensively studied and used in a variety of applications over the last two decades, including oxygen storage capacitors[4], catalysts[5,6],UV blockers[7,8], gas sensors[9,10], solid oxide fuel cells[11], and in chemical mechanical planarization[12]. Numerous methods have been reported to produce CeO_2 nanoparticles with promising control of size and properties. Among various chemical methods for producing metal oxide nanoparticles, sol-gel process proves advantageous over

the other methods for its better homogeneity, controlled stoichiometry, high-purity and phase-pure powders at a lower temperature.

In recent years, the aqueous synthetic method has been intensively studied, modified, and improved to find simple and environmental friendly synthesis for fabrication of controlled metal oxide nanostructures[13]. Chemical precipitation methods are largely investigated for the industrial scale synthesis of CeO_2 nanocrystals. Hydrothermal treatments have been successfully used for shape-controlled synthesis of CeO_2 nanomaterials, such as nanopolyhedra[14], nanowires[15], and nanotubes[16]. All of these investigations highlighted the possibility of a convenient aqueous synthetic route to highly controlled CeO_2 nanocrystals, but all these methods need more time and require organic reagents.

For this, we have adopted the simple environmental friendly sol-gel method for the bulk phase preparation of CeO_2 NPs. Ammonium cerium nitrate was used as a precursor for the cerium oxide nanoparticle synthesis. In this paper, the crystalline nano cerium oxide nanoparticles were successfully synthesized by a facile sol-gel method and the formation of CeO_2 nanoparticles were investigated. This method has novel features which are of considerable interest due to its low cost, easy preparation and industrial viability. The structural, morphological and optical properties of the experimentally derived CeO_2 NPs have been analyzed with XRD, FTIR, SEM and TEM, UV-Vis characterization tools.

Experimental Section

Materials

Ammonium cerium nitrate [$(NH4)_2Ce(NO3)_6$] is purchased from E-Merck with 99% purity and all other reagents supplied by Rankem.Ltd.

Sol-gel Synthesis of Cerium Dioxide Nanoparticles

2.17g of Ammonium cerium nitrate ($(NH_4)_2Ce(NO_3)_6$) was weighed accurately and it is precipitated with 10% NH_3, until an yellow precipitate of $Ce(OH)_4$ is obtained. The formed supernatant solution is decanted off and precipitate is washed with double distilled water and centrifuged for 10 minutes at a speed of 3000 rpm. This is done at least 5 times. Then the residue is re-dissolved in 500 ml double distilled water using a magnetic stirrer. Then the pH of the solution is adjusted to 2 (acidic range) by adding 10% HNO_3. The acid addition is continued (drop wise) till a stable sol is obtained. The sol is then dried in an air oven at 100 °C. The dried sol is then calcined in a muffle furnace at 600 °C for 3 hours. The yellow CeO_2 NPs were kept in air-tight containers.

Sample preparation and characterization methods

The crystallinity and size of the obtained CeO_2 NPs was studied using a X-ray diffractometer (XRD Rigaku miniflex, Japan) employing CuKα radiation and the data was recorded over the range 20–80 in increments, at an angle 2θ. The size and morphology of formed CeO_2 NPs were studied using a Transmission electron microscope (JEOL JEM 1200 EX II, Japan) and

Scanning electron microscope (JEOL 5200, Japan). FT-IR analysis were noted in the range of 400-4000 cm^{-1} by using a FTIR spectrometer (Schimadzu IR Affinity,Japan). The UV-Vis spectra of CeO_2 nanoparticles were measured between 200 to 800 nm using UV-visible spectrophotometer (Schimadzu , Japan).

Results and Discussion

Characterization studies on cerium oxide nanoparticles

The X-ray diffraction analyses of CeO_2 NPs were carried out and the results were compared with the standard International Centre of Diffraction Data (ICDD) and presented in Figure 1. The XRD peaks located at (2θ) angles 28.8, 33.1, 47.46 and 56.04 corresponds to the (111), (200), (220) and(311) planes, respectively, which indicate the cubic fluorite structure of CeO_2 NPs (JCPDS file no: 75-0076, of CeO_2).The average crystallite size D of the sample is calculated using Debye-Scherrer's formula, average crystallite size = $0.9\lambda/\beta\cos\theta$, where λ is the wavelength of X-ray used (1.5405 A), β is the angular peak width at half maximum in radians and θ is the Bragg's diffraction angle. From the equation, the average crystalline size was calculated as 12 nm.

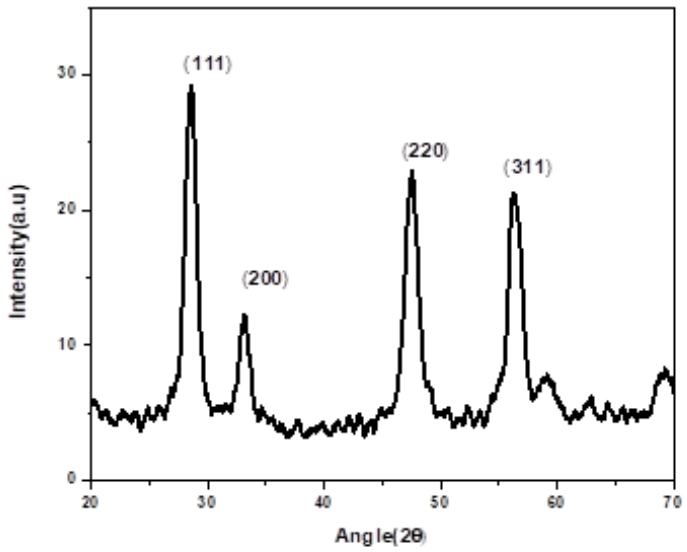

Figure1. Powder X-ray diffraction patterns of CeO_2 NPs.

The FTIR spectra of as prepared CeO_2 NPs were carried out and it is given in figure 2. The absorption peak at around 1630 cm^{-1} can be assigned to the OH bending vibration of water molecules. The bands located at around 1051 cm^{-1} can be attributed to the C-O stretching vibration. An intensive band at 2335 cm^{-1} is due to atmospheric CO_2. The intense band at 438 cm^{-1} corresponds to Ce-O stretching vibration.

Figure 2. FTIR spectra of prepared CeO_2 NPs.

The UV-Vis absorption spectra of CeO_2 NPs are provided in Figure 3. The absorption peak found at 375 nm can be assigned to the excitation of electrons from the valence band to the conduction band of CeO_2 NPs in the presence of light. The band gap energy of CeO_2 NPs can be calculated from the equation,

$$E_g = hc / \lambda$$

Where h is the Planck's constant, c is the speed of light and λ is the wavelength. The small band gap energy value was measured to be 3.02 eV. From the analysis it can be confirmed that the obtained CeO_2 nanoparticles are highly transparent in the Visible region.

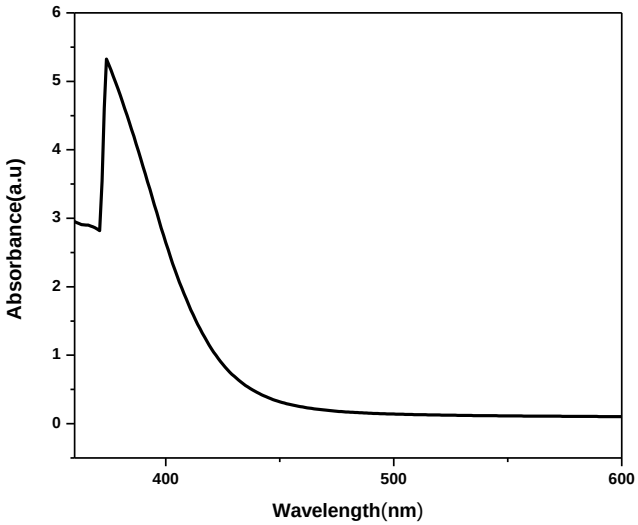

Figure3. UV- Vis absorption spectrum of CeO_2 NPs.

SEM and TEM analysis were carried out in order to find the size and shape of as-prepared CeO_2 nanoparticles. Figure 4(a) depicts SEM images of CeO_2 nanoparticles obtained using the present controlled sol- gel technique. The presence of strongly agglomerated non-homogeneous cerium oxide particles was confirmed by SEM analysis. From the TEM (Figure 4(b)) analysis, the studies indicated that the as prepared cerium oxide nanoparticles are constituted of spherical cerium dioxide nanoparticles.

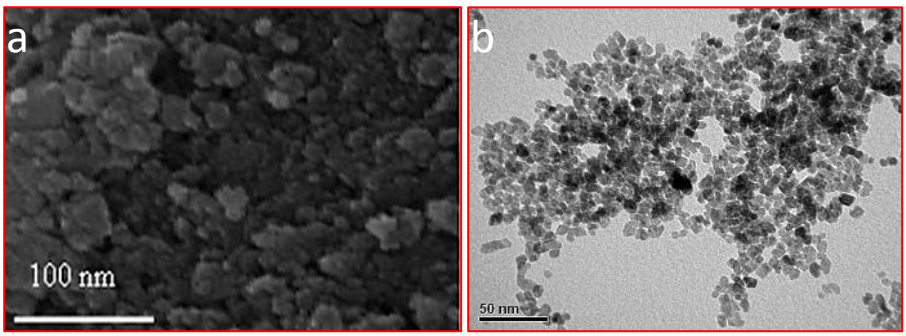

Figure 4: **a**) SEM images of CeO_2 NPs, **b**) TEM images of CeO_2 NPs.

Conclusions

Nanocrystalline CeO_2 NPs were successfully prepared from ammonium cerium nitrate by using simple controlled sol gel synthesis. The SEM and TEM images showed that obtained CeO_2 NPs are highly agglomerated nonhomogeneous spherical and smaller in size (20±5nm). XRD studies confirmed that the resultant crystalline nanosized cerium oxide have cubic fluorite structure. UV-Vis spectra confirmed that the prepared CeO_2 NPs are transparent in the visible region. The present method can be used for simple bulk scale production of cerium dioxide nanoparticles.

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GENDER DISPARITY AMONG MARGINALISED COMMUNITY: A STUDY OF MARINE FISHERFOLK IN KERALA

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Abstract

Human rights are rights inherent to all human beings, regarding of race, sex, nationality, ethnicity, language, religion or any other status. Human rights include the right to life and liberty, freedom from slavery and torture, freedom of opinion and expression, the right to work and education, and many more. Everyone is entitled to these rights, without discrimination. These rights are interrelated, inter dependent and indivisible. It means that the improvement of one right facilitate the advancement of other rights. Also, human rights are inalienable; they should not be taken away, except specific situations and according to the procedure established by law. The present study focused on the Socio economic status of fisher women and the problems faced by them in Kerala.

Key words: Fisher folk, Marginalisation

Introduction

The human rights are those minimal rights which are available to every human being. Women and girls rights are human rights. They cover every aspect of life-health, education, political participation, economic well-being and freedom from violence, among many others. Women and girls are entitled to the full and equal enjoyment of all their human rights and to be free from all forms of discrimination- this is fundamental to achieve human rights, peace and security, and sustainable development. The protection and promotion of human rights is the first responsibility of governments. Achieving gender equality and empowering all women and girls is one of the sustainable goals of the United Nations (UN) Sustainable Development Goal 5 (SDG 5). The UN recognizes ending discrimination against women as not only a basic human right but as a necessary condition for a sustainable future. It is very evident that significant progress toward gender equality and women's empowerment has happened in the past four decades. However, as a global community, we are still far away from being a gender-equal world. India is ranked 140th among 156 countries in the World Economic Forum's Global Gender Gap Report 2021. Further, the Gender Inequality Index (GII) also offers a picture of gender disparities in India in sectors such as health, empowerment and the labour market. As per the 2011 census, the ratio of women to men for Kerala is 1,084, which is high compared to the national figure of 940. Women constitute 52 per cent of the total population in Kerala. Children aged 0-14 years represent 23.44 per cent

of the total population in Kerala, 48.91 per cent of whom are girls. In contrast to the national average of 11 per cent, 22 per cent of all households in Kerala are female-headed. In recent years there was an increase in women's employment in Departments such as Police and Excise. In 2017, 605 police constables were recruited (including a police battalion of women, commanded by a woman commandant) and another 154 were recruited in 2018. In Excise Department, 133 women were inducted for patrolling in 2018. After the pandemic substantial recruitment of health workers has been occurred, large number of the new health workforce being women.

Objectives

To study the status of Fisher women and the problems faced by them in Kerala

To identifies socio-economic background of fisher women in the study area

Methodology

The study has made use of empirical and analytical approaches. Both quantitative and qualitative techniques were used in the collection and analysis of data. Information had been gathered from secondary sources and primary sources and by interviewing the target groups. The secondary data comprises books, journals, articles, government publications and websites. Primary data collected from 290 fisherwomen from Thiruvananthapuram district. Out of this 190 samples were selected from Anchuthengu, and 100 samples from Vettukad in Thiruvananthapuram District. Simple random sampling techniques were used for collecting data.

Development economists discovered that despite a common national strategy for the development of the whole economy, India was witnessing differential development at the regional levels. In this matter the case of Kerala has been unique. This was a state which achieved a high physical quality of life as reflected in birth rate, death rate, infant mortality rate expectation of life at birth, literacy rate, sex ratio and infrastructural development (Nair, 1993). Kerala baffled development economists with its high quality of life coexisting with low per capita income, high level of unemployment, a virtually stagnant production base and a level of nutrition/calories intake much lower than the standard norms prescribed by the Indian Council of Medical Research.

Problems faced by Women in Kerala

India is a country where women are given the status of a goddess. However, the problems they have to face just show the opposite of this concept. On hand they worship them as goddessesand on the other; they abuse them endlessly and consider them inferior. Indian women always had some problem or the other to face in society. People evolved and so did the problems; they did not go away but changed from one to another In the early days there were severe issues like the Sati, no widow remarriage, devadasi system and more. While most of them are not prevalent now, there are new issues that women face. They may be not the same but they are still as severe as the early ones. They hinder the growth of a country

and make the women feel inferior. Violence against women is a very grave issue faced by women in Kerala. It is happening almost every day in various forms. People turn a blind eye to it instead of doing something. Domestic violence happens more than that. There is also dowry related harassment, marital rape, genital mutilation and more. There is the issues of gender discrimination. Women are not considered equal to men. They face discrimination in almost every place whether at the work place or at home.

Gender Disparity

Many studies reveal that both professional and non-professional women experience heavy stress due to gender bias. Although women have proved the best of their abilities in various fields of work at par with men, they still continue to have a grip over their household responsibilities. In spite of their hard work, women have been given second importance in their field of work. Patriarchy and gender inequality in society is the main cause of women's deprivation by way of health, food and nutrition, more susceptible to mortality and contributing to unbalanced male female ratio as well as in the sphere of education, employment, wages and that of political representation. Women are treated by men only as consumers, sex objects or reproductive machines as a result of which their status in the family and society has been demoted. Subsequently this has led to increasing violence and denial of human rights, liberty, equality, justice. The patriarchal family system that prevails in India gives more rights and authority to the male enabling them to enjoy more power over the female in the family. Women are considered inferior, secondary individuals to men. So they are suppressed, oppressed, harassed, subjugated and deprived of even their basic rights till date. Atrocities and crimes are committed against them by their own family members. They used to face innumerable problems in their post married life for their family in different dimensions such as a bride due to no or less dowry, as a wife not bearing a male child, as a widow responsible for her husband's death. Above all if they are working women, they are expected to accomplish all the activities from dawn to dusk to satisfy needs of all family members. So though women play a key role in the socio economic development of a country yet they are discriminated against almost in every walk of life right from the very earliest stage.

Dual Responsibility

Women's attitude towards their stereotyped (traditional) role is rapidly changing and their participation in different job sectors is increasing alarmingly due to low economic condition of family, advancement in the field of women education, granting of more liberty, rights and privileges to women. Managing both the family and job responsibility on the part of the women today are quite tough and challenging. It is very difficult for them to carry dual responsibilities at home and the workplace. It creates psycho-socio problems both in the family and professional field; despite the fact that it provides economic security. Thereby it had done more harm than good for which women are experiencing stress and frustration in life.

Illiteracy and Traditional Belief

Illiteracy and traditional beliefs and practices of family have prevented a great majority of women from access to health care and knowledge about their rights and privileges resulting high rate of maternal mortality and morbidity. In our society male members of the family are supposedto eat fresh and nutrition's food in comparison to women because either they are the earning member or head of the family or they are supposed to be more important than female members. The high mortality rates among women as revealed by maternal death due to anemia, toxemia, hemorrhage and abortions indicate that women health in general and reproductive health in particular are neglected due to her illiteracy and ignorance about her health and balanced diet. Healthy women produces healthy child but from analysis of data of various studies it is observed that nutrient intake is significantly less among illiterate pregnant women. Illiteracy limits women's ability to earn money and participation in decision making in the male dominated families. Statistics shows that higher the female literacy level, lower is the fertility rate and birth rate. Maternal mortality are normally higher in states with a low literacy. Illiteracy and low educational status result in lack of information, knowledge. There is a saying that if you educate a boy you educate an individual but if you educate a girl you educate a family.

Social Stigma and Poverty Condition

Crime and violence against women are on the rise. This is only due to social stigma that women are weaker section of society. Poverty condition compels the poor women to sell their minor girl like commodity and give away their grown-up daughter into slavery to another family to perform household activities. They are subject to victim of STD. (Sexual Transmitted Disease) AIDS due to unprotected sex as they are able to protest. Due to financial constraints and acute poverty, young girls are often lured away by middle men and brokers with a false promise of being offered alluring jobs. In the process they are after cheated with sexual harassment which ultimately ends up in dubious condition. Lack of family and society support and consciousness of moral values create problems with the in-laws, dowry and torture for women. Lack of self confidence is the main cause of women problem. Women themselves are willing to aberrate the female sex. They are interested to participate in obscene picture and advertisement and wearing indecent and provocative clothes. They are quarrelling with parents for the dowry. They are creating conflict with in-laws instead of co-operating with them. The feeling of helplessness and frustration in women regarding their own problems must be taken care of without delay. Both the family and society should work together to eliminate such problems and give a woman the much needed self confidence and self respect. However during these few decades, industrialization, urbanization, westernization and spread of women education have brought about drastic changes in women's, lives but still they are facing multifarious and multidimensional problems. Despite so much hue and cry in the whole world for equal

treatment of-both men and women in every aspect of life we are still lagging behind in achieving the goal.

Marginalized sections are a group which has remained for long totally excluded from the mainstream population and isolated and deprived of opportunities and facilities of life, right from ancient times. Fisher folk, being an occupational category belong to the marginalized group, steeped in illiteracy and living far removed from the mainstream population. Fisheries sector is an informal sector, fisheries plays a crucial role in the economic development fishing occupies an important role in Indian economy as it is a source of food protein, its major revenue of employment, and recent years, it's become a major export industry. The role that women play in developing societies in preserving the social and cultural ethos intact can hardly be overemphasized. The responsibility of providing stable sustenance rests primarily with womenfolk. While men usually work outside the home as bread winners, women are considered the homemakers even if circumstances and opportunities warrant that they work outside the home for a living (Kurien, 2000). We intend to highlight the differing roles played by women in the fishing households and women in the fish consuming households in Kerala. Both play crucial roles in livelihood and food security.

Women in Fishing Communities

Women play an indispensable crucial role in maintaining the social and cultural foundations of the fishing communities in Kerala. In a multi-caste, multi-religious society these roles take varying socio-economic and cultural expressions. One common and strong taboo relates to women's involvement in actual fishing. This is considered to be "polluting" and consequently women in the fishing households never go to sea. The closest they may get to it will be for gathering shells and cockles on sea fronts with rocky fringes (Kurien,2000). The women of the Muslim Mappila fishing communities of the northern region are largely confined to their roles as mothers and providers of the basic needs of the family within the four walls of the home. Very gradually, with increasing education and greater socialization they do involve, to a limited extent, in some post-harvest activities in the villages (Mathur, 1977). The Hindu Araya fisher folk and the Christian Mukkuva fisher folk permit their women participate in the economic activities relating to fish processing, buying and selling in distant markets (Ram, 1991).

The fisherwomen play an important role in the terms of their involvement in fish related activities such as fish vending, fish drying, prawn peeling, sorting, grading, packing and net making. About 46.35 per cent of women are involved in marine fishing activities and 49 per cent of them are involved in inland fishing activities.

Socio-Economic Profile

Kerala which has a high number of fishermen population, is a state in which all the three major religions have significant presence. Fishing is considered in Kerala an occupation of

backward communities. The family characteristics of the samples in the study areas may now be examined. Family background is an important variable determining the income earning capacity and the consumption pattern of households. They have also an important place in determining the standard of living, educational level and health status of the population. Family size has an important determinant of the health status of an individual. The study reveals that there exists joint family system among the Coastal population. How many persons can be accommodated under a roof is a legitimate question to address in the case of marine fishermen community, the housing conditions of whom are reported as alarmingly congested. Marine Census of CMFRI in2005 and HRDC report 2009 reveals that the household size of coastal population is higher than the total population.

The higher household size of fisher folk implies two things. One, the possibility of higher birthrate or fertility rate than the state's total population: and two, due to the non availability of land for new houses within stipulated distance from the shore and also because of financial reasons to build new houses, the congestion in already existing houses go on increase with family formation.

Educational Status

Education plays an important role in every phase of life as it enhances informed choices regarding issues in life especially health seeking. Education to women has a major impact on health and nutrition. This is a common say, "if you educate a man, you educate an individual, if you educate a woman, you educate a family". Studies reveal that literacy has a direct impact on nutritional status of women. The main dietary intake of food and nutrients increased with increasing educational level. Ignorance is the most important factor underlying malnutrition. The level of education affects the status of women. Literacy of women plays an important role in reducing fertility and child mortality. Literate women tend to marry at higher age and thus the age of marriage increases. Thus education of women has significant impact on demographic process. Kerala's effort in making basic education facilities accessible to large majority of the people is well known. Primary and even upper primary schools exist in close proximity to all the fishing villages. Literacy movements in Kerala shows an increase in literacy rate of the general population

Occupational Profile

The economic condition of a household mainly depends on the occupation, level of employment and income of the working members of the household etc Poor quality of life is a reflection of low and unsteady income and nature of work. There is a reciprocal relationship between health and wealth. Financial difficulties foster poor health. Expenses involved in meeting treatment make the lower income group to forego treatment. The income stated by the fisher women need not be accurate. There is a tendency among women, especially the poor, to high light their poverty. However by cross checking with the amount they spend on food, medicine, etc, the approximate income was derived at. It was revealed that 79.1per cent of them had an average monthly income of more than Rs.12000.

Conclusion

Fish vending is a traditional occupation that has been a means of livelihood for thousands in India, with the majority of fish vendors being women. Fish vendors engage in their trade in various ways: they procure their fish directly from landing centers, where they participate in daily auctions of the catch; they buy from traders and merchants; or they buy from the wholesale markets of resale at retail/local markets. Vendors also carry out value addition by sorting, grading, cleaning and icing the fish. Women are thus the primary players in processing, marketing and selling the catch. After the fish has landed, it is the women who take charge of the catch and sell the fish for money and food, contributing to household incomes and food security, and to the local economy. Their labour is, however, often not recognized. Fish vendors operate as an important link between producers and the final consumers, making fish available to consumers, making fish available to consumers in urban and remote rural areas, and enhancing food security in tangible, but unrecognized ways. Women have always played an important role in the fishing industry by way of taking care of many of the shore based activities after the fish is landed. These include handling of fish; salting, drying, marketing etc. increasing entrepreneurial activities in post harvest segment of fisheries for women may provide more and more employment opportunities. Women fish vendors also play an important role in the development of the economy. Fisherwomen should be provided adequate knowledge and training on awareness of natural disaster and its management. If India's fisheries sector to be satisfactory sustained then fisherwomen empowerment, both socially and economically is essential. Hence skills and use of appropriate technology will enable them to empower socially and economically.

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Synthesis, characterization and antibacterial studies of curcumin metal complexes

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Abstract: Ca (II) and Ce(III) complexes of curcumin have been prepared from the metal chloride salts and commercially available curcumin in presence of pyridine catalyst. The prepared complexes were characterized using Infrared and UV spectroscopy. Anti-bacterial study of the synthesized complexes indicated that all the complexes possess antibacterial activity and particularly the Ce (III) complexes possess better anti-bacterial activity than the pure ligand against the gram negative bacteria Salmonella typhimurium.

Introduction: Curcumin, a major constituent of turmeric exhibits great promise as a therapeutic agent, and is currently in human clinical trials for a variety of conditions, including multiple myeloma, pancreatic cancer, myelodysplastic syndromes, colon cancer, psoriasis and Alzheimer's disease. The unique charge and bonding characteristics facilitate penetration into the blood brain barrier superior to other known non-steroidal anti-inflammatory drug (NSAID). Curcumin is a free radical scavenger and hydrogen donor, and exhibits both pro- and antioxidant activity [1].

Under physiological conditions (pH > 7.2),~90% of curcumin degrades within 30 min into several products, namely, trans-6-(4′-hydroxy-3′- methoxyphenyl)-2,4-dioxo-5-hexanal, ferulic acid, feruloylmethane, and vanillin. It is also susceptible to degradation on exposure to light. Curcumin also suffers from its poor bioavailability besides being susceptible to degradation in light. A more facile and convenient way to enhance the solution stability without compromising its therapeutic efficacy is binding to a metal ion. Binding of Curcumin to a metal ion via its β-diketone moiety significantly reduces the tendency of a Curcumin to undergo hydrolyses in aqueous medium, which could result in an improved therapeutic efficacy. By the suitable choice of the metal and the ancillary ligands in a ternary structure, the complex can be directed to targeting cancer cells without effecting the normal cells [2].

Antimicrobial studies of few metal complexes of Curcumin were already reported. A copper Curcumin was found to be useful for the development of a vaginal gel against viral infection. Also notable is an early report the inhibition of an HIV-1 and HIV-2 proteases and several Curcumin boron complexes. Antiarthritic/antirheumatic activity has been reported for vanadyl and gold complexes of curcumin. Reports were available on synthesis

of Fe (II), Zn(II), Ni(II), Cu(II), Co(II) and Mn(II) complexes of curcumin and their extended applications [3].

Literature review suggests that there is great scope in curcumin metal complexes study in biomedical field. Based on the above mentioned literature review, we have selected Ca(II) and Ce (III) as the metal ions for complexation with the commercially available curcumin. The prepared complexes were characterised using FT-IR and UV spectral analysis. Also antibacterial studies of the prepared complexes were done against the gram negative bacterium Salmonella Typhimurium as the pathogen. An attempt was also made to correlate the various characterisation results with the antibacterial activity.

Experimental procedure:

Materials: Commercial curcumin (96%) was purchased from Sreekumar Laboratory Supplies, Kollam. DPPH was purchased from Sigma-Aldrich . The metal salts, used for the synthesis of curcumin metal complexes are Calcium chloride ($CaCl_2$), silver nitrate ($AgNO_3$) and cerium chlorideheptahydrate($CeCl_3.7H_2O$) were purchased from S.D. Fine Chem. Ltd,.Pyridine(Analytical Grade, Merck)is used in catalytic amount during the synthesis. Solvents were purchased from S.D. Fine Chem. Ltd.

Synthesis of curcumin metal compexes:

Preparation of Curcumin-Ca Complex: The complex was synthesized by mixing curcumin with calcium chloride at a molar ratio of 1:1 in ethanolic solution. The ethanol solution of curcumin(0.54 m mol) and the metal salt of $CaCl_2$ (0.54 m mol) were prepared separately and to the curcumin solution catalytic amount of pyridine was added followed by metal salt solution with constant stirring on a magnetic stirrer. Stirring was continued for 4 hours. The metal complex precipitated was filtered and washed several times with cold ethanol to remove the residual reactant and dried. The complex was also synthesized by mixing curcumin with calcium chloride at a molar ratio 3:1 in ethanolic solution. Following similar procedure Curcumin-Ce complex was also prepared.

Antibacterial assay of curcumin and metal complexes: The disc diffusion technique or Kirby- Bauer method was followed in the present investigation which is the most preferred to follow antibacterial activity against rapidly growing organism. These studies were performed in CEPC, Kollam. Culture of Gram negative bacteria Salmonella Typhimurium was obtained from CEPC , Kollam. Detailed procedure is provided below.

1. Test organisms : Test organisms were collected from Institute of Microbial Technology, Microbial Type Culture Collection Centre, (IMTECH), Chandigarh. The bacterial stains were maintained on their respective medium in the slants at 2-8^{0}C.
2. Preparation of Muller Hinton Agar (MHA) : Muller Hinton Agar (MHI) medium was used for bacterial culture. MHA was prepared and sterilized at 121^{0}C for 15 minutes. After sterilization, required volume of the medium (20ml)

was poured in a sterile petri dishes and allowed to solidified.

3. Inoculam preparation : Use pure culture as inoculam. Selected 3-4 similar colonies and transferred them in to about 5ml of suitable broth such as Tryptone Soya Broth (TSB), incubate at 37^0C for 2-8 hours till light to moderate turbidity develops.

4. Method of Inoculation : Filter paper disc diffusion technique was applied for determining antibacterial activity. Dipped a sterile non-toxic swab on a wooden applicator into the standardized inoculam and rotated the soacked swab firmly against the upper side wall of the tube to express the excess fluid. Streaked the entire agar surface of the plate with the swab three times, turning the plates at 60 angle between each streaking. Allowed the inoculam to dry for 5-15 minutes with lid in place.

5. Drug (5 mg)(curcumin and its complexes) was dissolved in 10 mL DMSO (1%) to make concentrations of 0.5 mg/mL. Apply the disc (Hi media sterile 6mm disc) impregnated with the sample, approximately 30µl, using aseptic technique. Then placed the disc with centres at least 24mm apart.

6. Incubated immediately at 37^0C and examined after 16-18 hours or later if necessary. Measure the zone showing complete inhibition and record the diameters of the zones to the nearest millimetre.

Results and Discussions:

Curcumin metal complexes of Ce and Ca (1:1 and 3:1) prepared were characterized using FT-IR spectroscopy. Antibacterial studies were also performed with the prepared complexes. Observed colour and yield of the complexes calculated based on the amount of metal precursor taken is presented in table 1.

Table 1: Observed colour and Yield of the prepared complexes

Ligand: Metal Ratio	Colour	Yield (%)
Cur-Ce1:1	Red	80
Cur-Ce3:1	Red	78
Cur-Ca1:1	Yellow	85
Cur-Ca 3:1	Yellow	81

Optical photographs of the complexes were shown in Fig. 2. Both the complexes were found to be completely soluble in organic solvents like DMSO, DMF etc.

Fig.2 Optical photographs of A) Cur-Ce and B) Cur-Ca

FT-IR Spectra

The infrared (IR) spectra of curcumin show a strong band at 1619 cm $^{-1}$ and a broad band in the range 2800 – 3500 cm $^{-1}$ due to the stretching of the chelated carbonyl and the intramolecularly hydrogen-bonded enol functions, respectively. The absence of any band assignable to a normal α , β –unsaturated carbonyl group in the region 1640 – 1740 cm $^{-1}$ indicates the existence of the compound entirely in the enolic form [4,6].

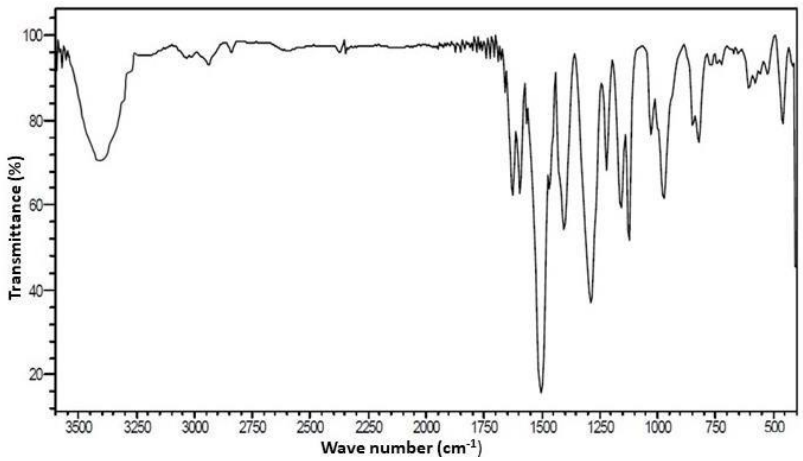

Fig.3 FT-IR spectrum of Curcumin-Ce complex

A representative FT-IR spectrum of Curcumin -Ce complex is provided in Fig.3. In the IR spectra of the metal complexes, the band at 1619 cm -1 of the ligand shifted to lower frequency 1595 cm$^{-1.}$ However, spectra of both Ce and Ca the complexes exhibited bands at ~3400 cm $^{-1}$slightly reduced in intensity due to the stretching of the OH group in the phenyl

ring. This reduced intensity may be due to the replacement enolic proton by metal cation. This suggests that only the enol proton is replaced by metal ion and the phenolic OH is excluded from co-ordination.

Antibacterial activity

The results of antibacterial activity of commercial curcumin and their complexes are represented in Table 2. All the compounds were taken in the concentration 5mg/ml in DMSO. Results are compared with that of standard drug reported in literature [7]. The activity is expressed as diameter of zone of inhibition in mm.

Table 2- Inhibition zone distance of samples measured in mm

Sample	Zone of inhibition distance in (mm) Salmonella Typhimurium
Cur-Ce1:1 complex	8 mm
Cur-Ce3:1 complex	9 mm
Cur-Ca1:1 complex	No zone
Cur-Ca3:1 complex	6 mm
Curcumin	6 mm
Amikacin [40]	21 mm
DMSO	No zone

The results of the antibacterial activity of curcumin and their complexes revealed that the ligands and their complexes possess slightly less antibacterial activity to that of standard drug Amikacin [7]. Metal complexes possess better antibacterial activity than that of ligands, except in the case of Curcumin-Ca complex. Though we expected better antibacterial activity with Ca based complex based on literature (8), the result was disappointing only 6 mm inhibition zone distance was observed with 3:1 complex. Exact reason is not known. Comparing the ligands, Curcumin-Ce (3:1) complex showed greater zone of inhibition(9 mm) towards Salmonella typhimurium. A high concentration of curcumin in the complex may have a higher antimicrobial effect (8).

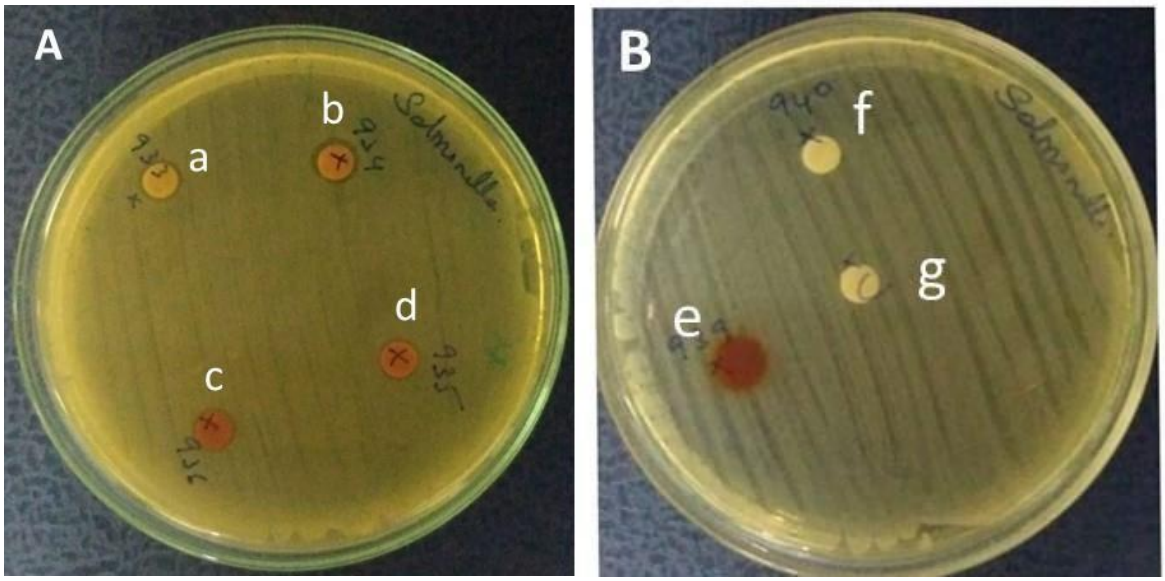

Fig 6 Inhibition zone against screened bacteria from disc diffusion method. A) and B) Salmonella typhimurium. a b, c, d, e, f and g corresponds to disc impregnated with DMSO solutions of Ce 1:1 complex, Ce 3:1 complex, Ca 1:1 complex, Ca 3:1 complex, disc which is impregnated with DMSO as solvent, control and curcumin respectively.

Mean while, the antibacterial ability of free curcumin was not higher than that of their complexes. This could be explained that complex curcumin released more slowly than the free form, so the possibility of oxidation was slower. So, the antibacterial activity of the complexes was higher than that of free curcumin (8).

Conclusion:

Curcumin metal complexes of Ce (III) and Ca (II) were prepared from respective metal nitrate precursors and curcumin. The complexes were characterized using FT-IR spectroscopy and the study revealed that the complexation of ligand to metal is via the enolic proton. Antibacterial studies were done via disc diffusion method. A common finding in antibacterial studies was that the studied metal curcumin complexes except Curcumin – Calcium complex exhibited a better activity(9 mm) against Salmonella Typhimurium than the free ligand (6 mm). Clearly, however, much more work is needed to establish more general trends and the most effective metal–ligand combinations. Extension of the present study towards preparation of composites of biomedical applications incorporating the prepared complexes is on the way.

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ISSUES AND CHALLENGES OF LOKPAL AND LOKAYUKTA ACT

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Introduction

The Lokpal is the first institution of its kind in independent India, established under the Lokpal and Lokayuktas Act 2013 to make inquiries and investigate into allegations of corruption against public functionaries who fall within the scope and domain of the above Act. The Lokpal of India is devoted to address concerns and aspirations of the citizens of India for clean governance. It shall make all efforts within its jurisdiction to serve the public interest and shall endeavor to use the powers vested in it to eliminate corruption in public life.

The Lokayukta is an authority at state level which deals with corruption and maladministration complaints prepared by the general public. This authority is constituted for a quicker redressed of public grievances. The concept of Lokayukta traces back to the ombudsman in Scandinavian countries. The Lokayukta is put into power when the Lokayukta act is approved in the state and works for the State governments and addresses the complaints of the people living in the state. The complaints can be against the integrity and effectiveness of the government or its administration which includes the people working in the government sector. The complaints can also be concerning any corruption faced by the people from the government administration.

Corruption is more or less man kind of symptom similar to the chaotic personality of a child who did not receive a proper moral upbringing. It reflects the sick health of a disorderly society .India's parliament has been steadily engaged in passing legislation, commencing with the extension of powers granted to the war time special staff in 1924 till the enactment, in 2014, of the lokpal and lokayukta act.

Lokpal and Lokayukta Act

Lokpal was one among the longest unfinished bills within the parliamentary history of India. Ever since the primary lokpal bill was presented in the fourth loksabha in the year 1968, number of times the different version of the lokpal bills were presented, however all these efforts went in vain. Apart from the public appeal, various governmental bodies and commissions in its reports had expressed the need to have the institution of lokpal. There were certain issues in the lokpal bill 2011 due to which this bill was referred to Department-

Related Parliamentary standing committee on personnel, public grievances, law and justice for examination and report. Some of the key problems in the bill were

The Lokpal bill provided that the lokpal had the jurisdiction to investigate group "A" offices. However, these offices at that time fell within the purview of Central Vigilance Commission, hereinafter referred to as CVC therefore; there would have been issue of dual jurisdiction over these officers.

The bill created and investigation wing under the lokpal. An earlier standing committee, in its report on Central Bureau of investigation, hereinafter referred to as CBI, had recommended against creating additional investigate agencies to tackle corruption, transnational terrorism or organized crimes.

The bill expanded the definition of public servant to include certain private persons under the lokpal, this provision differed from provisions under several other acts.

There were certain flaws in the prosecution and inquiring process. The lokpal could not prosecute any private persons who abet corruption. The seven year constraint on filling grievances may stop action of a two term Prime Minister, hereinafter referred to as PM, in the early years of his term. The punishment set for false and frivolous grievances is dissimilar from other alike laws and bills.

The Lokpal bill will be selected by a committee comprising, inter alia, the Chief Justice of India. It will be essentially an administrative committee, a part of the executive. Just as the executive cannot encroach on the judicial domain, similarly the judiciary should not be inducted into executive functioning. If judges of the Supreme Court were to be members of administrative committees, a very anomalous situation may arise. The Lokpal's jurisdiction is restricted to cases of disproportionate assets amassed by public figures. The act is redundant as the prevention of corruption act is adequate to serve the same purpose. Lokpal does not cover day to day corruption.

The provision in the Lokpal Act fixing the age of retirement at 70 has the potential for misuse. It could prove to be too tempting a prize for some retiring members of the higher judiciary to resist, as the appointment of the Lokpal will be in the hands of the executive. It is settled law that he judiciary has no role in the investigation of offences.

The Lokpal has been granted unlimited discretion to delegate his powers, which include raids, search and seizure to any 'officer or employee'. Such a provision is in violation of administrative law whereby a power delegated cannot be sub-delegated. He will be authorised to attach "proceeds of corruption", an expression whi8ch is vague and undefined. It is bad in law to empower an executive authority to do so, which is the lawful junction of an independent court of law, after examining all evidence. The whole Lokpal issue warrants a serious rethink.

The anti-corruption agitations in the year 2011 forced the government of India to hurriedly pass the Lokpal and Lokayukta Act in 2013, but, it turned out to be a law which could potentially discourage individuals forum associating themselves with charitable organisations. The Lokpal and Lokayukta Act, 2013 is an act intended to regulate and control corruption in public institutions. Unfortunately, NGO's and charitable institutions which are voluntary organisations for public purpose and public good have also been included within the purview of this law.

Many charitable institutions receive funds from foreign sources and have high net worth individuals on their board and these individuals are reluctant to disclose their personal assets and make themselves vulnerable and exposed to extortionists and other anti-social elements, merely because of their involvement with a charitable institution in a purely honorary capacity. Several charitable institutions are 'partly financed' by the Central Government and the term partly financed is neither defined explained where this particular sub-clause is concerned.

There was a lot of lobbying against the implementation of this law and currently, due to the amendment made to section 44 of the Lokpal Act by the Lokpal and Lokayukta (Amendment) Act, 2016, the public servants (furnishing of information and annual return of filling returns) Rules, 2014 and all the amendments made there to have become redundant. At present there is no requirement for public servant to file declarations of their assets and liabilities.

The high-decibel protests put a scare in the congress led United Progressive Alliance (UPA) government at the centre and resulted in the Lokpal and Lokayukta Act 2013. The legislation came into force on January 16, 2014, but before the UPA could appoint a Lokpal, it was unseated by the Bharatiya Janata Party led National Democratic Alliance (NDA) in the general election four months later. The NDA is now six months later. The NDA is now six months away from completing its own term, but there is now Lokpal. The 2014 act also called upon states to appoint a Lokayukta within a year of its coming to force. But now 13 temporary vacancies, seven states haven't ever had a Lokayukta.

The act defined public servant to include current and former Prime Ministers, union ministers, members of parliament, government employees and employees of public sector undertakings, and key employees of non-governmental organisations receiving more than Rs 10 lakh a year in foreign contributions, among others. Current public servants will also have to publicly declare their assets and liabilities and those of their spouse and dependent children India rank a lowly 81 out of 18countries and territories on transparency. International's corruption perception Index. An anti-corruption plank was key to Narendra Modi's 2014 campaign, but the delay in appointing a Lokpal has given short shrift to it.

The amendment was regressive. "It's impossible to catch people red handed taking bribes. One of the ways is through assets disproportionate to their known sources of income which are in the names of spouses and dependent children", says Anjali Bhardwaj, an

activist. Hazare says the government is scared of the Lokpal since it could investigate complaints of corruption.

Lokayuktas in different states do not all enjoy the same powers. For instance, the Maharashtra Lokayukta does not have a police wing under it to investigate graft complaints, unlike in Karnataka. There is widely held perception that Lokayuktas are not empowered enough and state Eurasia governments try to weaken them.

In 2016, Karnataka set up on an Anti-Corruption Bureau (ACB), which has been challenged by private petitioners in Court on the premise that it eats into the powers of the Lokayukta, which has joined the case as a respondent .The ACB was created under the condition that it shall not investigate officers and politicians holding certain officers unless prior sanction is given by the government.

The West Bengal Lokayukta law has reportedly been amended to exclude the CM from its purview for bureaucratic and police appointments. Moreover, the efficacy of Lokayukta in tackling corruption has been questioned in the contest of very few complaints being filled in the first place. Venkatesh Nayak of the commonwealth Human Rights initiative says most complaints made to the Lokayukta are to do with maladministration and non-availability of government services rather than corruption. People's aversion to filling corruption complaints is not limited to Lokayukta alone. The Lokayukta institution, as has existed in several states mostly remains a toothless tiger. A report well summed up."The institution of lokpal is still born while that of the Lokayukta in states are ineffective".

In short, Corruption is a sinister epidemic that has a wide range of caustic effects on societies. It undermines democracy and the rule of law, leads to violations of human rights, distorts markets, erodes the quality of life and allows organized crime, terrorism and other threats to human security to flourish. This evil phenomenon is found in all countries – big and small, rich and poor – but it is in the developing world that its effects are most destructive. Corruption hurts the poor disproportionately by diverting funds intended for development, undermining a Government's ability to provide basic services, feeding inequality and injustice and dispiriting foreign aid and investment. Corruption is a key element in economic deficit and a major obstacle to poverty alleviation and development.

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Notes

- The word "Lokpal" is derived from the Sanskrit word "loka" meaning people and "pala" meaning protector or caretaker. Together it means "protector of people".
- The aim of passing such a law is it to eradicate corruption at all levels of the Indian polity
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- The aim of passing such a law is it to eradicate corruption at all levels of the Indian polity
- Lokapal - the word “Lokpal” has been derived from the Sanskrit word “loka” which means people, and “pala” meaning protector—ergo, “protector of the people”.
- Lokayukta may investigate any action taken by the public servant if it is referred by the state government. It is tasked with speedy redressal of public grievances. The complaint will not be taken up if there is any alternate remedy. The procedure of investigation, etc, is the same as that of the Lokpal.
- Ombudsman is a Scandinavian word. It means an officer or commissioner. In its special sense, it means a commissioner who has the duty of investigating and reporting to Parliament on citizens‟ complaints against the Government. An Ombudsman has no legal powers except power of inquiry. In simple words, Ombudsman is an officer of Parliament whose main function is to investigate the complaints or allegations against the administration. The main object of the institution of Ombudsman is to safeguard the citizens against misuse of the powers of the administration.

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E-GOVERNANCE

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Abstract

E-Governance or electronic governance can be defined as the delivery of government services and information to the public using electronic means. Such means of delivering information is often referred to as Information Technology or IT in short forms. Use of IT in government facilitates, an efficient, speedy and transparent process for disseminating information to the public and other agencies, and for performing government administrative activities. E-Governance is not only about introducing the use of technological tools, it is fundamentally about a change in mindset and work culture by serving variety of ends, better delivery of government services to citizens, improved government interactions with business and industry, citizen empowerment through access to information and participation for decision making and more efficient government management. Although the term 'e-Governance' has gained currency in recent years, there is no standard definition of this term. Different governments and organizations define this term to suit their own aims and objectives. Sometimes, the term 'e-government' is also used instead of 'e-Governance'.

The goal of e-Government is not merely to computerize all the governmental records, but to transform the government in such a way, where each and every citizen can access the government services through a website where all forms, laws, news and other information will be available. It also intends to create a cooperative structure between the government and the people; and to seek help and advice from the people, to make the government aware of the problems of the people. E-Governance improves the country's information and communication technology and electronic media, with the aim of strengthening the country's economy by keeping governments, people and businesses in tune with the modern world.

The successful use of ICT is to strengthen the governance structure and provide better services to the people. In India e-governance is regarded as a high priority policy, as it is considered as the only way to take IT to the common public. The use of internet offers services more efficiently, but it also brings more accountability between the government and people. The government as already initiated various electronic governance mechanisms, some among which are already launched.

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BIOCHEMICAL AND CYTOLOGICAL CHARACTERIZATION OF GYMNEMA SYLVESTRE (R.Br) ACCESSIONS

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Abstract

Genetic diversity assessment is very important to identify groups with similar genotypes and to conserve, evaluate and utilize the genetic resources. During the last twenty years, the classical methods to evaluate genetic diversity have been complemented by molecular techniques. Molecular markers are more promising tools to study genetic variation as any change in the protein sequence would be brought about by a mutation in its DNA sequence. Protein electrophoresis is increasingly being utilized as an additional approach for species identification and as a useful tool for tracing back the evolution of various groups of plants. For analyzing the genetic diversity and interrelationships among the different accessions of *G. sylvestre,* molecular marker systems involving SDS - PAGE protein polymorphism was employed. The total protein content of different accessions of *G.sylvestre* clearly indicates that protein concentration varied with accessions. The activities of polypehenol oxidase and peroxidase enzymes were also found varied in different accessions. The cytotoxicity studies revealed that increasing concentration of the plant extract and consequently increasing toxicity there was an inhibitory effect on cell division leading to chromosomal abnormalities.

Keywords: Genetic Diversity, Molecular Marker, *Gymnema sylvestre*, Protein Content, Cytotoxicity.

Introduction

Plants represent unlimited sources of natural products. Biologically active compounds are accumulated in plants especially as secondary metabolites that have been used as a source of major phytopharmaceuticals ranging from anticancer activity, phosphodiesterase inhibition to cytotoxicity against HIV infected cells. There has been an explosive demand for herbal plants and extracts which can be used to improve human health and well being. In recent times focus on plant research has increased all over the world and a large body of evidence has collected to show immense potential of medicinal plants used in various traditional systems. The extraction cost of metabolites influences the market value of metabolite based drugs. Hence there is a need for identification and characterisation of elite genotypes with quality and yield. In the present scenerio, the assessment of genetic and chemical diversity is the most eminent approach for identification and characterisation of chemotypes. Molecular markers have provided a powerful approach to analyze genetic diversity and evolutionary relationships among and within germplasm accessions in many crop species. Molecular markers assisted genetic analysis provides a means to locate and select genes controlling important agronomic, pest resistance, stress tolerance, and food quality traits .Electrophoretic analysis of proteins offers an efficient and cost effective method towards cultivar identification (Sammour, 1999). Protein polymorphism serves as genetic markers as they are direct products of active genes and are quite polymorphic and generally heritable. The polymorphism observed in the protein profiles reflects the changes in the active part of the genome.

Biochemical markers such as proteins and isozymes have served as an important tool to detect genetic relationships in plants (Mukhlesur et al., 2004). Isozymes are good estimators for elucidating the possible mechanisms leading to the formation of genetic variability in plant populations (Zeidler, 2000). It is widely used in the studies of inter and intra-specific variation. They also show lower levels of polymorphism in a population where the expression of various isozymes differs both temporally and spatially which can correctly identify several levels of taxa, accessions and individuals since the assumption of homology can be more accurate than for same genomic DNA markers (Smila et al., 2007).

The present study conducted in various accession of *Gymnema sylvestre*. (Plate -1 fig 1) It is a slow growing large perennial and medicinal woody climber distributes throughout in India. G. sylvestre is a potent antidiabetic plant and used in folk, ayurvedic and homeopathic systems of medicine. It is also used in the treatment of asthma, eye complaints, family planning, snakebite, urinary complaints, stomach problems, piles, chronic cough, breathing troubles, colic pain, cardiopathy, constipation, dyspepsia and hemorrhoids, hepatosplenomegally. In addition, it also possesses antimicrobial, antihypercholesterolemic, anti- inflammatory and sweet suppressing activities and it also acts as feeding deterrents to caterpillar.(Potawale et.al,2008).The present study was conducted to assess the genetic diversity in Gymnema accssions using polypetide markers and to quantify the protein

content Another goal of this study is the isolation and assay of isozymes(polyphenol oxidase and peroxidase) as well as to evaluate the cytotoxicity of the plant extract.

Materials and methods

Plant material

Three different accessions of Gymnema were collected from three different districts of Kerala state, Thiruvanthanapuram, Kollam and Alappuzha. The plant was taxonomically identified by referring to standard flora (Gamble, 1967; Sasidharan, 2004). The collected plants were grown initially in pots and maintained under identical growth conditions at green house of botanical garden in SN College ,Kollam.

1) **Estimation of total Protein**

Estimation of total protein in the leaf by Bradford method.

2) Protein profiling

To study the protein profile from young leaf blades from tillering or flowering stage, well known SDS-PAGE (Sodium dodecyl Sulphate Polyacrylamide Gel Electophoresis) system was used.

Data analysis

Relative molecular weight of polypeptide bands were calculated by comparing bands of the protein molecular weight marker.

3) Isozyme analysis

Fresh leaf extract is used for this analysis.

Isolation and assay of peroxidase

Guaiacol is used as the substrate for the assay of peroxidase. The rate of formation of guaiacol dehydrogenation product is the measure of the peroxidase activity and can be assayed at 436nm.1gm of plant tissue is weighed and grinded in 20ml of 0. 1M Phosphate buffer pH 6. Homogenate was filtered through a cheese cloth and centrifuged at 10000rpm for 10minutes supernatent was collected from centrifugation tube. For assay, 2 ml of 0.1M Phosphate buffer of pH 7, 1ml of 20mM Guaiacol, 0-5 ml of 10mM Hydrogen peroxide and 0.5 ml enzyme from fridge is used as the test solution. 3 M1,1M Phosphate buffer of pH 7 and 0. 5 ml enzyme is used as the blank solution. OD is measured.

Isolation and assay of polyphenol oxidase

Phenol oxidases are copper containing enzymes which catalyze the oxidation of certain phenolic substrate to quinones, which are autoxidized dark brown pigments. Polyphenol oxidase is very stable at low temperature. 0. 1M Citrate phosphate buffer was prepared by dissolving 4.2g of 0.2M citric acid in 100ml distilled water and 3.56g of 0.2M dibasic sodium

phosphate in 100ml distilled water. 0.5% catechol prepared by dissolving 50mg in 10ml phosphate buffer.

Isolation of enzyme

1 g of fresh leaf tissue grinded in 10ml chilled 0. 1M Citrate phosphate buffer of pH 7. Homogenate filtered through a cheese cloth and centrifuged at 10000 rpm for 20 minutes at 5°C. Supernatent was collected and stored in refrigerator.for assay, 2.5 ml

0.1 M citrate phosphate buffer, 1 ml catechol (0.5%) and 0. 5 ml of enzyme is the test solution. 3 ml citrate phosphate buffer and 1 ml of catechol is the blank solution. OD is measured at 420nm.

4) Cytological studies

Extracts of *Gymnema* leaves were prepared using a homogenizer and diluted various concentrations as needed and stored in labeled bottles. The locally available Onion bulbs (Allium cepa, 2n=16) of equal size were chosen as the test material. The bulbs were grown in pots containing sand and sufficient water was given. When fresh roots came out and developed up to 2-3 cm long, the bulbs were taken out, washed and kept in bottles containing different concentrations of *Gymnema sylvestre* leaf extract (25%, 50%, and 100%).Distilled water was used as the control.Cytological preparations weremade according to haematoxylin squash technique devised by Marimuthu and Subramanyam (1960) & mitotic index was calculated.

Results and discussion

Estimation of protein

The amount of total proteins varied in different accessions and ranged from 13.405 to10.98 mg /gm tissue. The highest total protein content was detected in accession collected from Thiruvananthapuram and the lowest in accession from Kollam (Table.1).

Locations	Protein content (mg/gm tissue)
Trivandrum	13.405
Kollam	10.071
alappuzha	10.98

Polypeptide polymorphism

The total foliar proteins resolved on SDS-PAGE showed blue coloured bands with distinct qualitative and quantitative variations at intra specific level in terms of number, protein and band intensity. A total of 34 bands were scored among the three *Gymnema sylvestre*

accessions studied. Of these 34 bands, 32 were polymorphic and 2 were monomorphic. 94.11% polymorphism was observed in the protein profile. Each region expressed different proteins which act as representative of the expression of a particular gene of the studied *Gymnema* species. Among the three accessions of *Gymnema*, that from Trivandrum showed maximum number of protein bands and accession from Alappuzha showed minimum number (9) of protein bands. (fig: 2).Unique banding patterns observed among the three accession of *Gymnema* species acts as fingerprint of the selected accessions. Such finger printing is useful in differentiating the accessions and act as biochemical markers for identifying the accessions. These banding profiles will also facilitate the identification of the medicinally important *Gymnema* accessions in plant systematic studies. Similar to the present study, the similarity and variation among the plant species using SDS-PAGE have been carried out by many researchers (Smila et al., 2007; Johnson et al.,2009; Babu Nanthini et al., 2011; Johnson et al., 2012).The present study explores the existing polymorphic proteins through SDS-PAGE to facilitate the characterization of *Gymnema sylvestre*. Bands that consistently show up on each samples are very likely representative of the polypeptides, that characterize the plant. Additional bands are occurring due to change in environmental conditions of the different locations from which the samples were collected. Gardiner et al (1986) and Gardiner and Ford (1987) stated that electrophoresis can also be used to compare plants of different geographical origin and also to provide taxonomically useful descriptors that are substantially free from environmental influence. In the present investigation, the total protein polymorphism across three accessions is comparatively low.

Isolation and assay of isozymes

Peroxidase enzyme activity

Guaiacol is used as substrate for the assay. The accession from Thiruvananthapuram showed highest activity, reaching up to 0.28 Eu/gm tissue. The activity of the remaining accessions was 0.16 Eu/gm tissue (Kollam) and 0.08 Eu/gm tissue (Alappuzha).Result indicated that peroxidase activity were varied in different accessions used. (Fig. 3). An increase in peroxidase activity has been reported as an early response to different stresses and may provide cells with resistance against formation of H_2O_2 which is formed when plants are exposed to stress factors and so cause change in plant metabolism (Castillo, 1992). Peroxidase is also involved in a large number of biochemical and physiological processes and may change quantitatively and qualitatively during growth and development (Zhi, 2003). In biotechnology and associated research areas (enzymology, biochemistry, medicine, genetic, physiology, histo-and -cytochemistry), peroxidase have conquered a prominent position and it remains the major enzyme used to evaluate the heat processing of plants (Adams JB, 1977). The investigation of this enzyme may be interest not only for its negative effects on color and flavour degradation of pigme but has a positive impact on its medicinal value. Despite the variety of pl peroxides sources, there is no previous work on peroxidase from *Gymnema sylve* leaves.

Polyphenol oxidase

The polyphenol oxidase activities in the accessions were found between 0.12 - 0.8 gm tissue. The highest activities of polyphenol oxidase was found in Thiruvananthapuram accession whereas the lowest activity of the enzyme was fo in the accession collected from Kollam (Fig.4). Polyphenol oxidase, a co r containing enzyme, oxidized phenolics to highly toxic quinines and is involved in terminal oxidation of diseased plant tissue and is attributed for its role in dise s resistance. (Barilli, 2010). The enzyme has been shown to exist in multiple and i r convertible forms and is widely distributed in plant kingdom. It is well known that the enzyme plays an important role in the browning reaction in fruits and vegetables. It has been suggested that the polyphenol oxidase enzyme might be associated with many important physiological functions such as growth and differentiation (Nitesh et al., 2010).

PLATE-1

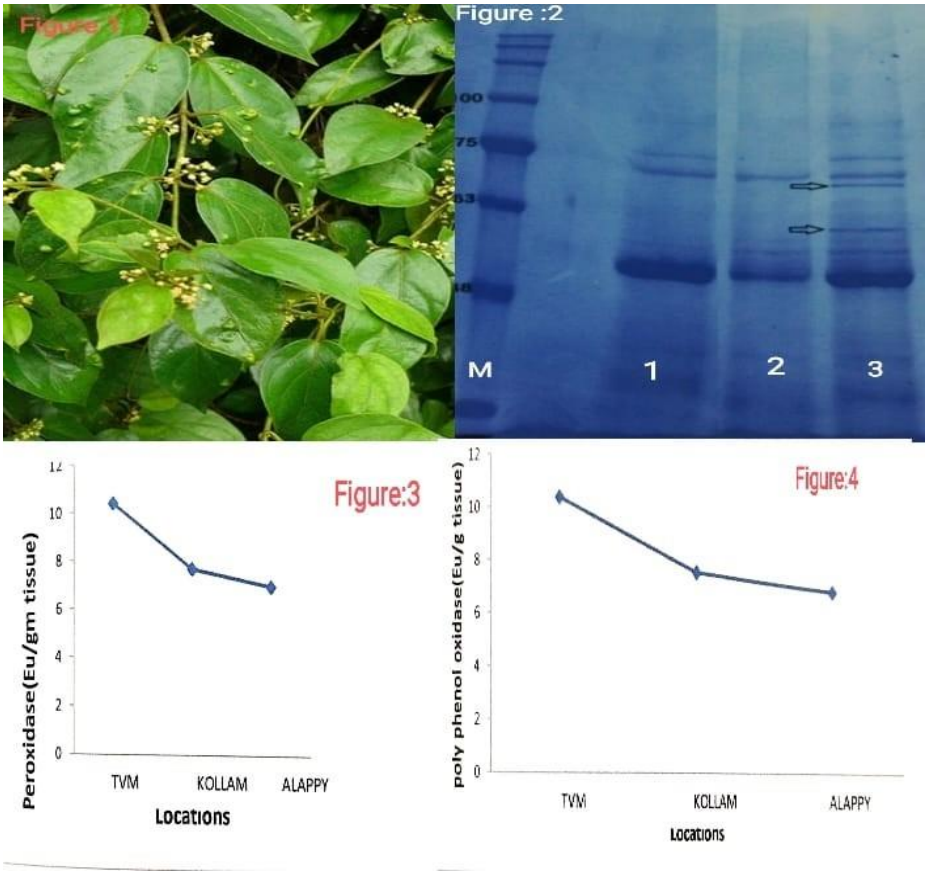

PLATE -1: Figure 1- Habit of *Gymnema sylvestre,* **Figure 2**- SDS-PAGE profiling of foliar proteins in *Gymnema sylvestre*. figure legends: M-Marker protein,1,2 and 3- Accessions of *G. Sylvestre* from Kollam, Alapuzha and Trivandrum. **Figure 3-** Graphical representation of peroxidase in accessions collected from different locations. **Figure 4-** Graphical representation of poly phenol oxidase activity in accessions collected from different locations

Cytotoxicity studies

Disturbances of mitosis

Good root growth was achieved in the control. At tested concentrations, root growth was highest at the 1% concentration of all the extracts while it was least at 50%. Inhibition of root growth was concentration dependent. In the entire samples restricted root growth implying toxicity was noted. All the tested extracts induced disturbances of the mitotic spindle disturbances at various concentrations. In the control roots, besides typical stages of mitosis, stickiness, abnormal metaphase and polyploidy occurred. The lowest (25%) concentration induced three additional types of mitotic disturbances, including chromasomal bridges, polyploidy and c-mitosis (Fig. 7). Delayed anaphase and C-mitosis were the most common effects followed by chromasomal breaks and bridges. On the other hand, 50% concentration caused as much as four mitotic abnormalities that were not observed in the control (Fig. 6) that is sticky metaphase (Fig. 6. 3 & 6. 7), fragmentation (Fig 6. 4), laggard chromosome (Fig. 6. 5), delayed progression of prophase to metaphase (Fig. 6. 2 & 6. 8). The maximum abnormalities was observed after the treatment with higher concentration of leaf extract, mostly due to high number of chromosome bridges and sticky chromosomes, as well as appearance of irregular anaphase (Fig. 5. 1 & 5.4), laggards (Fig. 5.7), vagrant chromosomes (Fig. 5. 5, 5. 9 & 5. 11)

The stickiness of the chromosome observed in here may due to any upset in the spindle formation (Borah and JantaTalukar, 2002). However Onyenwe (1983) opined that stickiness may result from DNA depolymerization, partial dissolution of nucleoprotein, breakage and exchange of folded units of chromatids and the stripping off of the protein coat of DNA. Single, double and multiple chromatin bridges were found. Chromosomal bridge formations have been attributed to chromosome breakage, stickiness and reunion of broke ends. The stickiness in turn ensured gluing together of chromosomal ends, leading to the formation of connecting bridges (Bada et al., 1992). Such chromosomal bridges eventually result in inhibition of cytokinesis causing mitotic arrest. In the roots treated with 100 percentage extract increase in the number of all mitotic abnormalities was mainly the result of huge c-metaphases enhancement and moderate number of chromosome bridges (Fig.5).

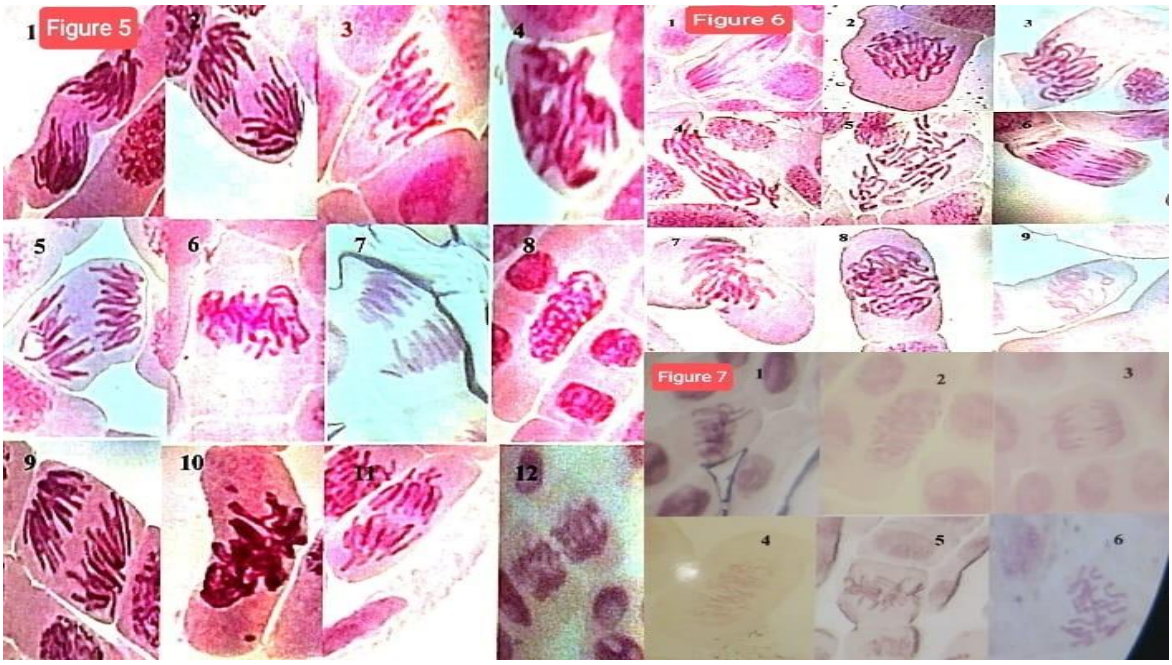

PLATE-2 **Figure 5:** 1) Irregular anaphase 2) Chromosome fragmentation 3) Sticky metaphase 4) Delayed anaphase 5, 9 & 11) Vagrant chromosomes 6) Abnormal metaphase 7) Laggards 8) Abnormal spiralization 10) Chromosome stickiness 12)Chromosome bridge.

Figure 6: 1) Chromosomal Bridge 2&8)Delayed progression of prophase to metaphase 3&7)Sticky metaphase 4)Fragmentation 5) C-mitosis 6)Laggard chromosome 9)Abnormal metaphase.

Figure 7:1) Abnormal Metaphaseic 20Thickiness 3)Chromosomal Bridge 4)Polyploidy 5)Disrupted Metaphase 6) C- Mitosis

Mitotic index

Leaf extract treatment induced progressive decrease in mitotic index as function of increased concentration. All the tested concentration of the extract diminished the number of dividing cells in *A. cepa* root meristem. The most pronounced effect was noticed in low (25%) concentration, while the least after incubation in high (100%) concentration. Additionally, proportion of mitotic phases (mainly prophases and telophases) in MI value changed with concentration. The highest mitotic index value in treated group was 10.36 at very low concentration (25%) whereas the lowest value (6.95) was found in the highest concentration. The results shows in table 2.

Table 3: Mitotic index at different concentration

Concentration (%)	Mitotic index
25	10.36
50	7.65
100	6.95

Conclusion

In this particular study, the protein profiles revealed a greater number of polymorphic markers; the variability generated using polypeptide profile was high. In the result of total protein content it clearly indicates variation in different accessions.in the case of peroxidase and polyphenol ,the results also varied with different accessions. Finally the cytotoxicity studies shows that with increasing concentration of the plant extract and consequently increasing toxicity and also the result indicates the presence of various types of chromosomal abnormalities.

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SYNTHESIS, CHARACTERIZATION AND BIOLOGICAL STUDIES OF TRANSITION METAL COMPLEXES OF Mn(II), Cu(II) AND Zn(II) WITH AN AZO DYE (E)-4-((2,6-DIHYDROXYPHENYL) DIAZENYL) BENZOIC ACID

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ABSTRACT

The present work includes the synthesis and characterization of complexes of (E)-4-((2,6-dihydroxyphenyl) diazenyl) benzoic acid with metal ions Mn(II), Cu(II) and Zn(II) and characterized by elemental analysis, spectroscopic data including FT-IR, 1H-NMR and Electronic spectra. It has been found that the azodye behaves as a neutral bidentate N, O donor which chelates with the metal ions Cu(II) and Mn(II) in 1:2 and with Zn(II) in 1:1 stoichiometry. Magnetic moment and electrolytic conductance data confirms this. The azodyes and complexes were screened for antimicrobial activity. The ligand and the complexes show better antimicrobial activity.

Key words: 4-amino benzoic acid, resorcinol, antimicobialactivity NMR spectra

Introduction

Many of the metal complexes are deeply colored and are used as dye and pigment before they were recognized as co-ordination compounds.1 The structure and constitution of metal complexes of azo dyes are extensively studied by co-ordination chemists. It was Morgan and his students, who made significant contribution on the importance of co-ordination chemistry in dyeing technology. Variation in color or shade, resulting from changes in metal ion present in the bath, as on the fiber during dyeing supports the formation of co-ordination compounds.2,3

The azo dyes having a donor group in the ortho position to the azo group, are generally chelating agents. Stability and unstability refers to the position of equilibrium, ie, to the equilibrium constant. This constant is a measure of enthalpy and entropy changes and hence a thermodynamic property. The thermodynamic stability of metal chelates is influenced by the basicity of the ligand , chelate ring size, number of chelate rings per ligand and nature of metal. The stability of metal complexes increases with increase in basic strength.4 It is found that the chelate ligands form stable complexes than those formed by their mono-dentate

analogues. The chelate stability arises largely from favorable entropy changes.5 In this work we have prepared an azo dye from resorcinol and 4-amino benzoic acid; (RABA). The complexes of Zn(II), Mn(II) and Cu(II) were prepared using RABA.

EXPERIMENTAL

PREPARATION OF LIGAND

The ligand used for the present study is resorcinol azo benzoic acid [RABA]. 3.425g of 4-aminobenzoic acid was dissolved in 14ml 1:1 HCl. Then it is cooled. This solution was diazotized by using a cooled solution of 1.725g of NaNO2 in 10ml of water. This solution was filtered and cooled. Prepared another solution by dissolving 2.75g of resorcinol in 22.5ml 2%NaOH. Into this the diazotized mixture was added with constant stirring. The red precipitate obtained was allowed to attain room temperature. It was suction filtered and dried over anhydrous CaCl2 in a decicator.

PREPARATION OF COMPLEXES

The complexes are synthesized by a general method. Methanolic solution of the metal salt(0.01mol) and ligand(0.01mol) are mixed. The ligand solution is added gradually in small portions with good stirring to the metal salt solution when sudden color change was occurred indicating the complex formation. Then it was kept under reflux for 2-3 hours, on a water bath for completion of reaction. Afterwards, the solid complexes formed were filtered, washed with ethanol to remove excess ligands. It was then dried in vacuum decicator.

Materials and methods

All the chemicals used are of analytical grade and purchased from Merck. The complexes were analyzed for metal and halide content by standard methods [8]. The electrical conductance of the complexes in methanol and DMF (10-3 m solution) were measured at room temperature using a Systronics direct reading conductivity meter. The Infrared spectra of the ligands and complexes were recorded in the range of 4000-400 cm-1 on a Perkin Elmer spectrum 65 IR spectrophotometer. Electronic spectra of the ligands and the complexes in methanol were measured in the range 200-900 nm on Perkin Elmer Lamda 25 UV-Visible spectrophotometer. The Elemental analyses (C, H, N) were carried out on a Vario EL-III CHN Elemental analyzer at the SAIF, Cochin University of Science and Technology. The magnetic moments were measured at room temperature on a Sherwood Scientific magnetic susceptibility meter.. The proton NMR spectrum of the ligand and zinc complex was recorded in Brucker, AscendTM 400 NMR spectrometer at 400MHz.

Results and discussion

The complexes reported here are stable, colored and non-hygroscopic amorphous solids. They are partially soluble in acetone and methanol, and completely soluble in DMSO, but insoluble in water, chloroform and ethanol.

The microanalytical data are shown in the table 1 given below. The experimental values are in good agreement with the theoretical values. Based on the elemental analysis , the empirical formulae of Zn(II), Mn(II) and Cu(II) complexes can be formulated as $[Zn(RABA)(H_2O)_2]CH_3COO^-$, $[Mn(RABA)_2(H_2O)_2]$ and $[Cu(RABA)_2]$ respectively.

Table 1

Compound	Carbon %		Hydrogen%		Nitrogen %		Oxygen %		Metal %	
	Cal	Obs	Cal	Obs	Cal	Obs	Cal	Obs	Cal	Obs
RABA	60.47	60.54	3.88	3.81	10.85	10.91	24.81	23.5	-	-
$[Zn(RABA)(H_2O)_2]$ CH_3COO^-	43.53	43.57	3.63	3.67	7.81	7.78	26.79	26.71	18.24	18.27
$[Mn(RABA)_2(H_2O)_2]$	51.58	51.52	3.64	3.61	9.26	9.30	26.45	26.47	9.08	10.01
$[Cu(RABA)_2]$	54.03	54.10	3.12	3.08	9.70	9.63	22.16	22.21	11.00	10.98

The magnetic moment value calculated for Mn(II) and Cu(II) complexes are 6.12 BM and 1.81 BM respectively. The magnetic moment value supports octahedral structure for Mn(II) complex and square planar structure for Cu(II) complex.The molar conductance of the complexes (10^{-3} molar concentration) were carried out in DMSO indicated that Mn and Cu complexes are non-electrolytes[6]. But Zn(II) comples act as 1:1 electrolyte.The values are presented in the table 2 below.

Table 2

Complex	Molar Conductance in DMSO ($ohm^{-1}cm^2mol^{-1}$)	Assignment
$[Zn(RABA)(H_2O)_2]CH_3COO^-$	65	1:1electrolyte
$[Mn(RABA)_2(H_2O)_2]$	27	Non-electrolyte
$[Cu(RABA)_2]$	32	Non-electrolyte

UV-Visible Spectra

Table 3

Compound	λ_{max} (nm)	Assignment
RABA	393	$n\rightarrow\pi^*$
	259	$\pi\rightarrow\pi^*$
$[Mn(RABA)_2(H_2O)_2]$	394	$n\rightarrow\pi^*$
	259	$\pi\rightarrow\pi^*$
	648	d→d transition
$[Cu(RABA)_2]$	390	$n\rightarrow\pi^*$
	259	$\pi\rightarrow\pi^*$
	597	$^2B_{1g}\rightarrow{}^2E_g$
	684	$^2B_{1g}\rightarrow{}^2B_{2g}$

Table 3 shows The ligand is characterized by two absorption bands in the UV region. A high intensity band at 393nm is attributed to $n\rightarrow\pi^*$transition and low intensity band at 259nm is attributed to $\pi\rightarrow\pi^*$ transition of azo group. The absorption bands in the complexes are shifted and new bands are appeared due to d→d transition. The band at 648nm in Mn(II) complex suggests an octahedral geometry to the complex. The bands at 597nm and 684nm in Cu(II) complex suggests a square planar geometry to the complex.[7]

FT**-IR Spectra**

The IR spectral data of the ligand RABA and complexes with Zn(II), Mn(II) and Cu(II) are in agreement with an expected range. The band at 1477cm^{-1} in the ligand is attributed to azo group. This is shifted to 1417cm^{-1}in Zn complex, 1412cm^{-1} in manganese complex and 1420cm^{-1} in copper complex suggesting a coordination of metal ion to nitrogen of azo group. The band at 1242cm^{-1} in the ligand is attributed to C-O stretching. This is shifted to 1236cm^{-1} in Zn complex, 1241cm^{-1} in manganese complex and 1229cm^{-1} in copper complex. The carbonyl absorption of ligand and complexes are given by the bands at 1602cm^{-1} (in ligand), 1597cm^{-1} (in Zn complex), 1596cm^{-1}(in Mn complex) and at 1601cm^{-1}(in Cu complex).

Table 4

RABA ($\bar{\upsilon}$ cm^{-1})	$Zn(RABA)(H_2O)_2]CH_3COO^-$ ($\bar{\upsilon}$ cm^{-1})	$[Mn(RABA)_2(H_2O)_2]$ ($\bar{\upsilon}$ cm^{-1})	$[Cu(RABA)_2]$ ($\bar{\upsilon}$ cm^{-1})	Assignment ($\bar{\upsilon}$ cm^{-1})
1477	1417	1412	1420	$\bar{\upsilon}_{N=N}$
1242	1236	1241	1229	$\bar{\upsilon}_{C-O(chelated)}$
1602	1597	1596	1601	$\bar{\upsilon}_{C=O(free)}$
–	778	728	768	$\bar{\upsilon}_{M-N}$
–	690	667	653	$\bar{\upsilon}_{M-O}$

NMR Spectra

Proton NMR spectra of the ligand RABA shows the following signals: Multiplet of aromatic proton of the benzoic acid part at 7.6 -8.1 ppm. Multiplet of aromatic proton of the resorcinol part at 6.3 -6.6 ppm. Singlet signal due to –OH of –COOH group at 12.39 ppm. Singlet signal due to –OH of resorcinol part at 10.89 ppm.

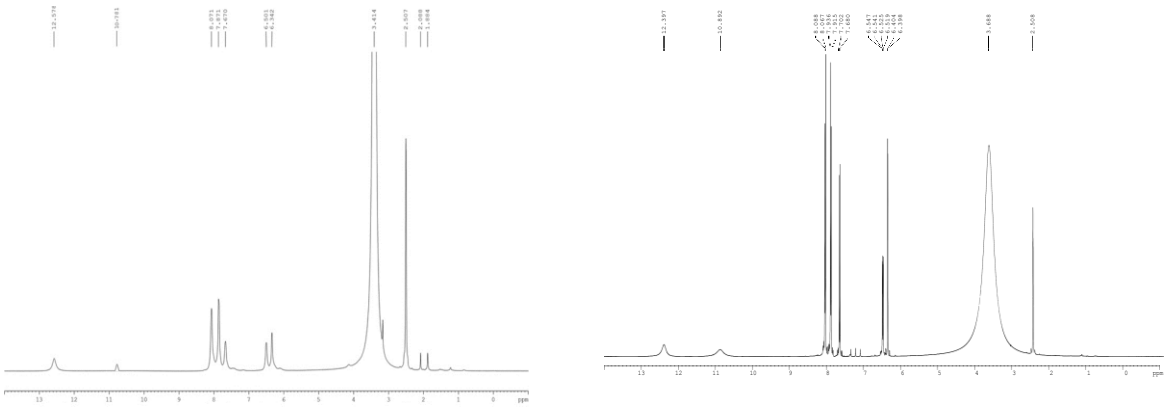


Fig: 1 NMR Spectrum of zinc complex,$[Zn(RABA)(H_2O)_2]CH_3COO^-$ Fig:1NMR Spectrum of ligand (RABA)

The Proton NMR spectrum of the Zn(II) complex shows the following signals: Multiplet of aromatic proton of the benzoic acid part at 7.6 -8.1 ppm. Aromatic proton of the resorcinol part shows a multiplet at 6.3 -6.5 ppm. Singlet obtained due to –OH of –COOH group at 12.57 ppm. Singlet signal of –OH (resorcinol part) is obtained at 10.79 ppm. From the spectra of the ligand and the complex we can confirm that one of the –OH group in the resorcinol is coordinated to the metal. The less intense peak at 10.78 ppm indicates the second –OH group of the resorcinol remain unchanged in its position. It is not coordinated to the metal.

On the basis of these observations and discussions it can be suggested that RABA is acting as a bidentate ligand. The Zn(II) and Cu(II) complexes have co-ordination number four and

assumes tetrahedral and square planar geometry respectively and Mn(II) complex has co-ordination number six and assume octahedral geometry.

The proposed structures for the complexes are shown in Fig. 3 ,4 and 5.

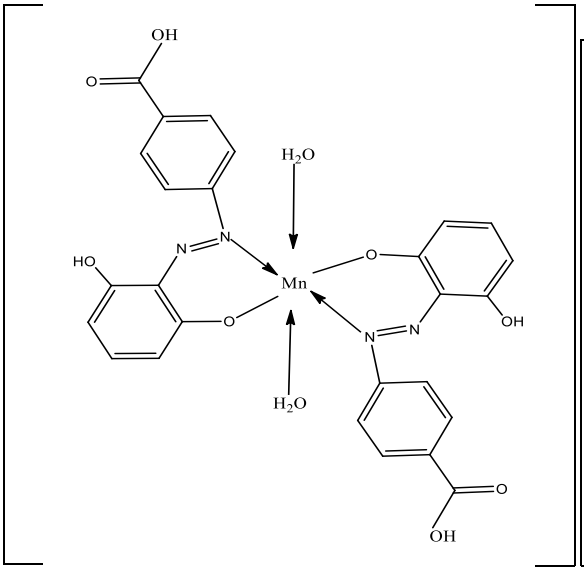


Fig:3 Proposed structure for [Mn(RABA)$_2$(H_2O)$_2$]

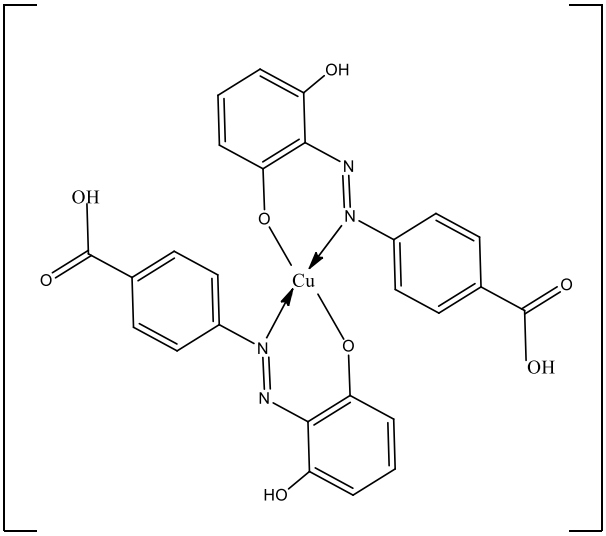


Fig:4 Proposed structure for [Cu(RABA)$_2$]

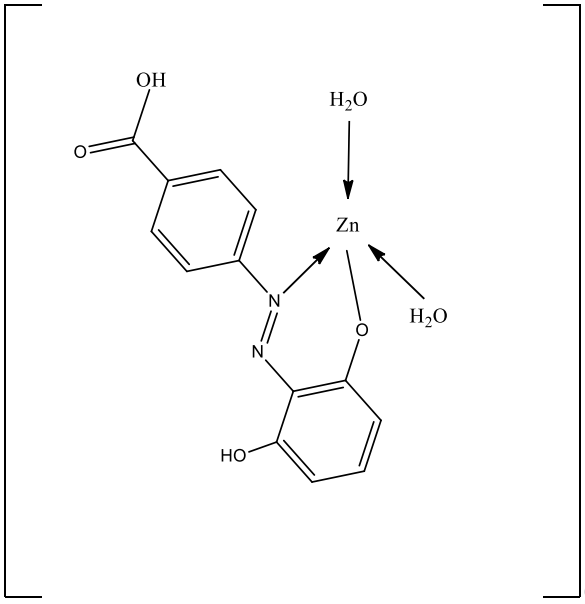


Fig:5 Proposed structure for [Zn(RABA)(H_2O)$_2$]CH_3COO^- Fig:

ANTIBACTERIAL ACTIVITY

The invitro biological screening effect of the investigated compounds were tested againt the bacteria Staphylococcus aureus by using Agar-well diffusion method by taking DMSO as solvent. The result indicates that the [Mn(RABA)$_2$(H_2O)$_2$] shows greater antibacterial activity than RABA against Staphylococcus aureus. Stock concentration 10mg/ml.

Organism: Staphylococcus aureus

Sample	Concentration (μg/mL)	Zone of inhibition (cm)
Ligand RABA	Streptomycin (10μg)	3.5
	250	Nil
	500	Nil
	1000	1.0

Sample	Concentration (μg/mL)	Zone of inhibition(cm)
Mn complex $[Mn(RABA)_2(H_2O)_2]$	Streptomycin (10μg)	3.5
	250	Nil
	500	Nil
	1000	1.3

ANTIFUNGAL ACTIVITY

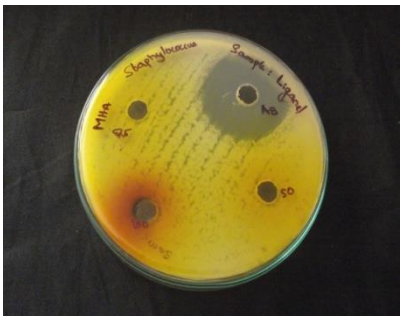
The antifungal activity was determined by Agar well diffusion method. Concentration of Stock: 10mg/ml

Organism: Candida albicans

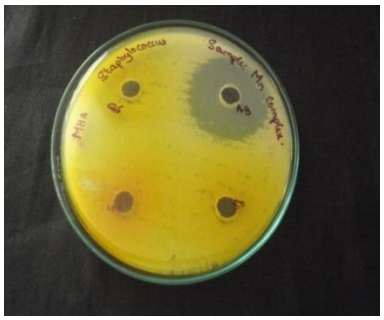
Sample	Concentration (μg/mL)	Zone of inhibition (cm)
Ligand RABA	Clotrimazole	1.5
	250	Nil
	500	Nil
	1000	1.0

Sample	Concentration (μg/mL)	Zone of inhibition (cm)
Mn complex $[Mn(RABA)_2(H_2O)_2]$	Clotrimazole	1.5
	250	Nil
	500	Nil
	1000	1.3

The result indicates that the $[Mn(RABA)_2(H_2O)_2]$ shows greater antifungal activity than RABA against Candida albicans.

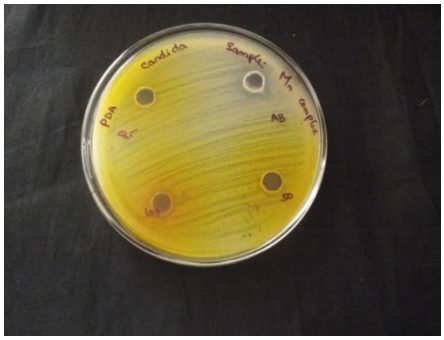


Antibacterial activity of ligand (RABA)



Antibacterial activity of $[Mn(RABA)_2(H_2O)_2]$

Antifungal activity of ligand (RABA)



Antifungal activity of $[Mn(RABA)_2(H_2O)_2]$

Conclusion

An azo dye is prepared from resorcinol and 4-amino benzoic acid; (RABA). The complexes of Zn(II), Mn(II) and Cu(II) were prepared using RABA. Characterization of the ligand and complexes has been done on the basis of analytical and physico chemical methods. From their spectral and magnetic data it is concluded that the manganese complex possess octahedral geometry having the formula $[Mn(RABA)_2(H_2O)_2]$ and copper complex possess square planar geometry having formula $[Cu(RABA)_2]$. Tetrahedral geometry is assigned for the zinc complex $[Zn(RABA)(H_2O)_2]$ on the basis of conductance measurements, IR and NMR spectral studies. The ligand and metal complexes were screened for their biological activities against Staphylococcus aureus and Candida albicans. The ligand and the complexes show better antimicrobial activity.

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THE QUALITATIVE ANALYSIS OF PHYTOCONSTITUENTS OF SIDA ROMBIFOLIA L.

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ABSTRACT

Malvaceae family member *Sida rhombifolia* is frequently used in Ayurvedic medicine to treat infectious infections, fever, diarrhoea, and as a diuretic. It has been discovered that the plant contains a number of bioactive chemicals with therapeutic properties. Today's medications used to treat a variety of disorders are often based on plants and plant-based products. Many species of *Sida*, also referred to as "Bala," are known to have analgesic, anti-inflammatory, hypoglycemic, and hepatoprotective properties. In the current study, *Sida rhombifolia* leaves were subjected to phytochemical screening utilising six different solvents, including acetone, alcohol, chloroform, petroleum ether, and benzene. Standard techniques were used to screen the qualitative phytochemical content of the extracts made from powdered plant components. phytochemicals examined were discovered in different solvent extracts of *Sida rhombifolia* L. This research proved that the chosen plant species is a potent source of helpful medicines. However, additional research in this area is necessary for a full investigation, including qualitative, to characterize its chemical structure and evaluate its biological activities.

Introduction

In the Family Malvaceae, *Sida rhombifolia*, often known as arrowleaf sida, is a perennial or occasionally annual plant that is indigenous to the tropics and subtropics of the Old World. For the treatment of infectious infections, fever, diarrhoea, and diuretics is frequently used in Ayurvedic medicine. *S. rhombifolia* is a woody, variable-year or perennial bush that grows to a height of about 1.5 metres. It has symmetrical hairs and sharp branches. The leaves have a short petiole, are rhomboid-lanceolate to pointy, unpleasant at the top and bottom, and measure up to 5 mm by 18 mm in size. According to reports, the plant has a number of bioactive chemicals with therapeutic properties. Particularly in warmer locations, it is a global species. It is a little shrub or woody herbaceous plant with stems that are upright. It is

employed as an emollient and demulcent for conditions affecting the stomach, including as discomfort, indigestion, flatulence, and gastritis. It has also been demonstrated to have hepatoprotective and restorative properties (CSIR,1999 and ICMR 2005). Different *S. rhombifolia* morphological components have been the subject of numerous biological activity studies. When hyper bilirubinemic rats were given aqueous extract of the leaves, this plant's potential as a source of novel medications for those with the condition was demonstrated (Mohd FF 2012). It is said that *Sida rhombifolia* can treat a variety of diseases, including rheumatism, seminal weakness, and diarrhoea (Rainsford KD, 1980).

Materials and Methods

Collection of plant material

Five separate places throughout Kollam were used to collect the *Sida rombifolia,* L. Plant pieces were collected and dried in the shade for ten days. To prevent microbiological contamination, there was continuous monitoring. To create a fine powder, the dried plant material was taken and pounded in a mortar and pestle. To obtain finer particles, the powder was again run through a 2 mm screen. The powdered samples were kept in a clean glassware container and kept at a low temperature until analysis was required. (Das *et al*., 2010).

Preparation of plant extracts

A sample weighing 5 grammes was obtained, dried and pulverised. It was put in acetone, petroleum ether, chloroform, ethyl alcohol, benzene, and distilled water individually. 24 hours of continuous stirring while the mixture was mixed and extracted on a stirrer. The extracts were centrifuged for clarity after extraction, filtered through Whatman No. 1 filter paper, and then kept for additional phytochemical research. (Das *et al*., 2010).

Qualitative test for phytochemical detection

Numerous phytochemical components, including carbohydrates, alkaloids, saponins, phytosterols, glycosides, phenols, tannins, flavonoids, steroids, and terpenoids were analysed using the protocols outlined below (Harborne, 1998).

A. Test for Carbohydrates

Benedict’s test: - In order to confirm the presence of carbohydrates, the test solution was combined with a few drops of Benedict's reagent (an alkaline solution containing cupric citrate complex) and heated in a water bath. The production of a reddish-brown precipitate was then seen.

Fehling’s Test: - Filtrates were heated with Fehling's A & B solutions after being hydrolysed with dilute HCl, neutralised with alkali, and hydrolysed presence of reducing sugars is shown by the precipitation of red colour.

Molisch’s Test: - Two drops of an alcoholic -naphthol solution were applied to filtrates in a test tube. The violet ring that forms at the junction denotes the presence of carbohydrates.

B. Test for Alkaloids

Wagner's Test: - A portion of the extract was subjected to 3–5 drops of Wagner's reagent, which is a solution of 1.27g of iodine and 2g of potassium iodide in 100ml of water, to detect the presence of alkaloids by looking for the development of a reddish-brown precipitate (or coloration).

Mayer's Test: - Mayer's reagent was used to process the filtrates (Potassium Mercuric Iodide). Alkaloids are present when a precipitate with a yellow hue form.

C. Test for Saponins

Foam Test: - A test solution and water mixture were agitated to create froth, which should remain stable for 15 minutes. This outcome suggests that saponins are present.

Froth Test: - Using 20ml of distilled water as a dilution, the extracts were shaken in a graduated cylinder for 15 minutes. Saponins are present when a layer of foam measuring 1 cm thick forms.

D. Test for Phytosterols

Salkowski's Test: - Chloroform was used to process and filter the extracts. Conc. Sulphuric acid was added to the filtrates in little amounts, agitated, and left to stand. Triterpenes are present if they have a golden yellow appearance.

E. Test for Glycosides

Liebermann's test: - 2ml of acetic acid and 2ml of chloroform were combined with the crude extract. Ice was used to chill the concoction. A carefully diluted H_2SO_4 solution was added.

The presence of the steroidal nucleus, which is the glycine part of the glycoside, was shown by a colour shift from violet to blue to green.

Salkowski's test: - Two millilitres of chloroform were combined with crude extract. Afterward, 2ml of concentrated H_2SO_4 was cautiously added and gently shaken. The glycone part of the steroidal ring, which gives the substance its reddish-brown colour, was present.

Keller Killiani Test :- A few drops of glacial acetic acid and ferric chloride solution were added to the test solution before being blended. Concentrated sulfuric acid was applied, and the development of two layers was watched. A positive test for glycosides would show a lower layer that is reddish brown and an upper layer that is acetic acid that turns bluish green.

Tannins, alkaloids, sugars, terpenoids, steroids, and flavonoids are some of the chemical compounds found in medicinal plants that have defined physiological effects on humans. Medicinal plants contain some organic compounds which provide definite physiological action on the human body and these bioactive substances include tannins, alkaloids, carbohydrates, terpenoids, steroids and flavonoids (Edoga, 2005; Mann, 1978).

The primary or more accurately secondary metabolism of living things produces these chemicals. Secondary metabolites are incredibly diverse chemically and taxonomically and have unknown purposes. They are extensively employed in a variety of fields, including veterinary medicine, agriculture, scientific research, and numerous others (Vasu, 2009).

F. Test for Phenols

Ferric Chloride Test: - Three to four drops of a ferric chloride solution were added to the extracts. Phenols are present when a bluish black colour forms.

G. Test for Tannins

Gelatin Test: - A sodium chloride-containing 1% gelatin solution was added to the extract. The presence of tannins is shown by the formation of white precipitate.

Braymer's test: - 10% alcoholic ferric chloride solution was used to treat 2ml of the extract. Tannins can be detected by the formation of blue or greenish coloured solutions.

H. Test for Flavonoids

Shinoda test: - A small amount of magnesium ribbon pieces was combined with crude extract. HCl was added drop by drop. After a little while, a pink scarlet colour emerged, indicating the presence of flavonoids.

Alkaline reagent test: - 2% NaOH solution was dissolved in 2ml of crude extract. When a few drops of diluted acid were added, a bright yellow colour that had formed went colourless, indicating the presence of flavonoids.

I. Test for Steroids

Liebermann Burchard test: - A few drops of acetic anhydride were added to the crude extract before it was heated and cooled. Then, concentrated sulfuric acid was introduced from the test tube's sides, and the development of a brown ring at the intersection of two layers was watched for. Positive results for steroids are indicated by the upper layer's green colouring.

J. Test for Phlobatannins

Precipitate test: The presence of phlobatannins was determined by the formation of a red precipitate after boiling 2 mls of extract with 1 ml of 1% aqueous hydrochloric acid.

K. Test for Quinones

HCl Test: - The production of a yellow precipitate was monitored after a little amount of extract was treated with concentrated HCL.

L. Test for Oxalate

Acid Test: - There were a few drops of glacial ethanoic acid added to the 3ml portion of the extracts. Oxalates are present when there is a greenish black colour.

Results and Discussion

Phytochemical screening in the extracts of distilled water, alcohol, chloroform, petroleum ether, and benzene, but they were completely absent from the acetone extract. Phytochemicals were screened qualitatively in several *Sida rhombifolia* , with the following findings. Alkaloids were absent from other extracts and only present in the petroleum ether extract. Contains phenols in all five extracts excluding extract of chloroform. acetone, distilled water, and alcohol extracts all contain tannins. All other extracts lack flavonoids, while they are found in distilled water, alcohol, and chloroform extracts. Only extracts of alcohol and chloroform reveal the presence of steroids. phytochemicals such phytosterols, glycosides, phlobatannins, and quinones and oxalate weren't present in any of the extracts. Alkaloids were remarkably present in petroleum ether and benzene extracts, but not in any other extracts, according to the data. Alcohol extract demonstrated the presence of steroids. Alkaloids, steroids, flavonoids, and phenols were found in the extracts of *Sida rhombifolia*, L., according to phytochemical analysis. In petroleum ether and benzene extracts, alkaloids are also present that have some metabolic functions and regulate growth in biological systems. Particularly the steroidal alkaloids, they have a role in animal defence mechanisms and are utilised as medicines.

Conclusion

Carbohydrates were detected by phytochemical screening in the extracts of distilled water, alcohol, chloroform, petroleum ether, and benzene, but they were completely absent from the acetone extract. The qualitative phytochemical study has revealed that the extract is positive for saponins, flavonoids, alkaloids, phenols, and the same extract tests negative for glucose, tannins, glycosides, cardiac glycosides, terpenoids, steroid and phytosteroids, phlobatanins, and anthraquinones. The assessment of flavonoid, tannin, and total phenol concentration is part of the quantitative analysis of phytochemicals. The findings imply that *Sida rhombifolia* leaf extract has a significant number of phytochemicals useful in the complementary and alternative medicine and pharmaceutical industries.

Phytochemicals	Distilled Water	Acetone	Alcohol	Chloroform	Petroleum ether	Benzene
Carbohydrates 1.Benedict's test	+	-	+	+	+	+
2.Molisch's Test	+	-	+	+	+	+
3. Fehling's Test	+	-	+	+	+	+
Alkaloids 1.Wagner's Test	-	-	-	-	+	-
2. Mayer's Test	-	-	-	-	-	-
Saponins 1. Foam Test	+	-	-	-	+	+
2. Froth Test	+	-	-	-	-	+
Phytosterols 1. Salkowski's Test	-	-	-	-	-	-
Glycosides 1. Liebermann's Test	-	-	-	-	-	-
2. Salkowski's test	-	-	-	-	-	-
3. Keller Killiani Test	-	-	-	-	-	-
Phenols 1. Ferric Chloride Test	+	+	+	-	+	+
Tannins 1. Gelatin Test	+	+	+	-	-	-
2. Braymer's test	+	+	+	-	-	-
Flavonoids 1. Shinoda test	+	-	+	+	-	-
2. Alkaline reagent test	+	-	+	+	-	-
Steroids 1. Liebermann Burchard test	-	-	+	+	-	-
Phlobatannins 1. Precipitate test	-	-	-	-	-	-
Quinones 1. HCl Test	-	-	-	-	-	-
Oxalate 1. Acid Test	-	-	-	-	-	-

Table 1. Result of phytochemical screening of *Sida rombifolia* , L.

Conclusion

The introduction of innovative, biologically safe, and efficient pharmaceuticals is essential for living an eco-friendly lifestyle. The presence of phytochemicals in *Sida rhombifolia* L., raises the possibility that the plant may be a source of ideas that could result in the creation of novel therapies. To characterise the chemical structure, assess the biological activities, and conduct a full analysis that includes qualitative or semi-qualitative analysis, further research is still required in this field. For this valuable plant species to be used effectively in medicine and pharmaceutical sciences, its full potential must be explored.

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സ്ത്രീസ്വത്വാവിഷ്കാരം - കെ.ആർ. മീരയുടെ 'മീരാസാധു' എന്ന നോവലിൽ

ഡോ. പെട്രീഷ്യ ജോൺ
അസിസ്റ്റന്റ് പ്രൊഫസർ
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ആമുഖം

ഫെമിനിസം അല്ലെങ്കിൽ സ്ത്രീവാദം ഇന്ന് വിപുലമായി വിനിമയം ചെയ്യപ്പെടുന്നൊരു പദമാണ്. സ്ത്രീസ്വാതന്ത്ര്യത്തിന്റെയും അവകാശത്തിന്റെയും സൂചകമായിട്ട് ഫെമിനിസം എന്ന പദത്തെ വിലയിരുത്തുന്നുണ്ടെങ്കിലും സ്ത്രീജീവിതത്തോടും അനുഭവത്തോടും സംസ്കാരത്തോടും പ്രവൃത്തികളോടും അത് വളരെയേറെ ബന്ധപ്പെട്ടു നിൽക്കുന്നുണ്ട്. ഈ പ്രസ്ഥാനത്തിന്റെ നിരൂപണശാഖയാണ് ഫെമിനിസ്റ്റ് സാഹിത്യസിദ്ധാന്തം. സമൂഹത്തിലും സാഹിത്യത്തിലും സ്ത്രീയുടെ സ്ഥാനം, സ്വാതന്ത്ര്യം, അവകാശങ്ങൾ എന്നിവയ്ക്കെല്ലാം ഫെമിനിസം പ്രാധാന്യം നൽകുന്നു. പുരുഷന്റെ കുത്തകയായിരുന്ന സാഹിത്യത്തിൽ പുരുഷനിർവചനങ്ങൾക്കുള്ളിൽ അകപ്പെട്ടുപോയിരുന്ന സ്ത്രൈണസത്തയും ആദർശാത്മകപരിവേഷങ്ങളിൽ അവതരിപ്പിക്കപ്പെട്ട പുരുഷസത്തയും യാഥാർത്ഥ്യത്തിൽ നിന്ന് അകലെയാണെന്നും സ്ത്രീകൾ പുരുഷന്റെ പൊയ്മുഖങ്ങൾ തിരിച്ചറിയുന്നതിനോടൊപ്പം സ്വയം തിരിച്ചറിയപ്പെടേണ്ടതുണ്ടെന്നും സമൂഹത്തെ ബോധ്യപ്പെടുത്തുകയായിരുന്ന സ്ത്രീപക്ഷ എഴുത്തുകാരികൾ.

എഴുത്തുകാരികൾ

സമകാലികസാഹിത്യത്തിൽ ഏറെ ചർച്ച ചെയ്യപ്പെടുന്ന ഉത്തരാധുനിക എഴുത്തുകാരിയാണ് കെ.ആർ. മീര. മീരയുടെ 'മീരാസാധു' എന്ന നോവലെറ്റിനെ സ്ത്രീവാദത്തിന്റെ അടിസ്ഥാനത്തിൽ പഠനവിധേയമാക്കാൻ സാധിക്കുമോ എന്ന അന്വേഷണമാണ് **''സ്ത്രീസ്വത്വാവിഷ്കാരം - കെ.ആർ. മീരയുടെ 'മീരാസാധു' എന്ന നോവലിൽ''** എന്ന പ്രബന്ധത്തിലൂടെ നടത്തുന്നത്.

സ്ത്രീ എന്തെന്നും അവളുടെ സ്വത്വം എന്തെന്നും തിരിച്ചറിഞ്ഞ് അത് സമൂഹത്തെ ബോധ്യപ്പെടുത്താനും പുരുഷന്റെ കടന്നാക്രമണങ്ങളോട് പ്രതിഷേധിക്കാനും പ്രതികരിക്കാനും സ്ത്രീയെ പ്രാപ്തയാക്കുകയാണ് സ്ത്രീപക്ഷസാഹിത്യങ്ങൾ. സ്ത്രീയനുഭവങ്ങൾക്ക് മേലുള്ള സ്ത്രീയുടെ കാഴ്ചപ്പാടുകൾക്ക് പ്രസക്തിയേറുന്ന ആധുനികാനന്തരതയിൽ സ്ത്രീയുടെ ഉടലെഴുത്ത് പുരുഷാധിപത്യ സങ്കല്പങ്ങളോടുള്ള നിരാകരണമാണ്. മലയാളസാഹിത്യത്തിൽ ആധുനികഭാവങ്ങൾ കണ്ടെത്തിക്കൊണ്ടിരിക്കുന്ന കെ.ആർ. മീരയുടെ കൃതികളിലെല്ലാം നിറഞ്ഞു നിൽക്കുന്നത് സ്ത്രീസ്വത്വത്തിന്റെ മുഴുവൻ ആധികളാണ്.

ഉത്തരാധുനിക എഴുത്തുകാരിയായ കെ.ആർ. മീരയുടെ 'മീരാസാധു' എന്ന ലഘു നോവൽ ഭദ്രമായ രൂപശിൽപ്പവും സാർവ്വജനീനമായ ജീവിതാനുഭവങ്ങളുടെ ആവിഷ്കരണവും കൊണ്ട് വ്യത്യസ്തത പുലർത്തുന്നു. 'തുളസി' എന്ന അതിശക്തമായ നായികാകഥാപാത്രത്തെ മുൻനിർത്തി, സ്ത്രീസമൂഹം അനുഭവിക്കുന്ന സംഘർഷങ്ങളും അതിനോടുള്ള അവരുടെ പ്രതികരണങ്ങളുമാണ് അവതരിപ്പിക്കാൻ ശ്രമിക്കുന്നത്. 'മീരാസാധു' എന്ന നോവലെറ്റിനെ അടിസ്ഥാനമാക്കി, സ്ത്രീ സ്വത്വാവിഷ്കാരത്തെക്കുറിച്ചുള്ള പഠനമാണ് ഈ പ്രബന്ധത്തിലൂടെ ലക്ഷ്യമാക്കുന്നത്.

മനുഷ്യന്റെ മാനസികവും വൈകാരികവും കായികവുമായ സൂക്ഷ്മാംശങ്ങൾ ആവിഷ്കരിക്കുന്നതാണ് സാഹിത്യം. മർദ്ദിതരും പീഡിതരുമായ സാധാരണ ജനങ്ങളുടെ ചിത്രമായിരുന്നു വിശ്വസാഹിത്യം മുതൽ അനുവാചകരെ കൂടുതൽ ആകർഷിച്ചത്. സ്ത്രീവർഗ്ഗം, അടിമകൾ, ദളിതർ തുടങ്ങിയ ഏതൊരു പീഡിതവർഗ്ഗവും ആശ്രയം കണ്ടെത്തുന്നത്, സാഹിത്യകൃതികളിലാണ്. അതിൽ ഏറ്റവും പ്രധാനം സ്ത്രീതന്നെയാണ്. തന്റെ അവഗണിക്കപ്പെടുന്ന വ്യക്തിത്വത്തിനും ആത്മാഭിമാനത്തിനും വേണ്ടി നിരന്തരം പോരാടുന്ന സ്ത്രീകഥാപാത്രങ്ങളെ തുടക്കം മുതൽ സാഹിത്യത്തിൽ കാണാൻ സാധിക്കും.

സ്ത്രീകളെക്കുറിച്ച് നിലനിൽക്കുന്ന മൂല്യരഹിതമായ ധാരണകളെ എതിർക്കുന്ന വ്യത്യസ്തമായൊരു കാഴ്ചപ്പാടാണ് ഫെമിനിസം. നിരന്തരമായ പരാമർശങ്ങൾ കൊണ്ട് വിധേയമായ ഒരു ചിന്താപദ്ധതിയാണിത്. സ്ത്രീസമൂഹത്തെ പുരോഗതിയുടെ വെളിച്ചത്തിലേക്ക് കൊണ്ടുവരിക എന്നതായിരുന്നു ഫെമിനിസത്തിന്റെ ലക്ഷ്യം. സമൂഹം സ്ത്രീകൾക്ക് ഏർപ്പെടുത്തിയ നിയന്ത്രണങ്ങളിൽ നിന്നും നിയമങ്ങളിൽ നിന്നും പുറത്തു കടക്കാനുള്ള വെമ്പലുണ്ടായതിന്റെ ഫലമായാണ് ഫെമിനിസം എന്ന ആശയം രൂപപ്പെട്ടത്. 'ഫെമിനിസ്റ്റ്' എന്ന പദം 'തന്റെ സ്വാതന്ത്ര്യം പടപൊരുതി തിരിച്ച്പിടിക്കാൻ കെൽപ്പുള്ളവൾ' എന്ന അർത്ഥത്തിൽ ആദ്യമായി പ്രയോഗിച്ചു കണുന്നത് 1895 ഏപ്രിൽ 25-ാം തീയതി പ്രസിദ്ധീകരിച്ച 'അഥിനീയം' എന്ന ആനുകാലികത്തിലാണ്. ലിംഗസമത്വത്തിന്റെ അടിസ്ഥാനത്തിൽ സ്ത്രീകളുടെ അവകാശത്തിനുവേണ്ടിയുള്ള വാദം എന്നാണ് ഓക്സ്ഫോർഡ് ഇംഗ്ലീഷ് ഡിഷ്ണറി ഫെമിനിസത്തെ നിർവചിക്കുന്നു.

ഫെമിനിസം അഥവാ സ്ത്രീവാദം വിപുലമായി വിനിമയം ചെയ്യപ്പെടുന്ന ഒരു പദമാണ്. സ്ത്രീസ്വാതന്ത്ര്യത്തിന്റെയും അവകാശത്തിന്റെയും സൂചകമായി ഫെമിനിസം എന്ന പദത്തെ വിലയിരുത്തുണ്ടെങ്കിലും സ്ത്രീജീവിതത്തോടും അനുഭവത്തോടും സംസ്കാരത്തോടും പ്രവൃത്തികളോടും അത് വളരെ ബന്ധപ്പെട്ടു നിൽക്കുന്നുണ്ട്. യഥാർത്ഥത്തിൽ അടിച്ചമർത്തപ്പെട്ട സ്ത്രീവിഭാഗത്തെ ഉയർത്തെഴുന്നേൽപ്പിച്ച കാഹളമാണ് ഫെമിനിസം. സ്ത്രീയുമായി ബന്ധപ്പെട്ട എല്ലാ പ്രവൃത്തികളും അവസ്ഥകളും പാർശ്വവൽക്കരിക്കപ്പെടുന്നു. ഇവയോടെല്ലാമുള്ള കലാപത്തിൽ നിന്നുമാണ് ഫെമിനിസത്തിന്റെ ഉത്ഭവം എന്നു പറയാം. പുരുഷാധിപത്യലോകത്തുനിന്നും സ്ത്രീയെ സ്വതന്ത്രരാക്കുകയും സമൂഹത്തിൽ സ്ത്രീയുടെ സ്വത്വം സ്ഥാപിക്കുകയുമായിരുന്നു ഫെമിനിസത്തിന്റെ പരമമായ ലക്ഷ്യം.

യഥാർത്ഥത്തിൽ, പുരുഷനോടല്ല, പുരുഷാധിപത്യവ്യവസ്ഥകളോടാണ് ഫെമിനിസ്റ്റുകൾ പൊരുതുന്നത്. പുരുഷാധിപത്യത്തെ ഉന്മൂലനം ചെയ്ത് ആ സ്ഥാനത്ത് സ്ത്രീയെ

പ്രതിഷ്ഠിക്കുകയല്ല മറിച്ച്, ആണും പെണ്ണും എന്ന ലിംഗവിവേചനമില്ലാതെ മനുഷ്യനായി മാത്രം കാണുന്ന ഒരു പുതിയ ലോകത്തെയാണ് ഫെമിനിസം വിഭാവനം ചെയ്യുന്നത്. തങ്ങൾക്ക് അനുഭവിക്കേണ്ടിവരുന്ന നിഷേധങ്ങൾക്കും അസ്വാതന്ത്ര്യത്തിനും എതിരെ പ്രതികരിച്ചുകൊണ്ടാണ് സ്ത്രീ തന്റെ സ്വത്വം നിർണ്ണയിക്കുന്നത്.

കെ.ആർ. മീരയുടെ കൃതികളിലെ സ്ത്രീപക്ഷചിന്ത

ഉത്തരാധുനികതയുടെ ആഖ്യാനപരിസരങ്ങളിൽ നിന്നുകൊണ്ട് സമകാലീന സാമൂഹിക സാംസ്കാരിക ഇടങ്ങളെ ശക്തമായ ഭാഷയിൽ ആവിഷ്കരിക്കുന്ന മലയാളസാഹിത്യത്തിലെ ശ്രദ്ധേയയായ എഴുത്തുകാരിയാണ് കെ.ആർ.മീര, സ്ത്രൈണത, ലൈംഗികത, ശരീരം എന്നിവയെക്കുറിച്ചുള്ള സ്ത്രീയുടെ സ്വതന്ത്രമായ കാഴ്ചപ്പാടുകൾ മീരയുടെ രചനകളിൽ ആവിഷ്കരിക്കപ്പെടുന്നു. പുരുഷനോടുള്ള എതിർപ്പുകൾക്കും സമരസപ്പെടലുകൾക്കുമപ്പുറം സ്വന്തം സ്വത്വം ഉറപ്പിച്ചെടുക്കുന്ന ഉൾക്കരുത്താർന്ന സ്ത്രീകഥാപാത്രങ്ങളെയാണ് അവരുടെ കൃതികളിൽ കാണുവാൻ സാധിക്കുന്നത്. ഭാവാത്മകതയും വൈകാരികാനുഭൂതിയുമാണ് മീരയുടെ എഴുത്തിനെ ആകർഷകമാക്കുന്നത്. പ്രണയം, ഏകാന്തത, കാത്തിരിപ്പ്, സമകാലിക സാമൂഹികാവസ്ഥകൾ, മതം, സ്ത്രീസ്വകാര്യതകൾ, സ്ത്രീപുരുഷ വീക്ഷണവിപര്യങ്ങൾ എന്നിങ്ങനെ ഒരേ സമയം ലളിതവും ആർജ്ജവുമാർന്ന വിഷയങ്ങൾ അവരുടെ കഥാപരിസത്തെ ബഹുസ്വരമാക്കുന്നു. സ്ത്രീത്വത്തിന്റെ സംഘർഷങ്ങളും പ്രതിസന്ധികളും പുതുനൂറ്റാണ്ടിന്റെ മൂല്യച്യുതികളും പങ്കുവയ്ക്കുന്ന മീരയുടെ കഥകളും നോവലുകളും പ്രകോപനപരമായ ഉള്ളടക്കങ്ങൾ ആലേഖനം ചെയ്യുന്നു.

സ്ത്രീയനുഭവങ്ങൾക്ക് മേലുള്ള സ്ത്രീയുടെ കാഴ്ചപ്പാടുകൾക്ക് പ്രസക്തിയേറുന്ന ആധുനികാനന്തരതയിൽ സ്ത്രീയുടെ ഉടലെഴുത്ത് പുരുഷാധിപത്യസങ്കല്പങ്ങളോടുള്ള നിരാകരണമാണ്. പുരുഷവീക്ഷണങ്ങളെക്കൂടി അംഗീകരിച്ചുകൊണ്ടും ഉൾക്കൊണ്ടുമുള്ള രചനാരീതിയിൽ സ്ത്രീയുടെ വിധേയത്വമനോഭാവത്തിനു പിന്നിൽ മറച്ചുവയ്ക്കപ്പെട്ടിരിക്കുന്ന ഉൾക്കരുത്തിന്റെ പ്രോജ്ജ്വലതയെയാണ് മീര തന്റെ കഥാപാത്രങ്ങളിലൂടെ ആവിഷ്കരിക്കുന്നത്.

സ്ത്രീസ്വത്വാവിഷ്കാരം - മീരാസാധു എന്ന നോവലിൽ

പ്രണയം, വിവാഹം, കുടുംബം, സദാചാരം തുടങ്ങിയവയെ സ്ത്രീപക്ഷത്തുനിന്ന് വീക്ഷിക്കുകയാണ് 'മീരാസാധു' എന്ന ലഘുനോവലിലൂടെ കെ.ആർ. മീര ചെയ്യുന്നത്. സ്ത്രീയെക്കുറിച്ചുള്ള മിഥ്യാധാരണകൾക്ക് പിന്നിലെ യാഥാർത്ഥ്യങ്ങൾ വെളിപ്പെടുത്താനാണ് എഴുത്തുകാരി ഈ നോവലിലൂടെ ശ്രമിക്കുന്നത്. സ്വന്തം ഉത്തരവാദിത്വങ്ങൾക്ക് പുറമേ മനസ്സിന്റെ ആഗ്രഹങ്ങൾക്കും സ്വപ്നങ്ങൾക്കുമനുസരിച്ച് ജീവിക്കാനുള്ള സ്വാതന്ത്ര്യം സ്ത്രീക്കുമുണ്ട് എന്ന സത്യാവസ്ഥ വെളിവാക്കുന്ന രചനയാണ് 'മീരാസാധു'. ആസക്തിയും പ്രണയവും ഭക്തിയും കമ്പോളവത്ക്കരണവും പുരാവൃത്തവും മിത്തുകളും ഇതിൽ നിറഞ്ഞുനിൽക്കുന്നു. തുളസി എന്ന കേന്ദ്രകഥാപാത്രത്തെ മുൻനിർത്തിക്കൊണ്ട്, വൃന്ദാവനത്തിലെ പതിനായിരത്തോളം വരുന്ന അഗതികളായ സ്ത്രീജീവിതങ്ങൾ അനുഭവിക്കേണ്ടിവരുന്ന പീഡനങ്ങളും ദുരിതങ്ങളുമാണ് ഈ നോവലിൽ പ്രതിപാദിച്ചിരിക്കുന്നത്.

വൃന്ദാവനം എന്നു കേൾക്കുമ്പോൾ ശരാശരി ഭാരതീയന്റെ മനസിലുണരുന്ന കാൽപ്പനിക മനോഹരവും ഭക്തിനിർഭരവുമായ ചില ചിത്രങ്ങളുണ്ട്. നമ്മുടെയെല്ലാം ഭാവ നകളിലെ സങ്കല്പചിത്രങ്ങളെയെല്ലാം തകർത്ത് തരിപ്പണമാക്കിക്കൊണ്ടാണ്, കെ.ആർ. മീര ഐ.ഐ.ടി യിൽ നിന്ന് ഒന്നാം റാങ്കോടെ ബിരുദമെടുത്ത തുളസി, വൃന്ദാവനത്തിലെ അഗതികളായ മീരാസാധുക്കളിൽ ഒരുവളായതെങ്ങനെയെന്ന് അവതരിപ്പിക്കുന്നത്. വൃന്ദാ വനത്തിൽ അയ്യായിരത്തിലധികം ക്ഷേത്രങ്ങളും പതിനായിരത്തോളം അഗതികളായ സ്ത്രീകളുമുണ്ട്. വെള്ളസാരിയുടുത്ത്, തലമുണ്ഡനംചെയ്ത്, രാപ്പകലില്ലാതെ കൃഷ്ണനെ ഭജിച്ച് ജീവിതം തള്ളിനീക്കുന്ന ഇവർ, ലൈംഗികചൂഷണങ്ങളിൽ നിന്നും കൊടിയദാരിദ്ര്യത്തിൽനിന്നും വിഭജനങ്ങളിൽ നിന്നും ഓടിപ്പോരേണ്ടിവന്നവരാണ്. ഇങ്ങനെ വ്യത്യസ്ത ഇടങ്ങളിൽ നിന്നും ജീവിതം നഷ്ടമായ സ്ത്രീകൾ നിവൃത്തികേടു കൊണ്ട് മീരാസാധുക്കളുടെ വേഷമണിഞ്ഞ് ജീവിതം തള്ളിനീക്കുന്നു. വൃന്ദാവനത്തിലെ അഗതികളായ വിധവകൾ മാത്രമാണവർ. ഭർത്യമതികളും കന്യകമാരും ഇവിടെ രാധാമയി മാരാണ്. ജീവിതസൗഭാഗ്യങ്ങൾ വലിച്ചെറിഞ്ഞ്, മീരാസാധുവാകാൻ തീരുമാനിച്ച തുളസി അതിശക്തമായ നായികാകഥാപാത്രമാണ്. ''എനിക്ക് രാധയാകണ്ട, മീരയായാൽമതി. രാധ പതിനായിരത്തിൽ ഒരുവൾ മീര ഒന്നേയുള്ളൂ.'' അതാണ് മീരാസാധുവിന്റെയും കരുത്ത്. ഉപേക്ഷിക്കപ്പെട്ടവളുടെ വേദന പകയായ് മാറുമ്പോൾ അതിന കാളകൂടത്തേ ക്കാൾ വീര്യമുണ്ടാവുമെന്ന് മീരാസാധുവിലൂടെ കാട്ടിത്തരികയാണ് കെ.ആർ. മീര.

കീഴടങ്ങി നിൽക്കുമ്പോൾ തോൽക്കാത്തവരും പൊരുതുമ്പോൾ പൂർണ്ണമായി ജയി ക്കാത്തവരുമായ സ്ത്രീകളുടെ നീണ്ടനിര മീരയുടെ കഥാലോകത്തുണ്ട്. അത്തരത്തിലുള്ള സ്ത്രീകഥാപാത്രമാണ് തുളസിയും. പുരുഷാധിപത്യത്തിന്റെ പരിധിക്കുള്ളിൽ താമസി ക്കുന്ന എല്ലാ സ്ത്രീകളെയും അവൾ പ്രതിനിധീകരിക്കുന്നു. എട്ടുവർഷംമാത്രം നീണ്ടു നിന്ന ദാമ്പത്യം അവളുടെ സിരകളിൽ വിഷവും പകയും നിറയ്ക്കുന്നു. വൃന്ദാവനത്തിലെ മീരാസാധുവാകുന്ന തുളസിയെത്തേടി പന്ത്രണ്ട് വർഷങ്ങൾക്ക് ശേഷം ഭർത്താവ് മാധവൻ എത്തുമ്പോൾ സ്വയം പീഡിപ്പിച്ച് വേദനിപ്പിക്കുന്ന തുളസി, തന്റെ പ്രതികാരം പൂർത്തിയാ ക്കുന്നത് ഭിക്ഷാപാത്രം അയാളുടെ മുന്നിലേക്ക് നീട്ടികൊണ്ടായിരുന്നു. അയാൾ തളർന്ന് നിലം നിലംപതിക്കുമ്പോൾ ആത്മസംതൃപ്തിയോടെ തന്റെ താമസസ്ഥലത്തേയ്ക്കു മട ങ്ങുന്നു.

ഐ.ഐ.ടി. യിലെ റാങ്ക് ഹോൾഡറായ തുളസി സമ്പന്നകുടുംബത്തിലെ അംഗവും കേരളത്തിലെയൊരു ഐ.ജി. യുടെ മകളുമാണ്. നേരത്തേപരിചയമുള്ള സുഹൃത്ത്, വിന യനുമായി നിശ്ചയിച്ചുറപ്പിച്ച വിവാഹത്തലേന്ന് തന്റെ കൂടെ ഇറങ്ങിവരുംവിധം അവളുടെ മനസ്സിനെ ആകർഷിക്കാൻ മാധവന കഴിഞ്ഞിരുന്നു. കൃഷ്ണനെപ്പോലെ ഇരുപത്തിയേഴു കാമുകിമാർ അയാളുടെ ജീവിതത്തിൽ വന്നിട്ടുണ്ടെന്നറിഞ്ഞിട്ടും, അവൾ മാധവനെ തന്നെ വിവാഹം ചെയ്യാൻ തീരുമാനിക്കുന്നു. തുളസിയെപ്പോലെ നിശ്ചയദാർഢ്യമുള്ളവരായിരു ന്നില്ല മറ്റ് ഇരുപത്തിയേഴ് കാമുകിമാരും. അവരിലൊരാൾ പോലും മരണപര്യന്തം വരെ അയാളെ മാത്രം ധ്യാനിച്ചുകഴിയുമെന്നും മാധവന വിശ്വാസം ഉണ്ടായിരുന്നില്ല. അതുകൊ ണ്ട്മാത്രമാണ് തുളസിയെ വിവാഹം ചെയ്യാൻ അയാൾ തീരുമാനിക്കുന്നത്. എത്ര കാമുകി മാർ വന്നുപോയാലും തുളസി മാത്രമാണ് എന്റെ സ്ത്രീ എന്ന മാധവന്റെ പൊള്ളയായ വാക്കുകൾ അവൾ വിശ്വസിക്കുന്നത് മാധവനോടുള്ള ആത്മാർത്ഥമായ പ്രണയം മൂലമാ

ണ്. സ്ത്രീയുടെ ഏറ്റവും വലിയ ബലഹീനത സ്നേഹമാണ്. അതു കൊണ്ടാണ് തുളസി വിനയനിൽ നിന്നും മാധവനിലേക്ക് ചേക്കേറിയത്.

പ്രണയത്തിന ശാരീരീകവും മാനസികവുമായ തലം മാത്രമല്ല ദിവ്യവും നിഗൂഢവു മായ തലം കൂടി നൽകുന്നു. മാധവനുമായുള്ള ദാമ്പത്യജീവിതം തുടക്കത്തിൽ മധുരമുള്ള തായിരുന്നു. മധുവിധുവിന്റെ ആദ്യദിനങ്ങളിൽ ഒരു സ്ത്രീയെ എങ്ങനെയൊക്കെ ആനന്ദി പ്പിക്കാമെന്ന് അവൾക്ക് അയാൾ കാട്ടിക്കൊടുത്തു. രതി ഒരനുഷ്ഠാനമായിരുന്ന മാധവന്റെ നെഞ്ചിൽ തൂവൽപോലെ അവൾ വാടിക്കിടന്നു. അയാളുടെ സാമീപ്യത്താൽ, നോട്ടം കൊണ്ട് സുന്ദരിയും സ്പർശം കൊണ്ട് ദേവതയുമായെന്ന് പലപ്പോഴും അനവൾക്ക് അനു ഭവപ്പെട്ടു. സ്നേഹിക്കപ്പെടാത്തവരും സ്നേഹിക്കാത്തവരുമായ സ്ത്രീകളെക്കുറിച്ചും സ്നേഹമറിയാത്ത സ്ത്രീകൾ പ്രസവിച്ച കുട്ടികളെക്കുറിച്ചോർത്തും അവൾ ദുഃഖിച്ചു. എന്നാൽ സ്വന്തം വാൽ വിഴുങ്ങിയ സർപ്പത്തെപ്പോലെയായിരുന്നു അവളുടെ പ്രേമം. സ്വയം വായിലാക്കാൻ ശ്രമിച്ച് അതു വട്ടംകറങ്ങി. മാധവന്റെ ജീവിതത്തിലേക്ക് ഇരുപത്തി യേഴ് കാമുകിമാർക്കുശേഷം എത്തിയ തുളസി, താനാണയാളുടെ അവസാനലക്ഷ്യമെന്നു വിശ്വസിച്ചു. പക്ഷേ അവൾ രണ്ടു കുഞ്ഞുങ്ങളുടെ അമ്മയാവുന്നതിനിടെ മാധവന്റെ ജീവി തത്തിൽ ഒരു യുവനടിയും അവർക്ക് പിന്നാലെ ഒരു രാഷ്ട്രീയനേതാവും ഒരു പത്രപ്ര വർത്തകയും പിന്നാലെ ഒരു ചാനൽ അവതാരകയും ഒടുവിലൊരു നർത്തകിയും പ്രവേ ശിച്ചു കഴിഞ്ഞിരുന്നു. തുളസിയുടെ പരിഭവങ്ങളും പ്രതിഷേധങ്ങളും മാധവൻ അസൂയ യെന്ന് ചിരിച്ചുതള്ളി. തന്റെ വിധിയെ പഴിച്ച് രണ്ട് മക്കളുമായി അയാൾക്കൊപ്പം കഴിഞ്ഞു കൂടാനേ അവൾക്ക് നിവൃത്തിയുണ്ടായിരുന്നുള്ളു. ശാരീരികമോ വൈകാരികമോ ആയ മോശംബന്ധത്തിൽ കുടുങ്ങിയ സാധാരണ സ്ത്രീയുടെ പ്രതിനിധിയാണ് തുളസി. അവൾ ഉയർത്തുന്ന ഓരോ പ്രതിഷേധവും, ശാന്തമായ വാക്കുകളാൽ അയാൾ നിശബ്ദമാക്കുന്നു. വ്യക്തമായ തെളിവുകളുടെ പശ്ചാത്തലത്തിൽ പോലും അയാൾ സ്നേഹിക്കുന്ന ഒരേ യൊരു സ്ത്രീ താനാണെന്ന് വിശ്വസിക്കാൻ അവൾ ആഗ്രഹിക്കുന്നു. ഒരിക്കലും തന്റെ വിധിയെ ഓർത്ത് അവൾ കണ്ണുനീർ പൊഴിക്കുന്നില്ല.

ഗാർഹികാന്തരീക്ഷത്തിന്റെ നാലുചുവരുകൾക്കുള്ളിൽ ജീവിക്കുന്ന സ്ത്രീക്ക് തന തായ വ്യക്തിത്വമുണ്ടെന്ന് അംഗീകരിക്കാൻ പുരുഷലോകം തയ്യാറാകുന്നില്ല. ഐ.ഐ.ടി. യിൽ നിന്ന് ഒന്നാംറാങ്കോടെ ബിരുദമെടുത്ത തുളസി, മാധവന്റെ എല്ലാ ആവശ്യങ്ങളും നിർവഹിക്കുകയും അയാളുടെ കുട്ടികളെ പോറ്റുകയും ചെയ്യുന്ന വീട്ടമ്മയായി മാറുന്നു. ഇന്ത്യയ്ക്ക് അഭിമാനമാകേണ്ട ബ്രയിനും ഒരുപക്ഷേ ഭാവിയിലെ ഒരു നോവൽ ജേതാവു മാകേണ്ടവളാണ് തുളസിയെന്ന് പറഞ്ഞ മാധവൻ തന്നെ വിവാഹശേഷം അവളെ നാലു ചുവരുകൾക്കുള്ളിൽ തളച്ചിടുന്നു. ആ ജീവിതം അവൾ സ്വയം അംഗീകരിക്കുന്നുണ്ട്. സാമ്പത്തികസ്വാതന്ത്ര്യത്തിന്റെയോ കുടുംബപിന്തുണയുടെയോ അഭാവത്തിൽ അവൾക്ക് മുന്നിൽ കൂടുതൽ മാർഗ്ഗങ്ങളുണ്ടായിരുന്നില്ല. ആദ്യകാലത്ത്, അയാളുടെ പരസ്ത്രീബന്ധ ങ്ങളെ ചോദ്യം ചെയ്യുമ്പോൾ ഭ്രാന്തുപിടിപ്പിക്കുന്ന സ്നേഹലാളനകളും രതിസുഖവും കോരിച്ചൊരിഞ്ഞ് അവളുടെ സംശയങ്ങളെ ഇല്ലാതാക്കാൻ ശ്രമിക്കുന്നു. അതേ സമയം ഡൽഹിയിലെ മിടുക്കനായ ജേണലിസ്റ്റായി മാധവൻ വളർന്നു കഴിഞ്ഞിരുന്നു. പണം, പ്രശസ്തി, ചാനലിലേക്കുള്ള മാറ്റം അതോടൊപ്പം അനവധി സ്ത്രീകളെയും അയാൾ സമ്പാദിച്ചിരുന്നു. തുളസിയും മകനും വിസ്മൃതരായിക്കൊണ്ടിരുന്നു. പിണക്കവും പരിഭ

വവും ശകാരവും മാധവനെ കൂടുതൽ അകലെയാക്കുകയും വീട്ടിലേക്കുള്ള വരവു തന്നെ വല്ലപ്പോഴുമാവുകയും ചെയ്തു. നിത്യച്ചിലവിനുപോലും പണം തികയാതെവന്ന ഘട്ട ത്തിൽ, പൂർണ്ണഗർഭിണിയായ തുളസി ഉപേക്ഷിക്കപ്പെട്ടവളും വിവരം കെട്ടവളും വിരൂപയു മായി ഭർത്താവിനെ അന്വേഷിച്ചു പോകുന്നുണ്ട്. അവനെക്കുറിച്ചുള്ള മതിപ്പായിരുന്നു അവളുടെ ആത്മവിശ്വാസം. പക്ഷേ അവളെ കണ്ടമാത്രയിൽ ഒരു അകന്നബന്ധുവിനെ പ്പോലെ പെരുമാറിയതും ജാള്യതയോടെ ചിരിച്ചതും അവളുടെ അഭിമാനത്തെയാണ് മുറി പ്പെടുത്തിയത്.

ഡൽഹിയിലെ ഫ്ളാറ്റിന്റെ കിടപ്പറയിൽ മാധവന്റെ കാമുകിമാരുടെ പ്രേമലേഖന ങ്ങൾക്കിടയിൽ ശവം തീനിയുറുമ്പുകൾ അരിച്ചുകൊണ്ടിരുന്ന കറുത്തപാമ്പിന്റെയും അത് പാതിവിഴുങ്ങിയ ചുണ്ടെലിയുടെയും ചിത്രം തുളസിയുടെയും മാധവന്റെയും പ്രണയബ ന്ധത്തിന്റെയും അതിന്റെ പരിണതിയുടെയും രൂപങ്ങളായിമാറുന്നു. ഇര വിഴുങ്ങിക്കൊണ്ടി രിക്കെ ചത്തുപോകുന്ന അവസ്ഥ. ഗർഭിണിയും ഏകാകിയുമായിരുന്ന വേളയിൽ ആ കാഴ്ച അവളിൽ ഉണ്ടാക്കിയ മനഃസംഘർഷം വളരെ വലുതായിരുന്നു. മാധവന്റെ കൊടിയ അവഗണന സഹിക്കാനാകാതെ, അച്ഛനു ക്ഷമാപണം ചോദിച്ച് കത്തെഴുതു കയും അദ്ദേഹം അവളെ നാട്ടിലേക്ക് കൊണ്ടുപോവുകയും ചെയ്യുന്നുണ്ട്. പ്രസവശേഷം പൊള്ളയായ സ്നേഹം അഭിനയിച്ച് മാധവൻ അവളെ വീണ്ടും ഡൽഹിയിലേക്ക് കൂട്ടി കൊണ്ട് പോകുന്നതോടെ അവളുടെ ജീവിതം വീണ്ടും ഉറുമ്പരിച്ചു തുടങ്ങിയിരുന്നു. അറിവും വിദ്യാഭ്യാസവും കഴിവുകളും സമൂഹത്തിൽ മാന്യമായ സ്ഥാനവുമുള്ള സ്ത്രീകൾ പോലും ദാമ്പത്യം എന്ന തടവറയ്ക്കുള്ളിൽ അകപ്പെട്ടുപോകുന്നതിന മുഖ്യ കാരണം അവളുടെ അധികാരി എന്ന ബോധം പുലർത്തുന്ന പുരുഷനാണ.

സ്ത്രീയുടെ മനസ്സിനെയോ വിചാരങ്ങളെയോ പരിഗണിക്കാതെ അവളെപ്പോലും പുരുഷന്റെ നിഴലാണെന്ന തോന്നൽ ഉളവാക്കുന്ന ഒരു സാമൂഹിക സ്ഥാപനമാണ് കുടും ബം. അവിടെ സ്ത്രീയെ വെറുമൊരു ശരീരം മാത്രമായി കാണുന്ന പുരുഷപ്രതിനിധി യാണ് മാധവൻ. അയാളുടെ പരസ്ത്രീബന്ധങ്ങളെ പ്രതിഷേധത്തോടെയാണെങ്കിലും അതെല്ലാം സഹിച്ച് തുളസി അവനോടൊപ്പം കഴിയുന്നത് അയാളോടുള്ള ആത്മാർത്ഥ മായ പ്രണയം മൂലമാണ്. ഒടുവിൽ തന്റെ ഭർത്താവ് മറ്റൊരു സ്ത്രീയെ ഗർഭിണിയാക്കു കയും നിർബന്ധിച്ച് ഗർഭം അലസിപ്പിക്കുകയും ചെയ്ത വാർത്ത നിർവികാരതയോടെ കേട്ടിരിക്കുന്ന തുളസി അയാളോട് കലഹിക്കുന്നുണ്ട്. അവിടെയും തന്റെ ഭാഗത്തെ ന്യായീകരിക്കുന്ന മാധവൻ, അവളാണ് തന്നെ ഉപയോഗിച്ചതെന്ന മറുപടിയാൽ അതി നെയും നിസ്സാരവത്ക്കരിക്കുകയാണ്. സ്ത്രീയുടെ സ്ത്രൈണത എന്ന കല്പന സമൂഹം നിർമ്മിച്ചു കൊടുക്കുന്നതാണ്. സമൂഹം കേന്ദ്രീകൃതമാകുമ്പോൾ സ്ത്രീയുടെ സ്ത്രൈണ തയ്ക്ക് നിർവ്വചനം കൊടുക്കുന്നതും സമൂഹം തന്നെയാണ്. ഓരോ സാഹചര്യത്തിലും എങ്ങനെ പെരുമാറണമെന്ന് പോലും പുരുഷൻ നിർണയിക്കുന്നു. ലൈംഗികതയെക്കുറിച്ച് ആൺകോയ്മാസമൂഹങ്ങൾ സൃഷ്ടിക്കുന്ന മൂല്യമണ്ഡലം വ്യക്തികളുടെ സാമൂഹ്യവിന്യാ സത്തിലെ ഉച്ചനീചത്വങ്ങൾക്ക് നിർണ്ണായകഘടകമാകുന്നു.

സ്ത്രീകേന്ദ്രീകൃതമായ മീരയുടെ കഥകളിലെല്ലം പുരുഷൻ വിമർശനം അർഹി ക്കുന്ന ഉടൽ മാത്രമാണ്. പുരുഷന്റെ ലൈംഗികതൃഷ്ണ ശമിപ്പിക്കുന്നതിനുള്ള ഒരുപകര

ണംമാത്രമാണ് സ്ത്രീ എന്ന ചിന്താഗതിക്കാരനാണ് മാധവൻ. എന്നാൽ സ്വന്തം ജീവിത ത്തിലൂടെ സ്ത്രീസൗന്ദര്യം ശരീരത്തിനല്ല മനസ്സിനാണ് വേണ്ടതെന്ന് തുളസി അയാളെ പഠിപ്പിക്കുന്നുണ്ട്. ''കനച്ചുനാറുന്ന സാരിയും പഴകിയ അടിവസ്ത്രങ്ങളും അഴിച്ചുമാറ്റി, എല്ലും തോലുമായ ശരീരം നഗ്നമാക്കി ഞാൻ അയാളുടെ മുന്നിൽ നിൽക്കും. ഇടിഞ്ഞുതൂ ങ്ങിയ മാറിടവും കൂനുപിടിച്ച പുറവും കൊഴുപ്പുരുകി ദയനീയമായ തുടകളും വിണ്ടുകീ റിയ കാലുകളും ഞാൻ ലജ്ജയില്ലാതെ അനാവരണം ചെയ്യും. സൗന്ദര്യത്തിന്റെ അർത്ഥം ഞാനയാളെ പഠിപ്പിക്കും.'' എന്നു പറയാൻ അവളെ പ്രേരിപ്പിച്ചത് അവളനുഭവിച്ച അപമാ നവും അവഗണനയുമാണ്. ആൺവഞ്ചനയിൽ സ്വയം ജീവിതം നഷ്ടപ്പെടുത്തിയ അവൾ ഉടലും ഉയിരും കൊണ്ട് അതേ തീവ്രതയോടെ പക വീട്ടുന്നു. തുളസിയുടെ ആത്മാർത്ഥ പ്രണയം വൈകിയാണെങ്കിലും മാധവൻ തിരിച്ചറിയുന്നുണ്ട്. ഒരിക്കൽ സുന്ദരികളായ സ്ത്രീശരീരങ്ങളെ കാർന്നു തിന്ന മാധവൻ, തലമുണ്ഡനം ചെയ്ത്, എല്ലുംതോലുമായി പല്ലു കൊഴിഞ്ഞതും കണ്ണുകുഴിഞ്ഞതുമായ തുളസിയുടെ മുഖത്ത് പ്രേമത്തോടെ നോക്കു ന്നു. തന്റെ തെറ്റുകൾക്ക് മാപ്പപേക്ഷിച്ച് മാധവൻ കേണിട്ടും അവൾ ചിത്തഭ്രമം ബാധിച്ച് ചിരിക്കുകയാണുണ്ടായത്. ജീവിതത്തിൽ നേടിയതെല്ലാം നഷ്ടപ്പെട്ട്, സ്ട്രോക്ക് വന്ന ഒരു വശം തളർന്ന മാധവൻ മടങ്ങിച്ചെല്ലാൻ കേണപേക്ഷിക്കുമ്പോൾ വിരൽ കുടിച്ചും മുഖം ചുളിച്ചും മരിച്ചുകിടക്കുന്ന മക്കളെയാണവൾ ഓർക്കുന്നത്. സ്ത്രീകളെ അയാൾക്കിന്ന് ഭയ മാണെന്ന് പറയുന്നതു കേട്ട് പൊട്ടിച്ചിരിക്കുന്ന അവൾ ഉന്മാദത്തിന്റെ ആനന്ദ നിർവൃതി യിൽ ചിന്തിക്കുന്നതിങ്ങനെയാണ് ''മാധവൻ എന്റേതാണ്. ഞാൻ ഇനിയും അയാളെ പ്രേമിക്കും പകയോടെ പ്രേമിക്കും. പ്രേമം കൊണ്ട് പരാജയപ്പെടുത്തും. പവിത്രീകരിക്കും. ഒടുവിൽ അയാളെത്തന്നെ വിലയം പ്രാപിക്കും.'' അവൾ നടത്തുന്ന പ്രതിഷേധങ്ങളും കലാപങ്ങളും കീഴടങ്ങാത്ത മനസ്സിന്റെ ബഹിർഗമനങ്ങളാണ്. ഒടുവിൽ ഗോവിന്ദ്ദേവ ക്ഷേത്രത്തിന്റെ മൂന്നാം നിലയിൽ ശവംതീനിയുറുമ്പുകളിൽ വലയം പ്രാപിച്ച് മരണത്തി നായി കാത്ത് കിടക്കുന്ന തുളസി പ്രതിഷേധത്തിന്റെയും പ്രതികാരത്തിന്റെയും പെൺരൂപ മാണ്.

കഥാപാത്രങ്ങൾക്ക് കഥാകാരി നൽകിയിരിക്കുന്ന പേരുകൾക്ക് സവിശേഷതയുണ്ട്. മാധവൻ പതിനായിരത്തെട്ട് ഭാര്യമാരുള്ള സാക്ഷാൽ ശ്രീകൃഷ്ണന്റെ നാമം തന്നെയാണ്. കൃഷ്ണന്റെ ഭക്തന്മാരിൽ അഗ്രേസരയായ തുളസീദേവിയുടെ നാമമാണ് നായികയ്ക്ക് നൽകിയിരിക്കുന്നത്. പ്രാണനാഥന്റെ പരസ്ത്രീബന്ധങ്ങളിലുള്ള ശക്തമായ പ്രതിഷേധം കേവലമൊരു വഴക്കിടലിലൊതുക്കാതെ അയാളോടുള്ള നിർവാജ്യമായ പ്രണയത്തെ അതിരൂക്ഷമായ പകയുടെ രൂപത്തിലേക്കാക്കി മാറ്റുമ്പോൾ പുരാണങ്ങളിലെ നായികമാ രിൽ നിന്നും തുളസി എന്ന മീരാസാധു തികച്ചും വ്യത്യസ്തയാകുന്നു.

ഇന്നത്തെ പെണ്ണിന്റെ അവസ്ഥകളെ ഫെമിനിസത്തിന്റെ അതിരുകൾക്കപ്പുറത്തേയ്ക്ക് കൊണ്ടുപോയി ആവിഷ്കരിക്കുകയാണ് കെ.ആർ. മീര. തന്റെ ജീവിതം നശിപ്പിച്ചവനോ ടുള്ള പകയും, ജീവിതകാലം എങ്ങനെയെങ്കിലും തള്ളിനീക്കണമെന്ന വിചാരവും, അപമാ നബോധവും അതിന്റെ പരിണിതഫലമായുണ്ടായ ഏകാന്തവാസനയും കൊണ്ട് മൂടപ്പെട്ട കഥാപാത്രമാണ് 'തുളസി'. പ്രണയത്തിന്റെ തീവ്രത എത്രയുണ്ടോ അത്രതന്നെ പകയുടെ പ്രതികാരവും ഇതിൽ നിറഞ്ഞു നിൽക്കുന്നു. പുതിയ ലോകത്തിലും കാലത്തിലും സ്ത്രീ അനുഭവിക്കേണ്ടി വരുന്ന വിവിധങ്ങളായ ജീവിതവ്യഥകളെ തീവ്രമായി ആവിഷ്കരിക്കുന്ന

മീരയുടെ എഴുത്ത് ഓരോ പെണ്ണിനും ഇതു തന്റേതെന്നുതന്നെ എന്നു തോന്നിപ്പിക്കുന്ന തരത്തിലാണ്.

ഉപസംഹാരം

സാംസ്കാരികമേഖലകളിൽ നിന്നും വ്യവഹാരങ്ങളിൽ നിന്നും അന്യമാക്കപ്പെടുന്നു എന്ന തിരിച്ചറിവിലൂടെ തന്റെ വ്യക്തിത്വം സ്ഥാപിച്ചെടുക്കാൻ സ്ത്രീകൾ നടത്തിയ ആശയമാണ് ഫെമിനിസം. സാമൂഹികമായ ലിംഗവിവേചനത്തെ എതിർക്കുക എന്നതാണ് ഫെമിനിസ്റ്റ് ചിന്തയുടെ കാതലായ വശം. പുരുഷ മേൽക്കോയ്മയെ ചോദ്യംചെയ്തുകൊണ്ട് സമൂഹത്തിൽ തങ്ങളുടേതായ ഒരു ഇടം ഉറപ്പിക്കുവാൻ സ്ത്രീകൾ മുന്നോട്ടിറങ്ങി. കേരളത്തിലും മറ്റ് സ്ഥലങ്ങളിലെന്നപോലെ ഫെമിനിസ്റ്റ് പ്രസ്ഥാനങ്ങൾ ശക്തിയാർജ്ജിക്കുകയും അതിന്റെ പ്രതിഫലനം സാഹിത്യം പോലുള്ള സർഗ്ഗാത്മകമേഖലയെ കൂടുതൽ സജീവമാക്കുകയും ചെയ്തു. മറ്റു ഭാഷകളിലുണ്ടായ പോലെ മലയാള സാഹിത്യകൃതികളിലും ഫെമിനിസ്റ്റ് പ്രവണതകളുടെ സ്വാധീനം ദർശിക്കാവുന്നതാണ്.

മനുഷ്യജീവിതനൈരാശ്യത്തെ അനുഭാവപൂർവ്വം പരിഗണിക്കുകയും അവയെ ചേതോഹരമായി ചിത്രീകരിക്കുകയും ചെയ്യുന്നവരാണ് ഉത്തരാധുനികത ഫെമിനിസ്റ്റുകൾ. മലയാളസാഹിത്യത്തിന്റെ പെണ്ണിടങ്ങളിൽ സവിശേഷമായ ഉടലും ഉയിരും ഉള്ളവരാണ് കെ.ആർ മീരയുടെ രചനകൾ. അപമാനിക്കപ്പെട്ട സ്ത്രീത്വത്തിന്റെ ശക്തി വിളിച്ചോതുന്ന ഒരു കൃതിയാണ് 'മീരാസാധു'. ഒരു കാലത്ത് സ്നേഹം യാചിച്ചിരുന്ന സ്ത്രീ കരുത്തോടെ തന്റെ ആധിപത്യം ഉറപ്പിക്കുകയാണ് ഇവിടെ. സ്ത്രീത്വത്തെക്കുറിച്ചുള്ള യാഥാർത്ഥ്യം നിറഞ്ഞ ഒരു ദർശനമാണ് മീര, മീരാസാധു എന്ന സാഹിത്യസൃഷ്ടിയിലൂടെ സമൂഹത്തിനു നൽകുന്നത്.

Sree Narayana College, Kollam
Affiliated to University of Kerala
NAAC 'A' Grade, ARIIA All India Rank II