

ESTD. 2010

Crossian Resonance

A Multidisciplinary Research Journal

(A Refereed Biannual Published in June and December)

ISSN 0976-5417

Vol. 8 No. 2 December 2017

A Crossian Publication



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Holy Cross College (Autonomous), Nagercoil – 629 004, Tamil Nadu, India.
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Coding Desire in Short Stories

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ABSTRACT

Literature in its mimetic process holds the essence of human experience. Deep cognitive processes are embedded in stories thus rendering them available for public perusal and repetitive consumption. What is at stake is the desires and anxieties that form the core of all subjective experience. Writers across the world, down the ages have written short fiction which can be sieved for commonalities. These kernels are universal and serve as the split image of human cognitive experience. This paper analyses these embedded kernels and the nature of desire.

Keywords: fantasy, objects of desire

But there are no lions in the Scottish Highlands. (Hitchcock)

The Greek concept of mimesis as a function of literature, and the Elizabethan concept of literature holding a mirror to life are undeniably text centered. If literature is mimetic in function then within it already a viewer is implied which tilts the focus to the audience / reader. The reader response criticism shifted the focus to the reader in spite of a lot of misgivings. With the introduction of visual media, the role of the reader/ spectator has been established unswervingly. The film studies has given rise to further delineation of functions of the spectator namely 'vicarious', 'voyeuristic'. What do all of these concepts contend with? Simply stated, literature imitates human experience and reader / spectator turns to it for viewing human life thus deriving pleasure and other benefits—an economy of consuming. What is involved in all of it is the human cognition, the sense of self.

Cognition is a term referring to the subjective experience of the world through or by the means of experience, thought and senses. While cognitive process may or may not be the focus of an academic inquiry it is the quintessence of all human lived experience. Art tries to recreate this cognitive process in order to predict or evoke a certain response from the reader. Eliot's far too oft – quoted words defining 'objective correlative' are of interest at this juncture too. "a set of words, a set of objects, a situation, a chain of events which shall be the formula of that particular emotion, such that when the external facts, which must terminate in sensory experience, are given, the emotion is immediately evoked." Even within this text centric approach lies the human cognitive process and the function of evoking feelings. Having traversed the range of literary criticism from bio-literary approach to text centric approach to reader response school, it is time for a Copernican turn. Can a certain literary work or technique control the economy of reading/ viewing? Does the power reside in the text or in the cognitive processes of the reader / viewer?

For example consider a story like 'The White Heron' written by Jewett, a brilliant local color writer who has purely focused on life around Maine in her writings. It is to be noted that Sarah Orne Jewett is a New England writer from the second half of the nineteenth century. The story, originally published in a magazine, went on to become a household name and to this day remains among the classic American short stories. It is about a young girl

named Sophie who lives on a rural New England farm. The little girl lives amidst the natural world for which she shares a keen sense of affinity. She meets a young man, a taxidermist, who is on the lookout for a white heron for his private collection. She deems it important not to betray the bird even for a much needed sum of money. When the young man leaves, she regrets her decision, having a crush on him. Her object of interest or pleasure is no more exclusively the wilderness but also the young man. This shift needs to be earmarked. Shorn of all verbal fillers, fictional diction, and narrative techniques one is left with the kernel of the story: girl meets boy and girl chooses to reluctantly let go of the boy. A story all too familiar, though is universal in its prevalence it is subjective experientially in terms of the cognitive process. The reader has memory traces not only of a previous relational loss but also that of the resultant anxiety. It is this subjective experience that is rippled by the kernel of the story which by itself serves as the 'objective correlative'.

Jay Blumler and Katz in their work on media and gratification have identified the various uses that audiences seek out of mass communication. Frequently referred to as UGT this group of media researchers has conceptualized audience as being active and not as passive. Of special interest is the finding that audiences meet their psychological and social needs in their interaction with media. Another researcher Denis McQuail in his findings concludes that an individual uses media for finding models of behavior, social empathy, emotional release and escaping from problems among others (p73). The social empathy and the emotional release are of significance even in the context of literature and readers. The psychosocial dimensions of the findings lead back to the cognitive process of the reader /audience.

How does the individual reader deal with his or her desire? Slavoj Zizek in *Looking Awry* describes desire or fantasy as "the way he organizes his universe of meaning in a way absolutely particular to him." (p156) Being a Lacan inspired thinker he shares the view that object of desire is not so much the desire for 'it' but rather the fantasy of the object. The way 'one organizes meaning' is highly personal, invisible even unto the subject at times. This particular way of organizing is what the objective correlative aims to relate to. Though the subconscious motives are hidden to the subject, there is a sense of agency which is involved in the selection and consumption of texts. The self gleans through the vast number of texts available to it in a recognizable pattern making predictable choices.

A story which is distantly similar to Jewett's 'White Heron' is Sergeyevich Turgenev's 'Mumu'. A brilliant Russian novelist and short story writer from the second half of the century Turgenev's mumu has become a legendary character. Again shorn of the verbal meat the kernel of the story is thus. A deaf mute serf is in love with a coworker but the mistress of the estate arranges the marriage of the girl with someone else. Then the serf rescues and adopts a dog named Mumu and bonds with it. Again the mistress insists on ridding of the dog. Finally the serf drowns the dog. Both the stories have similar kernels. The love between a boy and a girl which is lost forever (story rendered from the perspective of both the gender); the bird and the dog were also objects of desire at some point of time but then were lost. The resultant feeling is guilt and heartache. The kernels of the stories have universal elements which directly address the fantasy and anxiety of the individual.

What then of the mastery of the story teller? The popularity of the text then lies in the effective wielding of language to artistically and aesthetically present the universal concerns stemming from psychosocial needs. This can be further established by the fact that even unspecified presentations of these elements still evoke the same result. For instance, the ballads of loss have not the descriptive details of fiction but still evoke the note of sorrow and loss in them. When Blake writes in 'London', "In every voice: in every ban,/The mind forg'd manacles I hear" the abstraction does not take away from the connectivity. The broad categorizing of the 'Chimney-sweepers cry' and the 'Soldiers sigh' in the context of the church and palace sufficiently mark the crux of the helplessness of the individual and the coldness of the society at large. The power of the literary and media texts lies in their universal kernels – the core which holds the desires and anxieties of the human mind.

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Postcolonial Feminism in Anita Nair's *Mistress*

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ABSTRACT

Anita Nair's novel Mistress can be read as a postcolonial feminist text in its consistent dislocation of centre-margin binaries, its explication of the continuities and complexities inherent in the categories of the global and the local and its rhetoric of hybrid forms. The notion of desire deployed in Mistress can usefully engage the key conceptual categories of postcolonial feminist theory. By dislocating centre-periphery and global-local binaries and by locating female desire within a hybrid, Mistress envisions a powerful postcolonial feminist politics. As women do not belong to the dominant part of hegemonic society, their capacity to make decisions and craft opinions is limited. Like the female characters in Mistress, many women today long for freedom and cry for independence. In this situation, if women are subjugated, women should fight their way back to independence. To overcome isolation and loneliness women should be conscientized of their creative potentials. In order to attain power, women must draw their inner strength. They must attempt to critique hegemonic power.

Female desire is shaped by hegemonic discourses of culture and the gendered politics of the day-to-day life. This understanding of desire holds within it the possibilities of patriarchal collusion and critical feminist resistance. Anita Nair's novel *Mistress* can be read as a postcolonial feminist text in its consistent dislocation of centre-margin binaries, its explication of the continuities and complexities inherent in the categories of the global and the local and its rhetoric of hybrid forms. Nair's postcolonial novel *Mistress* narrates the fascinating tale of a woman's desire. The notion of desire deployed in *Mistress* can usefully engage the key conceptual categories of postcolonial feminist theory.

Nair's form of story-telling closely approximates what Robert Fraser terms the final stage in postcolonial narration, "a narrative that traces its own 'retrospective becoming,' constantly 'travelling' through 'inauthentic' cultural forms even while staying attentive to its own politics" (Debotri Dhar). This political aesthetic of postcolonial theorizing applies not only to *Mistress'* hybrid narrative but also to the novel's treatment of Radha's desire. A postcolonial reading of female desire has to locate desire within the cultural history of female embodiment. *Mistress*, with its complexity of characters and hybrid narrative logic, does manage to do this. This complexity is evident in the fragmented subjectivities of Shyam, Chris and Radha, the three characters in the triangle of desire.

Shyam, the traditional man and husband is a curious mix of rationality and superstition and of softness and strength. While Radha finds it impossible to desire and to love him, he is loved and admired by all his employees. Despite his material success, Shyam continues to suffer insult and humiliation in Radha's intellectually insulated world. However, there is no doubt that Shyam is inherently patriarchal. He not only rapes his wife when he is unable to come to terms with her apparent liking of Chris, but also thinks that killing an adulterous wife is justified. He asks himself: "What is the husband of an adulteress allowed to do? Am I permitted to vent my fury at being betrayed? Will I be able to defend my honour? Will any court of law, human or divine, hold it against me?" (350). Shyam also thinks of killing Chris but changes his idea only because he does not want Radha to turn her adulterous

love “into a temple” (297) and cut her ties with him. Despite his anger and pain, Shyam knows that he loves Radha deeply. So he ultimately decides to accept the outcome of her adulterous desire – Chris’ illegitimate child.

Chris, seems to be modern, liberated, intellectual, sensitive and accepting a woman’s equality and opinion. As they exchange their memories, Radha feels their “worlds nestled into each other. We belonged, he and I” (215). But as their relationship progresses, she realises that Chris is dogmatic in his own way and his modernity is completely circumscribed by his own location and identity. For instance in their insular world of soft caresses, their first argument occurs during a discussion on contemporary politics and war. When Chris talks of Saddam Hussein as evil, Radha retorts by comparing Hussain to Bush and pointing out the latter’s dubious political motives behind invading Iraq. Chris is angry and rebukes Radha, saying that he finds her attitude of tolerance unacceptable. Radha is dismayed to realise that their sense of history, of politics and of ethics is different and she hits back by saying that he will never understand what tolerance is about, since it is beyond the westerners. After this discord, Radha begins to compare her situation to that of the ravaged country, whose ravaging is supposed to be for its own good. “What do I have now? . . . I am a country that has to rebuild itself from nothing. I am a country that has to face recriminations and challenges and I don’t know where to begin. Worst of all, I don’t even know if you will be there to hold my hand through the rebuilding process. So wouldn’t it have been best to leave me alone?” (293). Radha is a curious mix of the Indian and the western sensibilities. She enjoys not only classical Indian dance and music, but also Yeats and American shows like ‘Friends’. She wears Indian sari as well as jeans and “little blouses” (202). On one hand she seeks freedom from Shyam’s traditional husband likebehaviour and on the other she is unsure and afraid of the uncertainties that her more free and more equal relationship with Chris brings. When Radha reminds Chris that they should use protection during intercourse he carelessly asks her to “pick up a few” (209). This terribly shocks Radha and she says, “No doubt in his country women think nothing of buying condoms. There are even vending machines, I hear. But this is India. And small-town India. How could he even ask me to do it? The horror of it makes me cringe” (209). This shows Radha’s unease at Chris’ westernized approach to desire. This unease in her experience of desire with Chris is not necessarily any lesser than the unease and unhappiness she feels with Shyam.

Radha’s desire thus reveals a desire that yearns for release, a desire that is both pleasurable affirmation and painful lack and a desire that seeks to break the constraints of culture. Radha’s desire is ultimately resolved through her rejection of both the traditional Indian Shyam and the modern American Chris. “In rejecting both men, Radha therefore enacts the postcolonial feminist theoretical injunction to expose both the “east” and the “west” as problematic and inauthentic formulations in themselves, and the need to look beyond” (Debotri Dhar).

Mistress as an exercise in postcolonial feminism rightly ends on an inconclusive note. It does not reveal what Radha’s next step will be. Will she continue to live with Shyam and rework the rules of their marriage? Will she eventually go to Chris while holding on to her own cultural identity? Will she strike out with or without another man? In symbolically rejecting both the “global” and the “local” versions of desire, Radha breaks out of her frozen mythological frame to enact a powerful feminist agency. Thus, by dislocating centre-

periphery and global-local binaries and by locating female desire within a hybrid, *Mistress* envisions a powerful postcolonial feminist politics.

As women do not belong to the dominant part of hegemonic society, their capacity to make decisions and craft opinions is limited. Like the female characters in the novel, many women today long for freedom and cry for independence. In this situation, if sexism is to be subjugated, women should fight their way back to independence. Consciousness raising is important to change women's feelings of isolation and loneliness. In order to attain power, women must draw inner strength. They must attempt to critique hegemonic power.

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Redefining Self in Monica Ali's *Brick Lane*

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ABSTRACT

"Redefining Self in Monica Ali's Brick Lane" is an attempt to present the lives of first and second generation Bangladeshi immigrants in Britain. It focuses on the lifestyles, work patterns, family structure, cultural, social, economic and religious dynamics of the Bangladeshi community. It also presents how Nazneen the protagonist establishes her identity in the midst of a chaotic world and her transformation as a result of her marriage. It also analyses geographical displacement of the protagonist, her relationship with her husband and outside world, her discontent and emancipation.

Identity is a multifaceted component of human experience. Woodward suggests "A person, who is conscious of his or her identity, continually searches for stability, security and belongingness". Monica Ali, in her novel *Brick Lane* focuses on the problems of woman's quest for identity. "Redefining Self in Monica Ali's *Brick Lane*" presents the consequences of dislocation and displacement through migration which are important to the construction of the identity of an individual.

The protagonist Nazneen's search for the self becomes a common thread that runs through the whole fabric of Ali's *Brick Lane*. After marriage Nazneen leaves her native land as well as her parental household. Her feeling as an immigrant therefore is quite different from that of her husband Chanu. While Chanu cares for social status Nazneen doesn't care so, rather her quest for identity comes mainly from the sense of bondage, lack of moving space on both literal and metaphoric senses. She neither adopts the values of the foreign land nor does she keep any link with the native land.

Initially Nazneen loses her sense of identity in the changing social, economical and political world in her own imaginative way. She meets obstacles and challenges while trying to adapt to the new and unknown life. The feeling of rootlessness in turn raises a quest for her identity. Though she wants to follow the western life style, the very thought that she has to retain her native tradition in London prevents her from doing so.

She longs to assert her identity by living a life as she wishes. But, Chanu, her husband suppresses her from moving towards the modern world. He tries to keep her indoor and doesn't want her to learn English or mingle with English people. He doesn't want Nazneen to learn or earn. To him she is not an independent individual but a dependent being who should wear the emblem of British culture. Nazneen desires to have an identity, so that she can speak, dress and work like the westerners.

A number of events in her life serve as a source for her to find her identity. The first incident that makes her realize herself is her interaction with Razia. Nazneen is influenced by Razia's attitude towards the western people and their culture. Razia tries to be more like the British and Nazneen too feels crazy of what Razia is practicing. Razia, trimming her hair and

wearing track suit for any occasions in fact lead Nazneen in the process of her self-awakening.

Nazneen's identity is developed through her fascination for Dr Azad's words. He says "If you are strong you withstand the storm. The storm comes and everything is blurred. But all that is built on a solid foundation has only to stand fast and wait for the storm to pass. Do you see?" (272). He shows her small containers made of glass filled with water and snow. He explains that they are similar to life and if Nazneen is strong, she can withstand the storm. Nazneen seems to find comfort and strength when she is told about these items that take on a symbolic meaning for her.

Nazneen's self-awakening is also connected with the character of Karim. He prefers speaking English to Bengali. He is politically active and organizes the first meetings of similarly radical individuals. With Karim, Nazneen gains new knowledge about the political situation and religious clashes between the radical Muslims and Christians. She learns the disparity between the strict religious rules and the secular western society from her relationship with Karim.

The next important influence on Nazneen is her two daughters, who inevitably grow up in the English style and are very critical about their parent's lifestyle. Shahana and Bibi who are born and raised in Britain develop a sense of hatred towards the Bangladeshi culture. At home they converse in English and dress like the Westerners. For Nazneen, her children's behaviour seems to reject racist practices and revolt against the system. She is alert to the different sounds coming from the community around them. She does not know which identification label to put on as she is influenced by how others see her.

Eventually Nazneen learns the facts of surviving and tries to make the differences into strengths. Despite male domination, she develops her identity independently. A sign of this can be seen through the symbol of ice-skating. When Chanu decides to return to Dhaka with his family, Nazneen plans to settle in London. She identifies herself with London and it becomes a land of opportunity and prospects for her. The new world is an adventure for Nazneen and a land of opportunity.

The assertion of identity and protest against submission is evident when she refuses to return to Bangladesh with Chanu. Nazneen finally integrates herself into contemporary British society. She is able to build up her knowledge of the English language slowly based on what she picks up from conversations. The unique representation of life in London makes her stay back in London and strive for her own identity. Not knowing her own identity, Nazneen suffers a nervous breakdown. But in the aftermath, she starts changing, accepting her life. She begins to make decisions on her own and corrects her husband, something that she has never done before.

Once Nazneen comes to know her power to choose her own identity, she chooses not to leave the country, which gives her the opportunity to do so. For Nazneen, England is not a place to earn money, a degree or rate historical revenge, but a place where she can exercise her power to form her own identity. Her experiences as a migrant evoke insights into the nature of migration. Initially she describes herself feeling trapped in her flat. Her accounts of

beginning a new life in London evoke a sense of rootlessness, isolation, loneliness and detachment from the wider community.

As an immigrant she initially lacks the excitement, expectation and new desires. When she becomes aware of her own self she develops all these attitudes. Ultimately the ability of Nazneen to adapt to a multicultural context is when she desires to become a strong individual.

In this current scenario, the issue of proclaiming an identity has become more important, as the people of one country move to another country. Though they suffer the problems of assimilation and adaption they overcome the predicament and lead a successful life. The process of adapting life styles to the patterns of the surrounding culture takes place with respect to different areas of differentiation and social divisions. Hence, Monica Ali brings into limelight the cultural consequences of dislocation and displacement, which are important to the construction of the identity of the individuals.

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Traces of Tuareg culture in Ibrahim Al-koni's *Gold Dust*

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ABSTRACT

Ibrahim Al-koni, a Tuareg is an African writer. Ibrahim Al-koni was brought up in the tradition of the Tuareg, properly known as "the veiled men" or "the blue men". His writings show how Tuareg traditions' endurance relies on the tuaregs' aptitude to interpret the complex signs within their surroundings. It is in this context that Al-koni proposes that the desert of which he speaks is the synonym of the world. The understanding of the symbolic representations highlights the specificity of the tuareg tradition as well as the universal elements it contains.

Ibrahim al-Koni's *Gold Dust* (originally published as al-Tibr in 1990) depicts desert life as a repository of essential values opposed to the more worldly, ephemeral obsessions of the oasis and the city. Set among the nomadic tribes of the Tuareg people in the deserts of Western Libya, the novel narrative develops two main themes: the profound relation of Ukhayyad, the main character, with his purebred camel, and the collapse of the contingent when confronted by the perennial. Throughout the novel the author gives an outlook of the existence and the convention of the Tuareg people.

The Tuareg language is a southern Berber language having several dialects among the different regions. Berber is an Afro-Asiatic language closely related to Egyptian and Semitic-Canaanite languages. The language is called Tamasheq by western Tuareg in Mali, Tamahaq among Algerian and Libyan Tuareg, and Tamajaq in the Azawagh and Air regions, Niger. The Tamajaq writing system, tifina (also called Shifinagh), descends directly from the original Berber script used by the Numidians in pre-Roman times.

Through its vivid descriptions of desert-crossings, *Gold Dust* masterfully portrays the vital role that camels play in Tuareg traditional life. Tuaregs are nomads, speaking their own Berber language, owning herds of camels. They used to be responsible for transporting goods through the Sahel from Mauretania to Sudan, Algeria or Guinea coast. Nowadays, traditions and customs are slowly changing, and some of them are leaving the nomad way of living and starting a new life at the cities around oasis. Nevertheless Tuaregs are still having their role in goods transportation. The salt from Taoudenni mine at Mali and Bilma mine at Niger is transported merely with camel caravan. Camel dance is very common in traditional Tuareg wedding parties this is intertwined by the author in the novel "In the desert, only noble men trained camels to dance in front the women folk"(7).

Tuaregs are sometimes called 'bleu people' because of their traditional blue dress. The colour is not blue by accident. They wear blue dress because it makes them feel less hot in the desserts. Tuaregs normally cover them from head to feet. Men have a long scarf around their head, called taguelmoust. It's a variation of turban. The only part visible out of it is usually the eyes. Taguelmoust is a good protection against sand, dust and heat, but it has a social meaning as well. It's not acceptable for Tuareg with lower social position to show his

face to Tuareg of higher social status. This is the in the cover page of the book *Gold Dust*. Women wear black dress, covering their head by scarf. They like decorations from beaten silver. One of the most favorite designs is Agadez cross in all different forms. The writer has brought this picture into his novel he describes “the men and boys stood across of them, their heads wrapped in lavish blue turbans. When they strode they swaggred with the pride of peacock” (9).

In the case of women they do not traditionally wear a veil, but men do wear the men’s facial covering originates from the belief that such action ward off evil. The veil has several other meanings too. It is a symbol of male identity. This veil helps Ukhayyad in a way to hide his embarrassment when questioned about the uniqueness of the piebald “Ukahayyad tried to hide his embarrassment behind his veil” (6).

Tuareg women wear wrap around skirts and embroidered flowers. Once women get married they wear the head scarf that hides their hair but marrying does not in any way diminish women’s power and authority but they Cherish financial, social and domestic dominance. Meanwhile a Tuareg woman keeps the possession of the things she brought through marriage and this includes their children too. There is one strange and unusual lurking within the Tuaregculture. It is highly rude for a man to eat in front of a woman. In front of the mother in law it is extremely shameful for a man to have his food. The idea is horrendous for the Tuaregs. The women are given due importance in Taureg tradition they also prepare the camels to dance before the women. This is described in the novel when Ukhayyad takes much effort to prepare Mahri for the dance “preparing to dance in front of women, swaying back and forth to rhythm and melody of music” (8). They sing songs in praise of the women. Women are placed at the Centre in Tuareg culture and also as the matrilineal society. The Tuaregs trace their families through women. In each family, women own the herds and family home. Women’s rights are embraced in all the aspects of a Tuareg life.

Women are free to marry as many times as they wish very often families throw divorce parties to their daughters to announce the society that their daughters are free to marry once again “The celebration was for one of the tribe’s vassals a habitual divorcer and marrier who had decided this time to take a beautiful mulatta, choosing a savor the taste of Tuareg blood mixed with the heat of Africans” (9).

Turegs live in a very simple and always ready for transport tents. They move very often with the herds of camels and goats. The families live togetherat camps. They build several types of buildings, but the most common are tents from lather, tight on wooden construction. The entrance is usually not covered, built from non-wind side. The floor is covered by mats. The closer surrounding is bordered by stones. The other common houses are huts from mats, houses from West Africa. Houses are very modest, Tuaregs does not own much. They possess a couple of containers to cook, leather pouches for water. They sleep on the plain ground covered by mats or leather. They cook at open fire outside their houses. The only problem is with firewood. There is always lack of the wood on desert, so they often use dried dung.

Tuaregs have a long tradition of music and poetry. In order to avoid loneliness while travelling across waterless deserts they have developed the habit of singing and dancing. Al-koni has brought this beautifully into the novel. When Ukhayyad receives a piebald he happily sings song “There he would Raise his voice, singing one of those bewitching songs, like charms against loneliness that riders take refuge in whenever they travel across the waterless deserts”(6). He even approaches a famous poetess to compose song. “He finally sought out a famous poetess of the KelAbada tribes. He asked her to compose a poem glorifying the Mahri’s innate qualities and extolling his talents, likening him to war heroes” (6).

Tuaregs are also proud of their rich tradition and culture. They have survived a thousand years and certainly will hold fast to the traditions which make them so very different from all others. They consider themselves to be superior races than any other civilization alive. They also consider other cultures a bit stupid and primitive. Much of Tureg art is in the form of jewelry, leather and metal saddle decorations called trik and finely crafted swords. They also make pilgrimage with intricate iron and brass decorations. The Tuaregs strive hard to preserve their traditions and values. It is interesting to know their folklore and culture, it also motivates the readers to shield their own indigenous culture.

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Mutual Bonding with Mother Earth in Easterine Kire's *When the River Sleeps*

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ABSTRACT

*Easterine Kire does a magnificent work to highlight the rich environment of Nagaland. The beautiful inter-mingling of humans with their natural habitat is bit wishful, on part of Easterine Kire. This paper aims at giving eco-awareness by presenting the mutual bonding with mother earth in Easterine Kire's *When the River Sleeps*. It is an attempt to make the people value nature and to acknowledge the importance of nature in everyone's life. It aims to give awareness to the modern society that man's way of life is determined by nature and patterned by the nature in which he lives.*

Human life is inconceivable without the existence of nature. It is a known fact that carbon-di-oxide released by men is used by trees while the oxygen released by trees is used by men. So says Lawrence Buell, "The nonhuman environment is present not merely as a framing device but as a presence that begins to suggest that human history is implicated in a natural history" (7). Easterine Kire is a prominent writer from Nagaland, India and her novel, *When the River Sleeps*, exposes human beings' deep connection with nature.

Nature is presented as a place of retreat and sanctuary and it becomes almost like a character in the novel as it helps Vilie overcome the fear of not just people but also spirits. He gets comfort and calmness in the wilderness as it protects him like a mother providing shelter. He is constantly awakened by dreams of a river which a seer had mentioned him earlier. The river has a particular stone which has the power to grant its owner any wish.

When the River Sleeps is set in the beautiful and scenic hills of Nagaland. Vilie, along with him, takes the readers also into the forest as he undertakes the epic journey in search of the river. As Vilie takes shelter in the village the readers are also transported to take a glimpse of the lives of Naga people.

Nature is presented as empowered and not oppressed. Nature has the power to endow blessings and grant wishes. The river mentioned in the title of the novel itself is a good example. Vilie narrates, "If you can wrest a stone from the heart of the sleeping river and take it home, it will grant you whatever it is empowered to grant you. It could be cattle, women, prowess in war, or success in the hunt" (3). Nature has full control and man waits for nature and its blessings.

Nature is also a benevolent provider almost equivalent to God. It generously provides food, shelter and all amenities necessary for survival to all who seek it. The home of the people is the forest and the people living there don't want to deceive or move away from the place. They feel restless if they settle somewhere away from the forest. This novel explores relationship between nature and human, which is as vital as the umbilical cord.

When we consume vegetable food, we take the energy of nature particularly that of the sun. But plants are also the food of herbivorous animals, and when we eat meat, we take this energy at second hand. In this context, nature serves as a mother in feeding the people who depend on it. In the story, when Ate feels hungry and in need of energy on the way “She ran to the nearest plantain and plucked two. They were so ripe that the fruit was almost bursting its skin. Ate bit off a bit and tasted it. It was good and sweet” (201).

Nature is Vilie’s protector and he is nature’s protector. The relationship is thus interlinked and mutual. Vilie’s death is significant because he dies protecting the heart-stone which is that bit of nature he considers sacred and precious. Vilie dies in the encounter with a thief who needs the heart-stone for the carving of money. While trying to save the heart-stone from the thief Vilie meets with death.

The healing touch of nature is emphasized by Kire in this novel. Nature provides an antidote and cure for all ailments and the people rely on it heavily for treatment of any kind. The people here are not provided with medicine or hospital. They use natural medicines like herbs, rock honey etc.

The guardian of the forest carefully tends the injured forest dwellers. Vilie makes “pastes of ciena for open wounds. That worked for smaller injuries, but for bigger wounds he liked to use pungent *Japan nha* and rock bee honey. He had tried these on himself, and the healing had been quick, with little scarring” (41). In the village, for the people who are affected by fever “the seer would give them a drink made of ginseng and *tsomhou*, the wild sour seed that grew on trees” (53-54).

Nature more than providing a backdrop in the novel is almost like a character in the novel. Nature helps Vilie to conquer fear. When he witnesses the murder in a shelter that he has taken refuge in the night, his first instinct is to run. He flees for his life and little does he think that there is a chance for them to blame him for the murder, for the other three people present, including the murderer, are brothers. He requires refuge in the forest to escape from people who are after him. In the forest his thoughts become clear. The serenity of nature helps him to think clearly and takes the right decision which is to walk to the ancestral village and try to attain justice.

Nature helps him not just to conquer the fear of people but also the fear of spirits too. As Vilie reaches the river of his dreams he realizes that the “river is a spirit” (108). Though literally he steps into the river to wrest the heart-stone, the force of the gushing water which almost strangles him makes him realize that his fight is against a spirit. He conquers the fear of this spirit by invoking nature as he says, “Sky is my father, Earth is my mother, stand aside death! Kepenuopfu fights for me, today is my day! I claim the wealth of the river because mine is the greater spirit. To him who has the greater spirit belongs the stone!” (103). Vilie used to tell his relatives that forest is his wife.

Man is constantly aware of the influence of nature in the form of the air he breathes, the water he drinks, the food he eats, and the flow of energy and information. And many of his troubles are a response to the natural processes and changes in the weather, intensified irradiation of cosmic energy, and the magnetic storms that rage around the earth. In short, we

are connected with nature by "blood" ties and we cannot live outside nature. In the story, the protagonist once says: "Sky is my father, Earth is my mother" (193).

Man is not only a dweller in nature, he also transforms it. From the very beginning of his existence, and with increasing intensity human society has adapted environing nature and has made all kinds of incursions into it. An enormous amount of human labour has been spent on transforming nature. Humanity converts nature's wealth into the means of the cultural, historical life of society. The characters in the story cultivate paddy for food and to sell the paddy and buy the things they need "a very flat land area of land with a row of rice fields west of the village. He could see paddy growing in neat lines there" (91).

Nature provides a vast bounty of resources and embraces human beings with warmth. It nourishes and nurtures and when man cherishes and relishes the wonderful riches of nature, he flourishes as wholesome human being with holistic perspective. Ecofriendliness is the close association of human beings with nature that is profusely celebrated in literature. To sum up in the words of Vasanth Moon, "Nature is a close friend. It distributes happiness to us with innumerable hands. Everyone has to decide for himself how much to take" (31). In this novel, Easterine Kire considers ecofriendliness as the mantra for holistic living and envisions a world of equality through an ecofriendly ambience. Through this novel, the author suggests, if there is no nature there would be nothing left in this world to admire and cherish. She also recommends the human beings to be accountable to the environment or else the consequences would be disastrous.

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Economic Disparity of Dalits in Sharankumar Limbale's *The Outcaste*

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ABSTRACT

Dalits are oppressed and exploited in the name of class, caste and creed. They are in poor social status and to overcome it they do all the menial jobs. They are pushed to the end by the dominating forces of the society and are made to feel guilty of their condition. This study is an effort to analyze the poor social status of the Dalits with reference to Sharankumar Limbale's The Outcaste. Limbale is a Marathi writer who was a victim of economic disparity. He puts forth it in his autobiography, Akkarmashi which was translated in to English as The Outcaste. He expresses traumatic experiences of a dalit in the contemporary society in his work.

Dalits face widespread discrimination in India and their social status is very poor. The Hindu caste system divides the people into different castes in which Dalits are at the bottom. They still undergo various problems as untouchables. They are denied their rights to mingle with the other people in the community especially the high-caste people. Eventhough they experience various privileges from the government they undergo discrimination in the name of social hierarchy. They work under the high-caste landlords, but don't receive the actual wages for their hardwork. Limbale clearly showcases the economic disparity in his Mahar community. His novel, *The Outcaste* is translated into English by Santhosh Bhoomkar. In his own regional language of Marathi, Limbale expresses the various atrocities he undergoes as a dalit.

Limbale foretells the pathetic condition of the Dalits in his autobiography, *Akkarmashi*. "The word *Akkarmashi* in Marathi means a person whose birth is illegitimate or one who is an outcaste" (Saini 7). It is about an untouchable family in general and the community struggles in particular. They are branded as untouchables and are alienated from the main society. Dalits are denied access to land, and are forced to work in degrading conditions, and routinely abused at the hands of the police and upper-caste community members who enjoy the state's protection.

In *The Outcaste*, Limbale shows how he struggles for a day's meal. Dalits receive the leftover food from the high-caste people and fill their stomach. Even in school, the students are forced to get the leftover food to fulfill their hunger. Due to the poor social status the Dalits are deprived of the basic necessities of life like food. Limbale says, "My stomach was like a way to the graveyard that continuously swallows the dead" (2). Since they don't receive enough food, they often go to bed with half-filled stomach. This reflects the condition of the oppressed class about half a century back. *The Outcaste* shows the real picture of the darker side of Indian society.

Along with the curse of untouchability, the dalits are not allowed to draw water from the common well; they are prohibited from entering temples; they are barred from the right to education and knowledge; they have to perform menial jobs for the higher castes; they are not

allowed to use the common burial ground; they are not allowed to live in the main village inhabited by the upper varnas; and they are deprived of ownership rights to land and property, leading to the lack of access to all sources of economic mobility. Thus, dalits are subjected to both social exclusion and economic discrimination over the centuries. In one form or the other, this continues even today in most parts of the country. Limbale's grandmother, Santhamai does all the menial jobs to serve her family. Everyday she sweeps the village streets and gathers cow dung. She goes to work daily like a government employee. She also works as a midwife. She accepts whatever work she is given to get food for her family. Their poor social status is revealed when Santhamai eats the grains which are collected from the cow dung. When he tastes it, Limbale comments that, "It stank of dung. As I chewed it, I felt I was actually eating dung" (11). Santhamai even goes to the extent of collecting the flour which is in the sand. She, along with Dada does whatever they can to uplift their poor social condition. Limbale says that, "Starvation was in our lot from the moment of our birth" (21). While these people suffer due to the lack of food, the high-caste people waste it during festivals and functions. Hunger is common to all human beings but only the low-caste people are experiencing it.

Caste discrimination is seen even among the Dalits. Limbale's birth itself is considered as inauspicious. He is born to a high-caste man Hanmanta Limbale and the low-caste woman Masamai. So he is treated lower than the Dalits of his community. Mahar community calls him *Akkarmashi* because his father is a high-caste man and the high-caste people call him an untouchable because he is Mahar. Dalits depend on the daily wages for their survival. Dada earns money by being a porter. He waits at the bus stop, "as a prostitute waits for her customers" (41). Though these people show their full effort they don't find any improvement in their social status. If the Dalits refuse to do the menial jobs, there won't be anyone to serve the high-caste men.

Dalits go to work on a contract basis. If one doesn't get a job he has to spend the entire day with an empty stomach. Due to their poor social status, the Dalit children are not able to get proper education. So they accept their condition as fate. The way Limbale expresses his poor state shows his concern towards the people who suffer like him. The prevailing caste system in India is so deeply rooted. Dalits still suffer the stigma of untouchability, even after caste discrimination has been declared an offence under law. Dalits are landless and take up the traditional occupation, which hinders any kind of economic upliftment in the life of the untouchables. They work as labourers in the fields of high caste for a small amount of grain.

Sharan Kumar Limbale, through his works expresses the differences in the treatment of Dalits. "The aim of Dalit Literature is to protest against the established system which is based on injustice and to expose the evil and hypocrisy of the higher castes. There is an urgent need to create a separate aesthetics for Dalit literature, an aesthetics based on the real experiences of life" (*The Aesthetics of Dalit Literature*). Limbale's work, *Towards an Aesthetics of Dalit Literature* shows that, people believe that independence will bring them freedom. But, social issues like unemployment, poverty and corruption make them lose their hope of freedom. *The Outcaste* is a fine example of the difficulties of Dalits. Limbale projects before the readers an objective and disinterested account of his life from birth to

adulthood, carefully creating the image of his community in conflict with the contemporary social and cultural conditions.

Even after independence, political rhetoric and constitutional protection have failed to end atrocities against Dalits. Limbale says that he often stays in the bus stand. He says: “‘My house’ was our village bus stand” (96). Most of the Dalits don’t have proper house to live in. They sleep wherever they find a place and eat whatever they get. According to the NHRC statistics, “37 per cent Dalits live below the poverty line, 54 per cent are undernourished, 83 per 1,000 children born in a Dalit household die before their first birthday, 12 per cent before their fifth birthday, and 45 per cent remain illiterate. The data also shows that Dalits are prevented from entering the police station in 28 per cent of Indian villages. Dalit children have been made to sit separately while eating in 39 per cent government schools” (Jha). Limbale wrote his autobiography when he was 25 years old. He tries to overcome the economic disparity by giving voice to his people. He believes in the words of Ambedkar and follows it throughout his life.

One who experiences the pain will move forward for a change. Likewise, Limbale portrays the poor condition of his people and desires for a change which he has expressed in *The Outcaste*. All are equal before the eyes of God. The man made rules and regulations create discrimination among people. Equal opportunities for all will abolish the caste system. This will provide good job opportunities for the Dalits and there will be solutions for all their economic problems. Limbale’s, *The Outcaste* stands as an example for their quest for upliftment and their longing for equal treatment.

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An Inexplicable Marital Kinship in Shashi Deshpande's *Strangers to Ourselves*

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ABSTRACT

This study attempts to explore the intricate nature of marital relationships in Deshpande's novel, Strangers to Ourselves. She writes about issues and problems of middle-class Indian women caught in the trap of Indian patriarchy. She has a comprehensive understanding of the grass-root reality and women's place and position, plight and predicament in a male-centric Indian society. Unable to bear restrictions and compulsions imposed on them in the name of gender discrimination in their parental homes, they use marriage as an escape route, but unfortunately, in most cases, marriage becomes a trap for them. They are humiliated, tortured and exploited in one way or the other. Deshpande's novels move around marital relationships which are marred by the evils such as male pride, ego and domination, patriarchal attitude to women, lack of understanding and communication.

Shashi Deshpande, a Sahitya Akademy Award-winning Indian woman novelist, depicts the plight and predicament, pain and anguish, suppression and exploitation of educated and career-oriented middle-class Indian women caught in the trap of Indian patriarchy. The woman, she believes, occupies an important position as a wife, a mother, a daughter, a sister, and most importantly, as a human being in all human relationships. In an interview given to Vanamala Viswanatha, Deshpande says: "It is necessary for women to live within relationships, but if the rules are rigidly laid that as a wife or mother you do this and no further, then one becomes unhappy. This is what I have tried to convey in my writings" (13).

Deshpande's novels deal with the theme of marriage and marital relationships. To be true, ideally, marriage is a beautiful thing. It is a special kind of friendship, a special kind of partnership between two people from the opposite sex, people with different tastes, interests, attitudes, likes and dislikes. In their future home a woman is expected to adjust herself completely to a new environment, customs and conventions of her marital home. It allows her to keep her social dignity intact and to find sexual fulfillment as a loved one. Taimavshi, in *Strangers to Ourselves*, says: "Apu, marriage gives you security; it leaves you free to live the rest of your life without worrying about loneliness or sex. And the greatest boon – you can have children. Life is transformed when you have children" (145).

A Happy and successful marriage is not everyone's cup of tea. Marriages, love as well as arranged, in Deshpande's novels, with some exceptions, are unhappy failures. The demand of the lifetime love and commitment makes it impossible for everyone. They fail on account of various factors such as sexual promiscuity, male-ego, male-domination, women's growing economic independence and awareness, the patriarchal attitude to women, men's treating of women as the objects of sex, lack of understanding and so on. Circumstances too seem to be responsible for the failure of marriages. The belief that a husband and a wife are to satisfy each other throughout their lives is monstrosity which gives rise to hypocrisy, lying, hostility and unhappiness which ultimately are loads of the failures of marriages. Outwardly, the marital relationship appears to be based on equality, mutual love and trust, but inwardly it

is marred by the evils in the form of male pride, male-ego, male-domination and inhuman marital sex which seek to marginalize women.

Marriage makes a woman sacrifice her name, person, self, identity, freedom, virginity, her dreams and aspirations. Simone de Beauvoir writes:

In marrying . . . she takes his name; she belongs to his religion, his class; she joins his family, she becomes his, half . . . She gives him her person, virginity and a rigorous fidelity being required . . . No doubt marriage can afford certain material and sexual conveniences: it frees the individual from loneliness, it establishes him security in space and time by giving him a home and children; it is a definite fulfillment of his existence. (445-51)

The patriarchal society expects the woman to submit passively to the demands and desires of her husband and to accept her husband who, as per conventions and traditions, is above her in each and every respect. Marriage assigns her the functions of satisfying her husband's sexual needs, providing children to her family and taking care of her husband, children and household. Deshpande is essentially concerned about the issues and problems related to marital relationships. This study intends to explore the intricate and inexplicable marital relationships in her novel *Strangers to Ourselves*.

Deshpande's latest novel, *Strangers to Ourselves*, is a story of love between two person from different fields - Aparna, an oncologist and Hari, a rising singer. It draws the readers deep into the pleasures, sorrows, contradictions and conflicts of falling in love and marrying. It moves around the theme of sex, love and marriage. Aparna's first marriage is a tragic failure. Aparna tells a tragic story of her marriage. She marries a man from her college, and enjoys their life in Paris, but they know that they are doing wrong. Her father dies and she never goes back to meet him. Their marriage life is very short. For her husband, marriage is no more than sex; it has nothing to do with the noble feeling of love which is the base of marital relationships. She too admits that she sleeps with him not for love, not even for lust, or for her bodily need, but just out of desperation and loneliness. After she decides to end her marriage, she wants to get rid of everything associated, with the man she has married. She loses her trust in marriage and decides not to marry again.

Aparna meets Shree Hari Pandit and falls in love with him. Their frequent visits bring them emotionally and physically together. He is eager to marry her but she is not prepared to marry him. Being afraid of marriage, she is determined not to marry again. In a response to his question, "Will you marry me, Aparna?" she responds: "Hari, I love you and I want us to live together" (251). But she does not mean to marry him. She offers herself physically to him and wants to be a part of his life without marrying him. He has been very uncomfortable with himself since the day of his physical relationship with Aparna. He writes: "I am uncomfortable with myself . . . Your body is sacred to me" (220). Jyoti wants Aparna to marry him says, "You want a perfect marriage and you are afraid it won't happen . . . Whatever time you have, doc, live it with the man you love" (260-62). Taimavshi, Madhu's mother too, wants her to marry him. She wants her not to burden herself with the failure of her parents' marriage. Aparna admires the courage of people who, having had one bad marriage and get into another. She wonders how Mel can be so optimistic about her second marriage to another man. She thinks of her own idea of living with Hari not tied in the tight

bond of marriage, but tied together only by love. She thinks a lot and ultimately prepares herself to be caught in the trap of marriage.

Aparna's parents, Gaja and Sulumavshi, initially a happy couple loving each other intensely but meets with an unhappy end when her mother leaves home never to come back. She is determined not to forgive her husband who gets involved in an extra-marital relationship with a singer and actress. Their marriage breaks up unexpectedly in a flash. Aparna wonders: "Why, then, did she refuse to forgive him in the end? . . . Does marriage mean tying two people in so tight a knot that to live together is difficult, and to separate is death?" (148). She thinks of how her mother, a typical Indian woman, had shaped her life to her husband's needs and requirements. She ends her marriage in a flash. Marriage of Jyoti's parents is not a happy one. It is deeply rooted in marital sex. Prabha, her mother, who doesn't even know that she cannot say no to her husband in bed thinks that it is her duty to do what he wants. She even thinks of scratching her face and spoiling her looks so that she will save herself from sex. Jyoti, an unloved child, defies her father whose focus is Deepak, the son of the family and the heir, and marries Akash and receives a gift of marriage in the form of children. For her, sex is a means of reconciliation between husband and wife; it is a means of bridging a growing gap between them after her husband's death, it is difficult for her to control her desire. She wants to satisfy her desires, but she does not do that because she has a son Tejas.

Deepak marries Mel but they cannot move on with their marital life in spite of their love for each other and their love for their son. According to Mel, her marriage to Deepak is more daunting as a result of their different races, cultures and religions. Madhu, a rebellious girl, marries and adjusts to living with Abbas, a Muslim. She happily copes and becomes a part of her marital family. She is friendly even with Nilu, Abbas's first wife and the children as well. It is the woman like Madhu who sets the tone for the way a couple lives. She believes that sex plays a vital role in keeping marital relationship intact. She says: "You can't insure your marriage against all possible problems . . . Once you sleep together, everything falls into place and your relationship becomes *pukka*" (115-116). Ahalya's second marriage with the painter is a happy beginning. She does not consider her second marriage a sin.

Through the characters of Aparna and Hari, Jyoti and Akash, Madhu and Abbas, Gaja and Sulu, the readers come to know about the inexplicable marital relationships. It is true that marital happiness and success are abstract concepts. Their meanings change from couple to couple, person to person. Their hard part of life becomes a barrier for them to lead a life in a peaceful manner.

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Voice of the Periphery: A Study of Chitra Banerjee Divakaruni's *The Palace of Illusions*

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ABSTRACT

Chitra Banerjee Divakaruni's works feature Indian born women torn between Old and New World values, giving laser-like insight in to the many-layered aspects of her characters and their respective worlds, which are filled with fear, hope and discovery. In the The Palace of Illusions Divakaruni focuses on the unexplored areas of female desire lacking attention, implicates the problems of discrimination, dislocation and disorder infested in the age-old patriarchal understanding of women in India. The present study examines the struggles endured by women in a traditional world and focuses on how she breaks the so called notions and taboos formed by the society to establish an independent state for women.

The concept of feminism, in general, has been concerned to an analysis of the trend of male domination in the society; the general attitude of male towards female; the exploitation and discrimination faced by females; the ways for improving the condition of women and so on. Chitra Banerjee Divakaruni's *The Palace of Illusions* gives the readers a chance to take a look into the mind of the women, who broke the stereotypical notions about them.

Woman plays a vital role in the family. She supports her husband, children and becomes a great homemaker. She remains with them in any dire circumstances and boosts courage in them to face the problems through her moral support. She has the power to create history by making or marring the relationships. One such woman is Draupadi. Divakaruni highlights the role played by Draupadi as well as other women characters. In her novel, Divakaruni places the women in the forefront. She makes Draupadi narrate "her joys and doubts, her struggles and her triumphs, her heartbreaks, her achievements, the unique female way in which she sees her world and her place in it" (Divakaruni XV). In the author's note she says, "It is her life, her voice, her questions, and her vision that I invite you into in *The Palace of Illusions*" (XV).

Draupadi narrates her birth from fire, marriage with five husbands, who are denied of their father's kingdom, her insult, exile and the impending war. Divakaruni's Draupadi is introduced as the "girl who wasn't invited" (Divakaruni 1). Draupadi is neglected by her father for being born as a girl and is brought up in her father's palace as a typical traditional girl. She is taught dance, music and sewing. And so, she feels that the world of women tightens its noose around her. Draupadi is more interested in learning the state affairs. She secretly learns all the lessons that are taught to her brother and shows dislike towards her father's palace due to her father's initial rejection and hesitation to accept her. She is marginalized in education.

Draupadi has a very distinct and assertive personality which is considered as a heroic quality in a man but as anti-heroic for a woman. The self-assertiveness, determination, intelligence and education of Draupadi ultimately turn against her in the course of the novel.

Draupadi, in reality, faces the harsh sufferings of a female. Draupadi falls in love with Karna. But her brother and Krishna prevents her from marrying him. She desires to have a husband of her choice, but it is suppressed. Arjun wins the archery test and marries Draupadi. Kunti, mother of Pandavas insists that Draupadi should marry her five children. Draupadi experiences the pangs of unfaithful love. The marriage of Draupadi with five Pandavas has not been accepted in Indian society. Women are prescribed to be chaste, loyal, and dedicated to a single man in their lives. Draupadi is forced to marry five men against her wish. Draupadi becomes a victim to her mother-in-law's selfishness, who wants to keep her sons united. She is looked down upon because of polyandry. But her husbands take in other wives freely in the name of certainly political arrangement. While Draupadi's loyalty is unquestionable, none of her husband's come to rescue her, when she is disrobed. Draupadi's wrath and vengeance that has been depicted in the novel act as a catalyst to bring the world to an end.

Draupadi's relationship with her mother-in-law is one typical of daughter-in-law and mother-in-law. Draupadi is denied of the natural pleasure that a newlywed has on their wedding night. She has to lie on the floor with a rat-nibbled mat near the feet of her husbands maintaining certain distance. She laments that instead of the bed of scented silks; instead of being held close and cherished she has to face this drudgery. Divakaruni's Draupadi is in many ways an ordinary woman's rebelling against the fact that major decisions in her life are taken by men without consulting her. Though Draupadi married the five Pandavas, she showered her love only towards Karna. Her urge for love could be seen throughout the novel. As a woman she loses everything in her life. Divakaruni brings out the condition of women after marriage. Men always search for a chance to humiliate woman and views the body of a woman to be a target.

Divakaruni's Draupadi proves the strength of womanhood. Draupadi tries to free herself from the so called notions, taboos of the society and the expectations of the scriptures. She leads a lonely life and so her life is filled with emptiness. She undergoes a terrible life of hiding, servitude, evading assault and finally, the grim justice of war and a lonely death falling off a mountain track. Draupadi never from her childhood feels at home but it is her exile that makes her incredibly adamant for her to create a home of her dreams. Her inner alienation drives her to push her five husbands to create a palace of her dreams which she can call her own. She almost rediscovers herself and her identity. Draupadi is an epitome of timeless woman. She wants to live an independent life. The emotions Draupadi feels are what every woman of South Asian origin encounters.

Draupadi's marriage life is a failure. Even her wish of selecting a groom of her own is dejected by her father due to political reasons. This is similar to the typical Indian system, where a woman is not allowed to choose her husband, but her parents decide on it. The society has prescribed certain norms and realities. The woman's mind is considered as a clean slate for men to write their desires and expectation. "Men wish to give different roles to women, according to their desires. She is taught to be shy, gentle and dignified as a person, pure and faithful as a wife and selfless, loving and thoughtful as a mother" (Bhatnagar 2).

In a world and society dominated by men, in a world where the role of the wife is just taking care of her husband, family and their needs, this novel urges the reader to take a look into the mind of the woman who changed it all and in the process sets the ball rolling for

generations to follow. The suffering that Draupadi endures is universal. Her pain and suffering could stand for the entire women silently suffering all over the world. The society wants married women to be mild, submissive, domesticated, non-protesting and self-sacrificing. Divakaruni brings forth the plight of Draupadi, who tries to assert her identity from the very beginning of her life. "To attain freedom physically and psychologically, one should have the courage and determination to do things in the right way" (Brunell).

Women are discarded, rejected and subordinated in the male dominated society. A woman is forced to suppress her dreams and desires. In India, women are brought up with the idea that they are only guests in their parental home and that their husband's house is their ultimate destination. Divakaruni gives a realistic picture of the suffering endured by women right from the mythical age to the present day. Through the character of Draupadi she gives voice for the voiceless women. This novel is Divakaruni's attempt to voice the feminine quest for identity. Thus through Draupadi's discourse, Divakaruni asserts that Draupadi is not merely the history of myth but also an epitome of feminist desire.

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A Spatiotemporal Study of Chimamanda Ngozi Adichie's Americanah

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ABSTRACT

The present study focuses on the spatial structures in the novel Americanah by Chimamanda Ngozi Adichie. It is a connecting story that takes its readers to Lagos, in 1990's, where the protagonists of the novel Ifemelu and Obinze experiences their first love and Nigeria faces challenging times under a military government. The aim of this study is to analyse the spatial and temporal scope of the character Ifemelu in an alien land and shows how she assimilates into mainstream culture and create a new identity, distinct from the identity they previously held.

Chimamanda Ngozi Adichie is one of the Nigeria's more prominent new generation female writers. She has published numerous short stories, essays, poems and three novels. Her works are primarily character-driven, interweaving the background of her native Nigeria and social and political events into the narrative. Adichie's works have been met with overwhelming praise and have been nominated for and won numerous awards, including the Orange Prize and Booker Prize. Adichie has spoken in a TED talk entitled 'The Danger of a Single Story'. At the lecture she says that the under representation of cultural differences may be dangerous: "Now, I loved those American and British books I read. They stirred my imagination. They opened up new worlds for me. But the unplanned consequence was that I did not know that people like me could exist in literature".

Americanah tells the story of young lovers Ifemelu and Obinze who meet as teenagers growing up in Nigeria. They form an instant bond between each other but when Ifemelu moves to America, Obinze is unable to go with her. Meanwhile he moves to England where he stays as an illegal immigrant. The study analyses the separation of the two lovers by time and space and how the two characters overcome their separation and achieve success, inspite of all the hardships in their native land and foreign land.

The novel revolves around the issues of worldwide identity and the struggle of the immigrant, especially within the liminal, 'Third space' created by the immigrant. The 'Third Space Theory' explains the uniqueness of each person, actor or context as a 'Hybrid' which is attributed by Homi Bhabha.

Several characters undergo transitions in Americanah, shedding old identities and developing new ones, and each of them seems to be linked to power in some form or the other. It can be a culture, a race, a social class, or even a loved one. At first, this assimilation feels unnatural, but it finally becomes harder and harder to separate one's past selves with their newly adapted identities. The character Ifemelu understands the American culture and adopts it in her life, especially with the hair situation. Hair salon becomes the setting for all of Ifemelu's initial flashbacks. Adichie begins the story in a salon, where readers can find Ifemelu getting her hair done. In Nigeria, hair is a sign of identity. The work *The Twice*

colonized: Women in African literature explores that “The fictional world which the African women inhabits allows us to intimately know her, and experience with her as she confronts aggression subjugation and learns to contend with it. We are both witnesses as well as participants in her struggle to find a place in the sun”(211). Hair is a symbol of oppression and independence in America. The cutting of the hair represents Ifemelu’s mother giving up her independence for the sake of religion. Ifemelu’s mother does not play a major role but one can witness her religious beliefs shaping Ifemelu as a strong woman.

Ifemelu talks about how race is not a prominent part of her identity until she came to America, which can be related to many of the international students. Ifemelu is directly characterized by her outer differences and becomes a ‘Black woman’. Ifemelu’s ethnic experience in the U.S further goes on to influence the other aspects of her identity. Ifemelu’s experiences cause severe harm to her ‘self’ worth. Her inability to find job forces her to sell her body in order to pay the rent, pushing her into a short period of depression that destroys her relationship with Obinze.

Ifemelu is actively involved with her blog when she meets Blane, and while her blog is meant to be an honest reflection of her experiences. She starts to feel a obligation to live up to her blog persona and her followers. She begins to write for the sake of impressing her well-educated followers through providing them with fresh material.

Ifemelu finds her identity through relationships. Curt is her first boyfriend in America, and it is with Curt, a white man that she has first looked in the mirror and with a rush of accomplishment seen someone else. Curt’s affection is a source of pride to her and a means of rebuilding her shattered confidence. It is Obinze, with whom she grows and feels more comfortable. Though it can be argued that he has the most prominent impact on her identity, he is someone without whom she never feels complete and is a major factor in her decision to return to Nigeria. Ifemelu thinks that ‘someone like her’ is not supposed to live in a place like Princeton: a wealthy, white, and well educated community. Ifemelu’s identity crisis urges her to move from the host land, but her cultural change prevents her from doing so. She feels bad that America has changed her, so that she is no longer true Nigerian.

They roared with laughter, at that word “Americanah”, wreathed in glee, the fourth syllable extended, and at the thought of Bisi, a girl in the form below them, who had come back from a short trip to America with odd affectations, pretending she no longer understood Yoruba, adding a slurred r to every English word she spoke. (65)

The word ‘Americanah’ is first introduced in the fifth chapter. It is a slang word making fun of Nigerians who go off to live in America and then come back pretending as if they are superior or foreigners. In the novel ‘Americanah’ is applied to Ifemelu, for she fore shades the struggle of identity crisis. The newness of everything becomes terrified for Ifemelu in America that she feels disconnected from American life. The oppressive power of America pushes Ifemelu down that it makes her feel value less. As a result of this she makes some changes in her life to fit in better and attain a greater height.

Obinze’s experience in England is not as successful as Ifemelu’s in America. He feels invisible as an illegal immigrant. Obinze recognizes that every immigrant has to build up a

new identity when they move to a western country. When Ifemelu goes back to Nigeria she has an American accent and is caught between not being an American in America and not being a Nigerian in Nigeria. Ifemelu achieves hybrid identity and creates her own 'self'. Ultimately, the characterizations and situations in the novel *Americanah* clearly show the many forces working upon the creation of Ifemelu and Obinze's own 'self' which is evidently achieved in course of time and space given to each of them.

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A Quest for Self- Identity: An Androgynous Cognizance in Virginia Woolf's *Orlando*

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ABSTRACT

"A Quest for Self- Identity: An Androgynous Cognizance in Virginia Woolf's Orlando" analyses the patriarchal, social and political system of values, particularly related with women based on the novel Orlando. Her works serve as a vehicle for motivating women to come out of their depression and get a new identity in the society. Virginia Woolf, in her novel Orlando, reveals the unjust and unequal position of women and how women are persecuted as well as bounded by male dominated society for no good reason. This work is a mixture of her opinion concerning art, position of women and sexuality. She is of the view that problems may crop in women's life, but they must learn to tackle it wisely. Women's life will be a peaceful one only when all men realize the traumas undergone by women and start respecting them. Her work becomes a mode of re-thinking about life, experimenting, exploring time, space, memory and consciousness, the very concept of self over and above with an impact on the creation of identity.

Woolf is a key figure in the modernist literary movement. Her works expose her taste of writing which had a mixture of bare truth focused on women as well as the treatment of men with women. Woolf brilliantly achieves the telescoping of the women's internal conflicts. She was intensely critical of patriarchal, social and political system of values, particularly related with women. Her works became a vehicle for motivating women to come out of their depression and get a new identity in the society.

Woolf's *Orlando* (1928) is a mixture of her own opinion concerning art, position of women and sexuality. The novel takes place in England and the Near East and it portrays the Elizabethan period in all its rich movement and colour. Orlando grows, during 342 years from an Elizabethan boy of sixteen to a twentieth century woman of thirty-six. It is a fantasy-biography which belongs to a class by itself. It shows step by step the changing process of personality that takes place in Orlando. Woolf reveals how unjust and unequal the position of women is and also how women are persecuted as well as bounded by male dominated society for no good reason.

Orlando, the protagonist is first shown as a young boy in the Elizabethan period having a passionate affair with a Russian princess. Next, he is shown as a British Ambassador Extraordinary in Turkey. Later he is mystically changed into a woman, and as such continues to live throughout the eighteenth, nineteenth and early twentieth centuries. She marries Marmaduke Bonthrop Shelmerdine, who leaves immediately after the ceremony to continue his career of sailing around Cape Horn. Woolf's strongest example for an androgynous mind in her work is seen in *Orlando*. She tries to bring the vision of male traits and female traits in a human being explaining the problems one has to face in society because of the sex. Woolf defends the androgyny of human beings – the male and female aspects that coexist in every person.

Being now a woman and having had the experience of being a man she realizes with a start the penalties and privileges of her position. Orlando as a woman undergoes a lot of hitches

but later she decides to face it boldly. Her journey throughout the novel oscillates between a desire to die and a desire to live. Orlando experiences many highs and lows throughout the novel. He confronts the difficulties of reconciling the past and the present, the constraints of gender, and the demands of society. In *Orlando* Woolf exposes the shallowness of social life and its restrictions. She learns the art of writing through nature and experiences of her sex. The problem of being a woman arouses in Orlando and her thoughts are seen in the following words:

‘Lord’, she thought, when she had recovered from her start, stretching herself out at length under her awning, ‘this is a pleasant, lazy way of life, to be sure. But’, she thought, giving her legs a kick, ‘these skirts are plaguey things to have about one’s heels. Yet the stuff (flowered paduasoy) is the loveliest in the world. Never have I seen my own skin (here she laid her hand on her knee) look to such advantage as now. Could I, however, leap overboard and swim in clothes like these? No! Therefore, I should have to trust to the protection of a blue-jacket. Do I object to that? Now do I?’ She wondered, here encountering the first knot in the smooth skein of her argument. (75-76)

Orlando remembers how as a male he enjoyed the pleasures with women and had a strong opinion about how women should behave. He wants women to stick to the rules fabricated for them. But now as a woman he says, “Now I shall have to pay in my own person for those desires” (76-77). Orlando is irritated by her sex because she is not getting that freedom and happiness which she used to have before as a man. Nancy Cervetti says that the “Gender trouble is contagious in *Orlando*, a playful trouble that questions the possibility, the need, or the advantage of any stable notion of identity” (169). At this moment she thinks of Sasha with whom she flirted when she was a man. She comes to a new conclusion about Sasha’s motivations and character. Thus without giving much importance to sex Orlando seems to divert her attention to complete her poetry. “The distraction of sex, which hers was, and what it meant, subsided; she thought now only of the glory of poetry, and the great lines of Marlowe, Shakespeare, Ben Jonson, Milton began booming and reverberating . . . in the cathedral tower which was her mind” (80).

Woolf also expresses her views that women get less freedom to write. They have to think a lot before they come up with their own topic. As soon as a girl is born she is allotted with an angel who keeps on reminding her about her sex. Thus in the same way Orlando as a woman has many restrictions to follow. Woolf says, “Surely, since she is a woman, and a beautiful woman, and a woman in the prime of life, she will soon give over this pretence of writing and thinking and being at least to think of a gamekeeper” (132- 133). Orlando’s experience helps him to discover the differences in female sexuality. She lives in a time of repressed sexuality which is seen when she encounters the sailor. “For it was this mixture in her of man and woman , one being uppermost and then the other, that often gave her conduct an unexpected turn. The curious of her own sex would argue, for example if Orlando was a woman, how did she never take more than ten minutes to dress?” (93).

Here, Woolf clearly provides an image of man and woman’s nature. Riviere argues that: “gender is not a natural bodily attribute but, for women at least, a struggle and a performance produced to allay men’s fears that women will usurp their intellectual and sexual dominance . . .”(qtd. in Hovey 396). As a man he can bravely face anything under the sun. As

a man he can violate the rules and chase his heart's savour. Orlando accepts Euphrosyne and on the other hand rejects Clorinda and Favilla's proposals. Lawyers on both sides of the wished-for marriage are busy drawing up all sorts of contracts when the Great Frost begins. Orlando happens to see Sasha and he is incredibly attracted towards her, and ignores his actual fiancé. Orlando calls Sasha an olive tree, an emerald and a fox, metaphors conveying elusiveness and carrying no signs of one gender or the other. "When the boy, for alas, a boy it must be - no woman could skate with such speed and vigour - swept almost on tiptoe past him, Orlando was ready to tear his hair with vexation that the person was of his own sex, and thus all embraces were out of the question . . . She was not a handsbreadth off. She was a woman" (17).

Orlando starts his plan by sketching how to escape from the clutches of the proposed marriage and marry Sasha. Later Orlando is seen to be totally crushed when Sasha goes away with a sailor. Woolf's unexpected twist in the novel is the cause of Orlando's rebirth as a woman. Orlando's connection with the poets makes her witty. Orlando notices their secrecy regarding women i.e., men's mentality towards women. Orlando recollects how these witty men have extremely snobbish attitude towards women. She strolls outside her garden and meditates under a willow tree for a long time and when night approaches she goes into her house and leaves in the disguise of man. She takes a turn or two before the mirror to make sure that "her petticoats had not lost her the freedom of her legs, and then let herself secretly out of doors" (106).

Orlando is confused a lot regarding life. Orlando senses that she need neither fight her age, nor submit to it; she was of it, yet remained herself. Now, therefore, she could write, and write she did. "She wrote. She wrote. She wrote" (131). No one can stop her from fulfilling her goals which is writing. Orlando completes her poem "*The Oak Tree*". Like every writer she also starts thinking about fame. She thinks as if her work has been printed in seven different editions and she has won many prizes. She plans of burying the book but realizes that the dogs will dig it up. She wants to give her poetry as a token of reverence to her land which has given her everything- a name, fame and position in the society. The novel ends with Orlando in her backyard, baring her chest to the moon and shouting for her husband who is about to arrive.

Arriving in each new historical era as an adult, Orlando has been spared deterministic primary socialization, whereas the conventions of secondary socialization have inevitably shifted. Hence s/he is perpetually "just outside of any congealed and solemn definition of what human society is, of what sexes are, or of what a self is; the possibility of evolution into a higher state is left open"(qtd. in Garrigan 376).

Woolf wishes that the society should give liberty to women. She is of the view that problems may crop in their life but they must learn to tackle it wisely. Women's life will be a peaceful one only when all men realize the traumas undergone by women and start respecting them. Her work becomes a mode of re-thinking about life, experimenting, exploring time, space, memory and consciousness, the very concept of self over and above with an impact on the creation of identity.

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Culture as Victimizer in Freidoune Sahebjam's *The Stoning of Soraya M.: A Story of Injustice in Iran*

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ABSTRACT

Culture is a form of norms woven with customs and traditions. The present study focuses on Muslim women who are the victims of cultural aberrations. The cultural injustice focused in this study is the 'stoning' punishment in Iran. Freidoune Sahebjam stood against 'stoning' punishment which is well known through his work La Femine Lapidee, translated by Richard Seaver as The Stoning of Soraya M.: A Story of Injustice in Iran. The Stoning of Soraya M. is a pathetic real story about an innocent woman who is sentenced to death by stoning for a fake crime in 1986. One of the reasons for the death of Soraya is that she wanted to choose her life partner. The aim of the paper is to analyze how culture acts as a victimizer in crushing a woman brutally. Her husband Ali accuses Soraya of infidelity and uses Iranian culture of stoning an adulterous wife: a punishment prohibited by Islam but widely practised.

Sahebjam, one of the prominent French-Iranian journalists, reflects the pitiable state of women in Iran realistically. He exposes the hidden face of Iranian culture and analyses how women undergo tortures in the name of cultural practices. *The Stoning of Soraya M.* has been credited as, "An unforgettable indictment, brilliantly written and translated, of man's inhumanity to woman—and of tyranny disguised as righteousness" (*Kirkus Review*). This novel projects how the failing of the principles of Islam leads to the death of Soraya. He also portrays the brutal practices of Islam religion. Stoning is a method of capital punishment practised in Iran whereby a group of people throws stones at a person until he/she dies. Women sentenced to stoning are placed in a stoning pit, buried to the neck and others hurl stones at them until they die. In Islam, a woman who betrays her husband is considered satanic and therefore given the capital punishment. This is called as 'stoning of the devil.' After stoning, the villagers boast themselves of receiving the blessings of the Almighty.

The novel explores the brutal murder of Soraya in the name of culture. At thirteen Soraya was given in marriage to Ali, in exchange for several herds of cattle, a plot of land and several rugs. As a part of their culture, Soraya is not given any chance to select her life partner. So there is no love between them. Ali just uses Soraya for having sex brutally. With the passing years he becomes fed up with her and begins to torture her by beating and abandoning her. The religion of Islam demands that women should be treated with respect, honour and justice. It condemns oppression of any kind. But Muslims fail to practise the true principles of Islam. Hence, women like Soraya are victimized.

In the city, Ali is attracted towards Mehri and decides to marry her. To marry Mehri he finds Soraya an obstacle. Under Islamic culture men can have multiple wives, but Ali finds managing two houses a risky task. He asks Soraya for a divorce. As there is no response from her Ali devises a treacherous plot along with Ebrahim, Hassan and Hashem: accuse Soraya of infidelity with Hashem, the recent widower for whom she does some housekeeping. As planned, they prove Soraya's guilt in public for committing 'adultery'. Ali shouts at Soraya,

“Whore . . . that’s all you are, a filthy whore! A bitch . . . daughter of a bitch!” (66). Soraya is surrounded by a group of men and women, all of whom are screaming and beating her. At one point Ali says, “She’s only getting what she deserves. . . . She’s been unfaithful to me. . . . Do you realize that? Unfaithful!” (67). Exhausted by a lifetime of abuse and hardship, Soraya said nothing, and the makeshift panel took her silence as a confession of guilt. The guiltless Soraya seems to be caught up in a trap like a rat. Finally according to their culture they bring the verdict as, Soraya is at the guilty side and that she should be punished. All the male villagers discuss the punishment and finally decide to put her to death and declare the punishment as ‘death by stoning’. They cry, “Let her be put to death! Death by stoning!” (79). People consider ‘stoning’ as a great ceremony and are in immense pleasure as the ritual is going to happen. They savagely shout, “Revenge by blood! Revenge by blood! Revenge by blood!” (81).

In Iran each member of the municipal community has an opportunity to voice his opinion. But here, not even a single soul raises voice against Soraya’s horrible crime. The mayor reads the declaration as, “We have unanimously decided that the guilty party, Soraya Manutchehri, shall be stoned before the day ends, until she is dead” (88). A cruel and hideous punishment is laid upon Soraya in the name of culture. It plays an important role in destroying her life. As Soraya is a good wife and a perfect mother, she holds her head high.

At the time of her execution Soraya appears as, “. . . buried up to her shoulders, her arms entombed in the soil, her long hair spread out around her” (116). A circle is drawn on the ground using Soraya’s head as centre so that the target will be clearly visible. By tradition, her father, husband, and sons hurl the first stones. More stones directly hit Soraya. Blood begins to flow like water falling from cataract. Soraya slowly begins to expire and is killed. After killing an innocent woman in a horrible way, an immense cry of joy breaks out, “Allah Akbar! Allah Akbar! God is great! . . . Praise be to God!” (124). In Iran, when they punish the accuser they consider that they have purified their village by cleansing the foul soul. Later, Soraya’s corpse is exposed to all as an example. As insisted by Hassan, everyone agrees that Soraya should not be buried at all. He says, “Let the bitch return to the animals where she belongs. . . . No burial. Only proper Muslims deserve a proper burial” (132). The women deposit Soraya’s corpse near the rapids between two thorny bushes, which was later eaten by stray dogs. Her bones are scattered. Unbearably, Zahra picks all the bones, washes them in the stream, digs a small pit and carefully places them in the earthen grave. This cultural ceremony ‘stoning’ has brought death and funeral of an honorable woman in such an awful way.

The Stoning of Soraya M. picturizes the cultural practices that serve as an important weapon in destroying poor innocent women. Culture is to patch-up the life in the right path. But men use this culture as a tool to destroy women in Iran. In order to stop such practices Sahebjam pours the real sufferings of women in Iran through *The Stoning of Soraya M.* which reveals the real life of a woman who has become the victim of culture. The novel starkly exposes the brutality of a regime where there is no escape for women.

This compelling book draws attention to the global dimensions of hatred and execution of women. Its main intention is to increase awareness of violence against women in the name of culture and encourage activism against it. Cultural practices should encourage human beings to lead a peaceful life and the entire practice should be in limitation and should

consider both the genders as equal. Proper remedies should be taken to carve these cultural practices in the right path so that the life of the innocent people will not be taken away in the name of culture.

This story represents the stories of thousands of women who suffered and continue to suffer the same fate. People hold the laws as God's words but their actions are completely against the religious preaching. The holy book Koran says that if a woman betrays her husband the punishment is hundred lashes for both the offending man and woman. The adultery must be proven with four reliable eye witness of the act. One should be careful before accusing a faithful woman. But now people have started to interpret their culture according to their needs. Culture should be given due respect. Men are always scot free. But women, even if there is slight suspicion of immortality men can take an upper hand to punish them or kill them. This is a social injustice promoted in the name of religion. The day equality dawns in our society is the new era of justice and equality.

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Power Politics vs Ecology in Michael Crichton's *Micro*

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ABSTRACT

Micro, a novel by the American best-selling author Michael Crichton, pits untamed nature against cutting edge science and technology, cautioning humanity of the scientific advancements going awry, resulting in worst-case scenario, depicting the pathological failure of complex systems and their safe guards, whether biological, military or technical. This paper "Power Politics vs Ecology in Michael Crichton's *Micro*" an eco critical probing in to the novel, analyses the ways in which the novel deconstructs the cultural conceptualization of nature in the interactions with the complex system, and the satire on the implementation of power in controlling life and nature through bio politics, bio prospecting, bio piracy.

Some literary works have the power to rise as crusaders and with great creative force facilitate full efflorescence of the human personality. The authors of such works come as harmonizers striving to build a bridge of understanding between man and nature, man and technology, man and the supreme intelligence. One such writer who has handled humanistic wisdom, scientific knowledge, and technological inventions, without open articulation of dissidence is Michael Crichton, the American writer whose works auger the well-being of humanity without the menace of machines. His novels epitomize the techno-thriller genre of Literature, often exploring technology and failure of human interaction with it resulting in catastrophes.

For ages, nature has been perceived through cultural constructs and man-made definitions, which gave him the licence to exploit, and plunder nature to feed his greed. Kate Rigby in her essay "Eco Criticism" puts forth the idea that, "Culture constructs the prism through which we know nature" (153). Peter Barry argues that nature cannot be reduced to a concept which is conceived as a part of our cultural practice. That man can control nature and use everything for his better living is a common dogma in cultural patterns. Eco criticism "calls this long standing theoretical orthodoxy into question" (Barry 243). The process of exploitation has given ground to commodification and economization of nature, which can be linked with ethical egoism, utilitarianism and deontology, represented in the novel by people like Vin Drake and other directors of the drug companies who harvest nature for wealth and power.

Micro, a combination of medical and technological elements, mingles both the beauty and horror of nature, satirizing man's power in comparison with the complex systems of the earth, provides a critique of the ways cultural norms of nature and the environment contributes to the environmental degradation and deconstructs the cultural constructs of man's freedom in exploiting nature. The title *Micro* and the shrunken humans act as metaphor to illustrate and contrast the diminutive quality of humans while confronting nature.

The three important aspects of exploitation and commodification of nature such as bio prospecting, bio piracy and bio politics are dominant in the novel. The process by which new products based on biological resources are discovered and commercialized are called Bio

prospecting. Bio prospecting involves Bio piracy, which is a practice in which the indigenous knowledge of nature, originating with indigenous culture, is used by others for profit without compensation to the indigenous people (Bio Politics: An Overview). In *Micro* exploitation of nature through Bio piracy, is represented through Nanigen Micro Technologies, a robotics company, which uses nano technology to study every minute dimension in the eco system in a rainy forest in Hawaii. Before the building of the company has been erected, a deep pit was dug into the lava rock and was filled with electronic equipment, thus disturbing the eco balance. Nanigen keeps a very low profile and gets a billion dollar in funding from a consortium put together by Davros Venture Capital, which is primarily composed of International drug companies. It also has a bio prospecting facility at an extinct volcanic crater and plunders it. Drake calls it “a gold mine full of potential drugs” (84).

The Hawaiian rain forest is an unexplored world, explored for the sake of money making, under the cover of saving millions of lives. Rick Hutter says to Karen King, “He [Drake] is looting this eco system for gold” (Crichton 85). Nanigen takes on thousands of patents on the compounds they find, and giant drug companies exploit the patents, earning billions, depriving the natives the access to the drugs of their own place and are left with no choice but to buy the medicines for a huge amount. When Danny Minot questions Drake, on how they would be able to know anything about the forest, linking the post-structuralism theory, that we create our own meaning of nature, Drake answers that they needn’t know the meaning of nature exploit it. Drake acknowledges that Commodification of nature for money-making is the way of the world. Drake claims that there are no indigenous plants in Hawaii as it is a region of volcanic islands and which has reverted into a more natural state. Nature is quick enough to fill the barrenness caused by natural disasters, but the worst part is its destruction by human activities.

The legalities of situation is one among the many reasons for locating the company in Hawaii. Evading the law is concealed under obeying the law as the anonymity of the remotest part provides a perfect cover for Nanigen, for the exploitation of the forest and to dump the biological wastes. The novel also deconstructs the man-made name for nature as mother, the implication being to assert their mastery over it. It reconceptualises the implementation of power over nature through Bio Politics.

Biopolitics another important aspect in eco criticism is the process by which the strategies and mechanisms through which human life and other life processes are managed under the regimes of authority over knowledge, power and the processes of subjectivism are examined. Christopher Manes in his article “Nature and Silence” argues that the knowledge about nature is always conditioned by historical and social formations of power (15). Power politics which play a crucial role in the exploitation of nature is central in the novel. Through the persuasion Drake’s speech, some ethics applied in the implementation of the power is disclosed. Whatever be the field, it will last only as long as the power structures allow it to be and it is them who determine life on earth. The talents of the seven young scientists in the novel are traded and demoralized for the benefits of the people with power. For their survival in the field of research the scientists and journalists must succumb to these power structures and help them loot the natural resources. The people in power even control the news to be revealed regarding the destruction levels of natural resources in the novel, thus cautioning the readers with the fact that the reports projected are not entirely true. The bitter reality in this

context is that no research is done for the betterment of life but for the sole purpose of minting money.

Crichton ridicules these power structures in comparison with the magnificent power and energy of nature. In the confrontation of the nature the seven students realize that it is an existential confrontation of man, facing raw nature, the real heart of darkness unfettered by false beliefs and literary conceits. Nature is so terrifying to them due to the lack of understanding and its perception through the general and cultural beliefs. Nature is fundamentally indifferent and unforgiving and all the names given to nature are to deny that nature rules over everything. The balance of power lies in nature and all one could do is to try intervene into the complex system and end up destroyed. The novel reduces the so called 'powerful position of man' by reducing him to nothing but protein, in comparison with the complex natural systems. Crichton opines that people would never exploit if they understood what nature really is and in fact with more confrontation the natural world would only become more mysterious, wasteful, aggressive, ruthless, parasitic and violent.

Crichton cautions that the change in behaviour of man at present will bring about his ultimate doom and the doom of other living organisms. Man must be stripped off of his illusion in controlling nature the realization of which is marred with his imprudent belief in cultural constructs which he has created to exploit nature. Thus, the novel calls for a realization in being considerate to establish peaceful co-existence with nature and other living organisms so that the flow of energy is reciprocal, total and beneficial.

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Assertion of the Self: A Reading of Jaishree Misra's *Ancient Promises*

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ABSTRACT

Jaishree Misra weaves her novels around the axes of love, marriage and loss. As a writer, she focuses on her preoccupation with familial themes and the female perspective of family, the man-woman bonding. Moreover, the conflict between tradition and modernity finds a prominent place in the portrayal of women by Jaishree Misra. In the novel Ancient Promises, Misra portrays some of the major issues that post modernism restricts in patriarchal constructs like marriage and family. The present study deals with the situation of women who are caught up in the institution of marriage and reveals how they extricate themselves from the clutches of marital life, and enjoy their legitimate freedom.

The institution of marriage is the central feature of all forms of human society. It is the deepest as well as the most complex of all human relationships. Marriage as an institution blooms with love and understanding, and fades with suspicion and non communication. It is bliss if there is trust and understanding, or else it is nothing more than a curse. Lack of understanding in a relationship causes innumerable problems in marital life. In India, marriage is always associated with culture and tradition. Although in a traditional society, a married woman is respected more than a spinster, she has to struggle against many social evils in a male dominated society. In South Indian families arranged marriage is a custom where parents force their daughter to marry a man against her wish. This forced marriage often leads to failure in marital life.

Jaishree Misra begins her debut novel, *Ancient Promises* with a firm statement “ My marriage ended today” (3). In the novel Misra explores the sufferings and agony of an eighteen year old girl Janu, a malayali, born and brought up in Delhi who is caught up in the web of marriage with its stringent laws that govern her life. Feeling suffocated, she begins to battle for her legitimate space and freedom in the society.

Misra paints her protagonist in the broad canvas of marriage and family. She explores a single woman's predicament due to patriarchal attitudes of the old belief system, the tradition, and custom, which are still prevalent in various parts of our country. Janu is forced by her filial ties into marriage. She is compelled to sacrifice her teenage love for the sake of her family. Like all mothers, Janu's mother too wants her daughter to be married into a good family. She is a typical woman who follows the customs of the Hindu tradition. She tells Janu, “The reputations of families were carried on the shoulders of their daughters” (46-47). Thus, it clearly shows how women are responsible for keeping the family from falling apart.

‘Conditioning’ plays a vital role in patriarchal society. For instance, Indian mothers are conditioned by patriarchy and various social taboos. For them, maintaining a relationship matters more and they teach their daughters to endure and continue a relationship by virtue of self sacrifice. This is clearly evident in this novel through Janu's mother. Janu accepted the fact that marriage is the only goal to be obtained in life. She enters a new life with a business man Suresh. With many expectations, Janu starts her marital life, but it seems to vanish

because Suresh fails to provide Janu any physical, moral or emotional support. He himself is merely shuttling between the office and the verandah in the house where business matters are discussed and where women are not expected to be present. Through Suresh's family, Misra explores the patriarchal system that is prevailing in rich traditional families. The maraar women are educated, but they are not expected to go for jobs. Money is provided by the man if they are in need.

Janu feels totally alienated and lonely in this environment. She is muted in her in-law's house and is not allowed to express herself. Though silenced, she tries her best to be in the good books of every member in the family. She accepts the betrayal of her in-laws. This shows the pathetic condition of a married woman, who has to endure the pain of her marital life because of the society and circumstances. Later Janu delves into a self examination to probe, how and why her marriage failed. Even after a year, Janu feels that she does not belong to a maraar family, but she never gives up her hope of reconstructing her marriage that is on the rocks. She thinks that motherhood will change her unfavourable condition in marital life, but it too fails. She gives birth to a challenged baby.

Now Janu's life seems to be dark. She is unable to accept the state of her child. Like a typical Indian woman, she thinks that she might have done some wrong deeds in her previous birth, so that karma follows her as a punishment. Later Janu plans to get away from the marital bond. Like Cindrella, Janu is a figure of abandonment and abuse who is in search of self-worth. The real self or her natural worth is totally denied to her. Marriage turns out to be a trap which negates Janu's rights to individuality, independence and self realization. She has to pretend and act out the role of a happy woman.

Marriage also plays an essential component of womanhood, but unfortunately it becomes a weapon in the life of some women, dominate them and destroy them emotionally and psychologically. She also loses her liberty under the institution of marriage. The traditional concept of marriage in patriarchal society makes a woman a helpless creature, a deprived soul, unaware of her own existence, her own desires. By this indifference, she should not feel powerless, she has to rise up and try to lead an independent life. Janu uses education as a tool not only for escapism, but also to get freedom. She has to make attempts to escape from oppression by living in solitude, so she decides to go to England to do her higher studies, where she can also take care of Riya in a better way. Through education, she can emerge as a new woman with the new self.

Janu decides to come out of the stifling bondage by opting for divorce. Though divorce gives relief from painful marriage life, it is hardly enough to re-establish the woman socially, psychologically or financially. Every woman after divorce seeks for peace, freedom and independence. With new freedom and courage Janu is ready to face her future responsibilities. She regains her identity the moment she decides to quit her marital entrapment and shatters the myth of female passivity. This symbolizes Janu as the modern progressive Indian woman.

Misra clearly portrays how the self is lost right from the day of the wedding ceremony. Life does not come to an end after a broken marriage, it has to go on. The reason for women's oppression is that they have a fixed mindset about marriage and also have not

freed themselves from mythology and orthodoxy. Women in India mostly feel like Sylvia Plath, who says, "Being born a woman is my awful tragedy." (qtd. in Sinha).

Violence against women is on the rise in the contemporary Indian society and women are more and more victimized by sexism, not only of the family, but also religion, state, law and media. So today, women have to battle against the customs, which suppress their independence. Women need confidence and courage to face life. Education becomes a very important tool to empower woman. Every woman should get proper education and has to empower herself. Women empowerment is the vital tool for advancing development in the country.

Today, women have forayed into all the projections of technology, finance and industry to prove that they can take an equal responsibility with men for national progress. Socially, all outdated customs and tradition, which demean, reject or devalue woman, as a human being should be abolished. Woman should realize, she is not the victim of marriage. She should be bold enough to face the challenges of life. Today every woman should recognize the achievement of other women who have made transformative changes in society to support women's empowerment. It is an indisputable fact that the real power of women should emanate from their homes.

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Battle of Colachel and its Economic Impact

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Introduction

Kanyakumari is the smallest district in Tamil Nadu. It is named after goddess 'Kanyakumari'. It is also known as Cape Comorin. Once it was a part of Chera kingdom and culturally it was a part of Kerala. The district has a long sea-coast of 66 kilometers. Colachel is the only natural port in this district. Kanyakumari is another minor part of the district. Changudurai and Chothavilai beaches are important in the district.

Colachel

Colachel attained importance from a very early period of Travancore history. It played an important role in the history of south Travancore. Colachel is also one of the important places in the present Kanyakumari District. Colachel enjoys a Mediterranean climate with the rest of the district. "Colachel" is a sea port town from the ancient past, served as an important commercial centre for the Cheras, Pandyas and even the Dutch. It is surrounded by small villages like Kottilpadu, on the South, Puthur on the East, Velliyakulam on the North and the Kalimar on the west. The importance of Colachel is due to the existence of the port.

Battle of Colachel and its Economic Impact

The Battle of Colachel was fought on August 10, 1741 between the forces of the Indian Kingdom of Travancore and the Dutch East Indian Company. It was the first major defeat of the Dutch military force by one from South Asia. The Dutch never recovered from the defeat and no longer posed a large colonial threat to India, assisting the British East Indian company's eventual rise to dominance on the subcontinent.

Internal and External enemies of Marthanda Varma

The reign of Marthanda Varma marked the beginning of the modern epoch in the history of Travancore. When Marthanda Varma ascended the throne, he found himself in a small state, surrounded by enemies like Ettuvetil Pillamars and Yogakhars.

War Against the Dutch

During the early half of the 18th century the Dutch held sway over the Malabar Coast. They possessed a number of factories like salt farming, dying, and printing along the Malabar Coast, Cochin and Anjengo.

Encouraged by their successful establishments of factories and the internal squabbles in Travancore, the Dutch East India Company entered into political intrigues with the kingdoms inimical to the Maharajah, with the object of maintaining the balance of power and there by perpetuating their commercial supremacy. In 1739, a war began between Elayadathu

Swarupam and Travancore in which the Dutch sided with the former and the Dutch Governor even extended asylum to the Rani of Elayadathu Swarupam.

In 1741 Van Imhalff reinstated Elayadathu Swarupam against the will of Marthanda Varma. Hence the army of Travancore drove away the Dutch and the kayamkulam forces and recaptured Elayadathu Swarupam. Then they tried to capture the Dutch out-post in Travancore. The possessions of the Dutch were attacked. Their store-houses and factories were looted. Thus the Dutch were badly humiliated. Finally the Dutch returned to Cochin, and waited for an opportunity to retaliate.

The victory of Marthandavarma gave a rude shock to the Dutch, whose survival in Malabar was under great threat. Under these pressing circumstances, the Dutch entered into another war with Travancore. Growing indignant at the aggressive policy of Marthandavarma, Van Imhalff sent forth a well-equipped, fourth grade army of Ceylon. On reaching Colachel, the Dutch army heavily bombarded Colachel and landed at Colachel on 10th February 1741 and continued to attack Travancore from the South.

Their selection of time and venue for war was most opportune, for Marthandavarma was concentrating his entire forces in the far north for dealing with his enemies. The Dutch took positions at Thengapattanam, Kadiyapattanam, Midalam and other places in South Travancore and began to harass the inhabitants. At Colachel they continued firing from the sea for two or three days. Hence the Maharajah sent 2000 soldiers of the coastal villages to prevent further landing of the Dutch forces.

In the meantime, a large Dutch force from Cochin landed at Colachel. The sudden move of the Dutch compelled Marthandavarma to seek French assistance from Mahe. As the French were involved in the contest for supremacy with the English East India Company, they readily responded to the request of the Maharajah. They prevented the English from shipping any goods from the port of Colachel, and gave orders to the Dutch ships to seize all enemy vessels that were found in any port in Travancore. The English at Anjengu could not do anything to counteract the Dutch activities.

As the entire Travancore army was in the north, the Dutch had made several inroads in south Travancore. The whole country was under the control of the Dutch. The Dutch further planned to attack Padmanabapuram, the capital of the State. On hearing this news of the Dutch design in the South, Marthanda Varma, who was engaged in a battle against Edayadathu Swarupam, an ally of the Dutch in central Travancore, hurried to Padmanabapuram. He worshipped at the Adikesave Temple at Thiruvattar and offered 500 panams to the temple and also put his sword at the feet of the God and prayed for his success in his battle against the Dutch. In the mean time Ramayyan Dalawa came from the north with a large reinforcement of infantry and cavalry and encamped at Nagercoil and Eraniel.

On May 27, 1741, Marthanda Varma advanced upon the Dutch forces at Colachel. It lasted for two months. It was one of the most severe battles recorded in the history of the state. It is said that in order to win over the enemy the soldiers of Travancore adopted cunning methods. They created manlike figures using plantain trees, palmara leaves and coconut leaves and installed them along the coast at Colachel.

They also cut the trunk of the Palmyra trees in the shape of artillery and portioned them along the sea shore. The Dutch under Delannoy were watching the activities of the enemy of the coast through the binocular and they mistook the Palmyra trees for artillery and the men like figures and fired the force and wasted their ammunition.

In the meantime, the Travancore army fired a red hot ball which fell into the enemy's huge stocks of food materials. On August 7, 1741, their supplies were cut off. The Travancore army attacked the Dutch mercilessly. The Dutch were left with no option but to surrender. They lost a large number of soldiers, arms and ammunition. The Travancore army captured twenty four European soldiers as prisoners and seized 389 muskets and a large number of cannons and swords from the Dutch. In order to celebrate their victory, a Pillar of Victory was erected at Colachel.

Economic Impact

A direct outcome of the event at Colachel, was the takeover of the black pepper trade by the state of Travancore. This development was to have serious repercussions on the Dutch and the trading world of Travancore at large. In 1753 the Dutch signed the Treaty of Mavelikkara with the Raja agreeing not to obstruct the Raja's expansion, and in turn, to sell Indonesian spices and sugar in Kerala until 1795 at which period the English conquest of the kingdom of Cochin ended their rule in India.

Captain De Lannoy, who joined the service of Marthanda Varma was promoted as the senior Admiral (Valiya Kappithan) and he modernized the Travancore army. He introduced firearms and artillery. He was granted the Udayagiri fort to reside. After the battle of Colachel the port has offered natural amenities for shipping by its physiographic structure. Small streamers anchor in seven fathoms off the shore. Small vessels anchor in a quarter of the mile of the coast. There was no light signaling at this port. A mast head light was put up in the flagstaff compound with red screen to denote the part and another at the fort beacon emitting white light to denote the anchorage. The latter is visible for about eight km, in clear weather. There is no Jetty at this port.

The people at Colachel carried on brisk internal trade also. The people who lived in the different regions of the land exchanged their goods. Trade was both by barter and by the use of currencies. They exchanged their fish and salt for paddy. The shells got from the sea were also exchanged by them for toddy. The merchants used mules for transporting their goods. External trade also flourished under the Maharajas of Travancore. At the outset they fished near the coast and gradually proceeded far into the sea. The well-to-do merchants shipped salt and dried fish in boats to Malaya, Indonesia and China in the East and to Arabia and Africa in the west.

The port had its importance in the industrial and marine fields also. It was the centre for transportation of the fine cotton fibers of Eraniel to foreign countries. Palmyra, mineral sands, fish and salt were also exported from this port.

Conclusion

Colachel is a historically important place. It served as an important commercial centre from the days of Marthanda Varma, whose reign marked the beginning of the modern

epoch in the history of Travancore. The name Colachel was originated from “Colachey”. During the 16th and 17th centuries, the European merchants like the Dutch and the English utilized this port for trading purposes. Marthanda Varma, the then Raja of Travancore decided to recover Colachel from the hands of foreigners. Hence, in 1741 A.D. a historical battle took place in Colachel. Rice, pepper, and cosmetics were the main products exported to the European countries through this port. The main occupation of the living in the coastal area is fishing. It determines the economic activities of the fishermen in Colachel. Fishermen of colachel belong to the most backward class. They live in groups. Mostly their huts are made up of thatched roofs. They go for fishing in groups. Besides fishing, making kattumaram, vallam, boat and different types of fishing nets also determine the economic life of the people. But most of them are living in poverty.

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Dr. Chempakaraman Pillai - An Unique Patriot

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ABSTRACT

Dr.Chempakaraman Pillai is widely known to the people as a unique patriot. The heroic activities of Pillai, the famous Revolutionary and freedom- fighter of Kerala during the first quarter of this century for the liberation of our motherland are also well known. Among the political leaders of Kerala, Dr.Chempakaraman Pillai is a man of unique touch of originality, romance and adventure. He tried to realise the objective of political independence by striking a new chord altogether. His revolutionary plan was to get active help from Germany for securing India's freedom. He dedicated his thoughts, deeds and life itself to this noble ideal.

Dr.Chempakaraman Pillai, a unique Indian patriot, was born on 15 September 1891 in Trivandrum [1]. His father Chinnaswamypillai was a police constable and his mother Mrs.Nagammal belonged to a rich family [2]. Chempakaraman Pillai began his primary education in 1896 in a Tamil Vernacular School near Gandhari Amman Koil, Puthenchanthai, Trivandrum [3]. Even from very a early age Chempakaraman displayed signs of Independence, love of freedom and a liking for Indian leaders. As his neighbours happened to be newspaper agents, he got an opportunity to go through the papers daily which created in him an interest in politics.

When Chempakaraman was studying in the Maharaja's Government English High School, Trivandrum, he began to evince keen interest in contemporary political events. Chempakaraman discontinued his studies and joined the freedom struggle while he was only a boy of fifteen. The young Chempakaraman organised the students, conducted anti- British propaganda and urged the peasants not to pay taxes.

Sir John Strickland, a Prosperous landlord of England was residing in Trivandrum. It was believed that he was closely associated with a violent anti- British secret organization in Germany and that his idea was to rouse the latent revolutionary spirit of smart young Indians give them adequate education and training at the European Universities for the sprouting of their leadership and make them participate in revolutionary activities against the British imperialism.

Sir. John Strickland met the lad Chempakaraman, who was a boy of fifteen then. It so happened that Strickland fell ill and Chempakaraman nursed him back to his health. On seeing the boy's love of human beings and love of his country's freedom the spy desired to take the boy to Germany for higher studies and for utilising him in anti- British activities in India and abroad. Chempakaraman gladly accepted the offer. In September 1908 he proceeded to Italy in a German ship [4]. In Italy he joined the Berlitz school of Languages and Italian language.During his stay in Italy he was busy propagating the necessity of Indian freedom and presenting a clean picture of the condition of India under the British rule.

In 1915 Subhash Chandra Bose chanced to meet Dr.Pillai for the first time at a Conference in Vienna. Dr.Pillai impressed Subhash Chandra Bose with his view that the British could only be removed from India with an army formed outside India. Dr.Pillai informed him of his formation of I.N.V.C. (Indian National Volunteer Corps) and its activities. The I.N.A. (Indian National Army) of Bose was, in fact, a translation of the ideas of Dr.Chempakaraman into practice.

While he was a student in Berlin, Dr.Pillai formed an organisation named 'Aid India International Committee'. Prominent Europeans were its members and Dr.Chempakaraman became its president. That organisation was very helpful in gaining sympathy and help for Indian Freedom Struggle. Dr.Pillai was even able to come in contact with the ruler of Germany, the Keiser William II and became his close friend. Dr.Pillai started an English Journal 'Pro -India' and he was its Editor [5]. That formed his organ to propagate and popularise ideas on gaining freedom for India. He championed not only the cause of his oppressed countrymen but the cause of all suffering human beings of the world. In 1919 he formed an organisation 'League of the Oppressed Nations' in Berlin. Its aim was to bring together all the downtrodden nations of the world to fight against injustice, domination and slavery.

Chempakaraman Pillai was very much concerned with the problem of oppressed people in the world [6]. In 1919 along with the American author, Mr. Edwin Emerson, he organised a League of the Oppressed People. Branches of the League were established at different centres in the world in connection with which he made a tour of the Far East Asia, South East Asia, Middle East, South Africa and America. He utilised the columns of the pro-India to condemn racialism and imperialist oppression of the British [7].

Chempakaraman Pillai did much after the First World War to develop trade relations between India and Germany. In 1924, he organised the first exhibition abroad of Indian swadeshi goods at the Leipzing International Fair [8].

Conclusion

Mr.Chempakaraman Pillai made a distinctive contribution in a constructive way, by his work aimed at enlisting the goodwill of the people of many lands for the Indian freedom movement Indian political leaders of all schools of thought ... were struck by his devotion and intensity of his passion for Indian freedom ... His words and deeds were the dream of Indian youth. Through his speeches, writings and personal contacts he collected friends who sympathised with India's cause. He took up every cause that appealed to his sense of justice. He was 'the greatest of revolutionaries who really carried the Torch of freedom to foreign countries.

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Contribution of Christian Missionaries To Tamil Language and Literature: A Case Study of German Missionary, Tharangambadi

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Christianity is one among the ancient Religions of India. The Apostle Thomas was invited to India by an Indian king Gandophares. He arrived at Malabar Coast in the year 52 A.D. and founded the first Christian Church in India. Nagapattinam district particularly Tharangambadi has its own significance in this regard from the early times. The Christian Missionaries played a vital role for the spread of Christianity in Nagapattinam district in A.D. 1543. St. Xavier visited Nagapattinam twice in 1545 A.D. At that time the Franciscans, the Augustinians and the Jesuits were all engaged in Missionary work. Nagapattinam became their headquarter. The 16th and 17th centuries witnessed the advent of the Europeans in the land of the Tamils. As a sequel, the Christian Missionaries of different denominations appeared in the history of the Tamils. In this paper an attempt has been made to throw light on the contribution of the German missionaries for the development of Tamil Language and Tamil literature.

Of the various Christian missionaries, the services of the German missionary to Tamil language and literature receive historical significance which can be supported by various primary and secondary sources. In 1612, the Danish landed at the Chola Mandalam and settled at Tranquebar on the Coromandel Coast. The Danish Crown acquired this place from the rule of Reghunatha Nayaka (1600-1633) of Thanjavur by an annual rent of Rs.3111 since 1620 A.D [1]. The Danish King Frederick IV (1699-1730) desired to spread the Protestant Religion in foreign countries, especially among the Tamils of Tranquebar or the ancient name of Tarangambadi. He sent Missionaries to handle nothing besides the holy doctrine and write down in their diaries, letters and proposals to promote the missionary activity in Tarangambadi. The Danish missionary group mainly included Germans, rather it can be called German Missionary.

Forty eight German Missionaries came to India to propagate the Protestant Religion [2] under the Danish patronage. The most remarkable among them were Bartholomeus Ziegenbalg, Heinrich Pluetschau, Benjamin Schultz, John Philip Fabricius, Walter and Schewartz. The first Protestant Missionary enterprise began with the arrival of B. Ziegenbalg and H. Pluetschau on 9th July 1706 at the Danish settlement of Tarangambadi [3]. Soon the Tranquebar Mission also known as Royal Danish Mission was established in the same year. (After that a number of Protestant missions such as LMS, CMS, WMMS, AMM and FCS commenced their activities in different parts of Tamil Country [4]. Since they happened to be the pioneers of the Protestant Missions, they didn't have any Missionary tradition to fall back upon nor a pattern of work to follow among the natives so they took a position midway between that of the Roman Catholics and the practice of the reformed who came later. They, like the Jesuits of the Madura Mission adopted the method of 'accommodation' permitting their converts to retain caste and thus endeavoured to establish an Indigenous Church [5].

The Missionaries landed with the preconceived notion that the "Tamils are barbarians". They found it otherwise, and wrote letters about Tamils to their superiors. They requested Pastor August Herman Franke in Hile (Germany) to publish these letters. But Franke unable to tolerate Ziegenbalg's praise of Tamil language and culture did not publish them. He even remarked that the Missionaries were sent to exterminate heathenism in India, not to spread heathen nonsense all over Europe [6]. The Tamils, their language, grammar, law, justice, philosophy and writing on palm leaves [7], were all great attractions to many German Missionaries. Ziegenbalg learnt Tamil from a pandit called Ellappan. He took special care in understanding the meaning of many Tamil words with the help of a great scholar namely Alagappan. For nearly three years he interacted with the Tamil students and society and learnt the greatness of Tamil language and literature. One of his remarkable achievements in the field of Tamilology was the introduction of Tamil Dictionary. This formed the basis and source for other Dictionaries which appeared later, particularly the Tranquebar Dictionary. He wrote a grammar or Tamil poems. He had established a Tamil manuscripts library and collected palm leaves from the neighboring places.

He also prepared an index for them, and spread the importance of Tamil language in Europe. He prepared 48 sacred songs on Christian theology and published them under the title "Gnanapadalkal". His other important works included Genealogy of Malabar Gods., Malabar, Heathenism, and miscellaneous writings, Konrai Vendan and Ulaga Neethi. He also wrote a few books on Ideology. In his book titled "Malabarisches Heidenthum" throws light on secured aspects. It includes the celebration of Hindu festivals i.e. *Deepavali* and *Pongal*, the architectural frame work of Siva and Vishnu temples, the architectural layout of the Hindu temples and 28 main Ragas found in Carnatic music. Another book "Conferences" deals with, conferences between the Danish Missionaries and the Malabarian Brahmanas. It focuses on the truth of the Christian religion and the letters received by the said Missionaries.

During this stay he engaged himself in the active translation of the New Testament into Tamil and making a comparative study of Christianity and Hinduism. In fact, Ziegenbalg has been named as an Ice breaker and regarded as the first European translator of a Tamil text into a European language'. He sent New Year greetings in Tamil to officials and others. He has translated into German many Tamil literatures such as Needi Venba, Nal Venba, Aathi Choodi, Kondrai Vendan and Ulaga needi [8].

Another of his great achievement was the establishment of a printing press at Tranquebar in the year 1712 A.D. [9]. It was brought from England with English and Tamil letters. Ziegenbalg's "Grammitica Timulica" was printed in the following year and this was used as a guide book by the later Missionaries like Ferocious, Gravel and others. He published nearly 213 religious books in Tamil. He established schools for the poor at Tarangambadi and Cuddalore [10], He took a Tamil student with him when he returned to his native land, so as to remember Tamils for ever.

The other German Missionaries who came after Ziegenbalg simply followed the footsteps of him. Benjamin Schultz (1689-1760 A.D.) landed at Madras in 1719 A.D. and learnt Tamil. He took care in training 40 native students and visited all the villages with them. He also visited schools at Tarangambadi, Cuddalore, Devanampattinam and Parangipettai. At Puducherry, at a place known as Muthaiyalpettai he rented a house for running a Tamil school. In 1749 A.D he returned to his native land where he taught Tamil to Rev. Christian Frederick Schwartz [11].

Walter (1699-1741) was a great scholar and linguistic in Tamil. He made additions to the Tamil Grammar of “Veerama Munivar”. In 1733 A.D, his translation of the New Testament into Tamil reveals that the art of translation had attained perfection during this period. He was very much impressed by the writings of Thayumanavar [12]. John Philip Furious arrived at Cuddalore in 1740 [13]. He did his first German work in Tamil. He was called as “Sanyasi Ayyer” [14], because of his simplicity and celibacy. He prepared the English Tamil Dictionary based on the works of Constantine Beshi. It was during this period colloquial Tamil attained importance. Further Tamil was influenced by Sanskrit. So he distinguished the Sanskrit terms from Tamil [15]. He read his translations in front of the people of different castes and simplified the difficult terms. He translated the whole Bible into Tamil [16].

Yet another remarkable German Missionary was Rev. Christain Frederick Schwartz the brightest star in the constellation of Danish Halle Missionaries [1]. He stayed for eleven years at Tranquebar. During his period the Tranquebar Mission entered a new phase of growth [17]. Extension work was made in Trichirapalli and Thirunelveli in the South. Educational institutions, which became well known in the later days, were started in Trichirapalli. His services to Tamils were placed on a new footing. Hence he was rightly called as 'Father of Tamil Christianity'. He learnt Portuguese and Tamil. He had a good friendship with the Maratha rulers of Thanjavur i.e. Tulajaji and Saraboji II. He translated many works into Maratti. It was because of his efforts, Saraboji II asserted his right over the throne of Thanjavur. In one of his letters he had emphasized very much the early schooling of children. All the Christian schools, south of the River Caveri were under his supervision. Many schools were established in his name at Ramnad and Thanjavur. It is known from the above, that the German Missionaries came to Tamil land for the propagation of the Gospel based on the (methodical) pattern of German pietism. Tamil became the instrument of their proselytizing activities. However their propagation of the Protestant religion consequently led to the development of the Tamil language. Though printing and publication of Tamil works were sequel to their Missionary work, the language got enriched in their hands. A major collection of the Franken's Archives in the Library of Halle includes the observation of German Missionaries in Tamil Nadu. A deep insight into the collection will shed more light on the Tamils, their language and their way.

Thus the Missionaries carried out their proselytizing activities and converted a large number of Tamil people from the lower strata of the society. Simultaneously, they introduced many reforms in the society by removing social evils that confronted the Tamil society. The Christian Missionaries played a vital role in the development of the Tamil society in the 17th century A.D. They rendered all kinds of services to people while propagating their religion. Illiteracy, infanticide, un-touchability, superstitions etc., were slowly eradicated of from the society. Besides reformist activities, the Missionary contribution to the Tamil society was a very remarkable one, and because of the valuable services to Tamil, Father Schwartz was called as father of Tamil Christianity. He learned Portuguese and Tamil. In one of his letters he had emphasized the early schooling of Tamil children and its importance to the Tamil society. All the schools south of river Cauveri were established in his name at Ramnad and Thanjavur. It is known from the above that Tamil became an instrument of propagating their religion in the land of Tamils. Though printing and publication of several Tamil works were sequel to their Missionary work, the language also got enriched in the hands of the Missionaries.

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Endeavours for the Educational Upliftment of Backward Class in Travancore

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ABSTRACT

Education is the movement from the darkness to light – Allan Bloom. Education breaks the chains of slavery, untouchability, and discriminations. The 19th and 20th centuries had tried to break the impediments like the caste system, slavery etc. for the upliftment of low castes. Education is also denied for low castes because of the caste system. The primary objective of this paper is to highlight the educational condition of the backward class in Travancore and the endeavours taken by the missionaries, the Travancore government and the personalities for the educational upliftment of the backward class in Travancore.

Introduction

The State of Kerala stands in the forefront of all the Indian states in the matter of literacy and education. The unique position which Kerala has attained in the educational map of India is not the result of a sudden spurt of activity in the field of education, but the climax of the early days on the intellectual pursuits of the people spread over several centuries. Though education was popular and universal in ancient Kerala, the later Sangam and post Sangam periods which were the ideal of universal education received a setback. The progress of Aryanisation and caste system ushered in a new social order in which high castes came to have the monopoly in the educational field. The higher learning centres like Salais, Subha Mutts also concentrated only the higher castes. The lower classes were deprived of the opportunities of education. Of course, the ‘untouchables, unapproachable’ and the down-trodden classes were denied education.

Missionary Endeavours

Among the Kerala regions, Education first flourished in Travancore and Cochin. The desired effects on the state of Travancore, in the field of education began in the nineteenth century with the arrival of western education. During this time people began to imbibe the qualities of education. Till the middle of the last century slavery existed in Travancore recognized by law. The lower classes formed the slaves attached to the land and were transferred and sold with it. They were hardly any better than cattles though, it must be admitted their masters treated them on the whole tolerably well. The first step at ameliorating their condition was due to the spread of Christianity among them by the labours of the Missionaries. Education was also spread among them, and beyond everything else this paved the way for their betterment. Not satisfied with elevating the condition of the low class converts, the Missionaries, accustomed as they were to the spirit prevailing in England and other European countries agitated for the abolition of slavery.

Rev. Mead and John Abbs rendered remarkable services among the oppressed society. Rev. Mead had great concern for slave education. In the beginning a few girls were trained in the boarding schools. The gathering of slave children in the schools in the south

began in a very interesting manner. The school master Ponnarai in the adjoining Manalicaud Church took much interest to admit the slave boys in the school. When Mead, the Superintending Missionary of Neyyoor district went through the monthly attendance list, he noticed this new name, that of the slave boy. He made some enquires with regard to this pleasing fact and published it as a rule that all School masters who collected slave children would get an additional monthly pay, of one '*fanam*' for every slave boy and half *fanam* for every slave girl. Thus he encouraged to collect as many slaves as possible for education.

The Christian Missionaries opened several schools and removed the restrictions to education and made it free for all. The Backward communities were admitted in these schools, and education was given. Many children of the Backward Community could not study regularly in the Missionary schools due to poverty. However, the Christian Missionaries started charity schools at Trivandrum for the benefit of Pulaya community. In 1861, Rev. Mead opened a school for Pulayas and named it Pulaya Charity School. He collected funds from gentlemen in and around town and supported these poor schools. When famine broke out in 1861, he secured a daily contribution of rice from various places for these poor children.

The Missionaries settled in Cheruvarakonam started schools for the benefit of the suppressed communities in and around Cheruvarakonam. James Emlyn took charge of the Parassala Mission in 1868. He began his work among the fisher folks at Vallaviali beach. Emlyn bought an extensive plot by the seashore at Vallavilai and Kollemcode and started two schools there. These were the stepping stones for the upliftment of the backward classes and gave motivation to the rulers. Hence, the kings of Travancore also involved in the educational transformation of the lower castes.

Endeavour of Government

The desire of the government to extend educational facilities to even the women of the backward classes took practical shape with the introduction of the Code of 1894. During 1895-96 the government established 15 schools exclusively for the backward classes. In the next year, 15 more similar schools were opened in different parts of the country. In 1903-04 there were 480 schools for backward classes with 43,580 pupils under instructions including those in schools open to all classes. In 1904, the government took a radical step and declared: "Governments are fully alive to their responsibility in the matter of primary education and their aim will be to see that no child in the state between the ages of five and ten, whatever his caste and status in life, is allowed to grow up without the benefits of education."

Nearly half a century ago the facilities provided by the Government of Travancore for the education of the backward classes attracted the notice of Lord Wenlock, Governor of Madras, who visited the state. He opined, "I know this country, like every country has to deal with the lower and more degraded classes of people, and I am glad to see that they are not going to be left behind in the race of life. I sincerely hope and treat that the steps that are now being taken may be able to raise them to a position of comparative affluence and happiness. I am glad to see His Highness is taking steps which will eventually raise the general load of the whole country".

As a first step towards the realization of this ideal, the government resolved to bear the entire cost of the primary education of backward classes. Theoretically, most of the schools in the state were thrown open to the untouchables, but in practice they were excluded. The rules issued by the government for the education of the girls and boys of the untouchables were not implemented by the officials and authorities of the schools. Among the untouchable females, the Nadars and the Ezhavas were the first to receive education. In the missionary schools they were admitted without any restriction and they got educated. The government became more aware of their responsibility towards the less privileged section of the society.

The Travancore government decided to extend the benefit of education to the backward classes also. The Sirkar schools were thrown open to the Ezhavas and other backward communities. One of the most important changes effected in 1911-1912 was the removal of the restriction on the admission of Pulaya boys and girls into Departmental Schools. This reform, intended for the benefit of the untouchables was not attempted in any other state. This was a striking proof of the generous policy of education pursued by H.H. Sri Mulam Thirunal.

Endeavour of Aiyankali

Aiyankali was a member of the Sri Mulam Popular Assembly of Travancore from 1912-1930, and he incessantly brought to the notice of the government the matter of education of the untouchable girls. In 1912 he represented in the Assembly that only very few schools were admitting Pulaya children, both boys and girls, and requested the government to throw open all the government schools in the state to his people. He further requested the government to grant special fee concessions to the Pulaya students. He added that the students of his community were not getting even the fee concessions allowed to the Mohammadans who were in every way far ahead of them. His appeals produced immediate results. The government decided to encourage the education of the untouchable girls by the grant of half-fee concessions, stipends, scholarships, boarding grants etc. He also requested that stringent orders might be issued for admitting the Pulaya boys and girls in the government schools without any opposition. Though there was much opposition, the Pulaya girls started attending the schools regularly and in 1917 there were 73 girls under instruction in the government schools.

In 1910, the primary education was declared free throughout the state. In spite of the concessions and encouragement given to the untouchable girls, they remained backward in education. Therefore, Aiyankali wanted the government to make primary education compulsory to the depressed classes. And the government issued orders making primary education compulsory to the depressed classes. Thus, the responsibility of primary education came under the supervision of the state. Travancore opened a network of schools in all the villages and taluks and helped private enterprise by grant-in-aid. More and more teachers were appointed simultaneously with the opening of new schools. Thus the state witnessed a steady growth of enrolment instead of a tardy progress. In 1918 special efforts were made to increase the number of pupils belonging to the poor and backward communities in attendance at schools. It was reported that 'hundred percent of literacy' was attained among the Ezhava and Pulaya communities in most of the taluks of the state. Separate schools were started for the benefit of Ezhava, Maran, Chekala, Velan, Nadar, Paraya, Pulaya and Vedan

communities. A scheme of free concession to pupils of the depressed and backward classes was sanctioned and brought into force in 1922.

The total number of pupils belonging to the backward classes, comprising Pulayas, Parayas, Kuravas, the hill tribes, etc., undergoing instruction during 1935-1936 was 31,250 including 9771 girls. As many as 60 Harijan schools for the education of the backward communities were started by people and associations interested in their uplift and the question of giving them recognition and Grant-in-aid was under the consideration of the government. The Harijan hostel in Trivandrum which was a private boarding home for pupils belonging to the backward communities was given a grant of Rs. 1200 during 1936 as against Rs.300 granted in 1935. The education of backward classes was systematically encouraged by the grant of Special fee concessions, Stipends, Scholarships, Boarding grants etc. There was during the year (1938-39) 87,841 pupils (59,565 boys and 28,276 girls) belonging to backward communities in English, Malayalam and Tamil Schools as against 77,707 (52,904 boys and 24,803 girls) in 1937. Totally 30 Harijan Schools were given grants during the year and an amount of Rs. 2,952 was spent on that account. 14 Harijan Schools run under the auspices of the Kerala Hindu Mission were for the first time given grants during the year 1938-1939.

Conclusion

The enthusiasm developed by the missionaries for the cause of education was really remarkable. Their efforts yielded high benefits. They established schools in the villages and that caused development of knowledgeable society. Education by the missionaries brought many changes in the social and cultural life of the people of Travancore which as well boosted the rulers of Travancore. It devised a liberal system of education open to all the inhabitants irrespective of caste or religion. The rulers concentrated on the backward classes and tried to satisfy their educational needs to the maximum. Really the voice of personalities like Aiyankali paved the way for the promotion of educational facilities to the backward classes. Everybody must accept that the backward class people are seeing the heights of their life through the torch of education.

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Role of Women in Kerala - Social Reform Movement from the 19th Century Onwards

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Kerala, the Malayalam speaking region of the extreme south of India had its due share in strengthening and articulating modern Indian nationalism. During the 150 years of British domination, which began in the 1790s, Kerala was divided into three regions-the British Indian district of Malabar in the north, the princely state of the Travancore in the south and the much smaller Cochin in the middle.

As in the other parts of India, Kerala also witnessed the sprouting of socio-religious reform movements in the 19th and 20th centuries. These reform movements, though mostly middle class centered did create an intellectual milieu in the society of Kerala, which led to the advocacy of civil liberty and social justice particularly to the weaker and depressed sections. Their attempt and mode of addressing the concerns of the people did help them not only to realise the servitude enforced by the colonial system but also to realise fully the social reality of the depressed classes and of the women. All the reformers starting with Sree Narayanaguru, Ayyankali, V T Bhattathirippad etc augmented the spirit of rationalism and created political consciousness against colonialism. The political awakening among women began only at the first quarter of the 20th century. Women of Kerala became active and powerful in the national movement only with the advent of Gandhi to the scenario of the freedom struggle. Setting aside the uneven political structure of Kerala, the aforesaid regions had made their mark in the Indian national movement.

In Kerala, V.T.Bhattathirippad was a pioneer in bringing the **antharjanams** from the kitchen to the stage. We shall surely call him the first man who worked for the liberation of women in Kerala. The play written by V.T.Bhattathirippad 'ADUKKALAYIL NINNUM ARANGATHEKKU' evoked a storm in the society.

Thus the women in Kerala shouldered critical responsibilities in the struggle for freedom. Let us have a look at the prominent among the women leaders.

Aryapallam

The storm of religious and social reform was unleashed by V.T.Bhattathirippad among the Namboothiri women. Several of them came out of the kitchen to participate in the public activities including the national movement. Aryapallam was in the fore-front of the newly emerged Nambootiri women or "antharjanam" to secure a place in the public sphere.

Along with the revolutionary activities of "yogakhema sabha", the "antharjanam" also came out of their traditional "veils or ghoshas" and began to take part in social activities. In 1932 a Namboothiri Women's organization was formed with the name "Antharsamajam" under the leadership of Arya pallam. The new organisations worked as the female counterpart

of the Yokakshema Sabha. The Antharjana Samajam, took the initiative to stage the play 'Marakkudakullile mahanarakam' (The Hell inside the palm leaf umbrella) by Mr. BHATTATHIRIPPAD.

The Antharjana Samajam established libraries and conducted many number of meetings. It stressed the need for women to change their attitude. Women should take a lead in smashing the old structures and build a new one. They took part in the national movement. Their significant contribution to public life was their active participation in the 'Paliyam Satyagraha' of December, 1947. Even after independence, the lower caste people were not permitted to walk through the Paliyam road, close to the Paliyam kovilakam in Kochi. The Namboothiri women under the leadership of Aryapallam actively participated in the Sathyagraha. This was the first time that the 'antharjanams' of Kerala participated in a public struggle. The sathyagraha was successful and the Paliyam road was opened for all, irrespective of their castes.

Breast Cloth Movement

Against the Brahmin dominated, caste hierarchical and patriarchal society, women displayed their discontent by organizing local revolts and reactions in Kerala.

One of the first episodes pertaining to women's emancipation movements was that of the Channar rebellion, or 'Melmundu kalapam' (Breast cloth movement) or Melsila kalapam of South Travancore of the 19th century. The Melmundu kalapam was started by the channar or the 'Nadars', as they are called, of South Travancore for the right of their women to cover their upper part of the body with cloth like that of higher caste women. The caste hierarchical society did not permit the women of lower castes like the Ezhavas, Pulayas, Nadars and the untouchables to wear jackets. This was the reflection of the society, which consciously tried to demolish the self confidence and morale of the men of the lower castes. Clothes are to be seen as forms of moral investiture rather than as a sign of progress, which legitimised the British support of the rebellion.

During the 19th century, several channar women were converted to Christianity and they started wearing jackets but the Brahmin dominated society did not accept this. They feared that the wearing of the jacket by the converted channar women would induce the Hindu channar women to wear jackets, and thereby destroy the existing social structure. The higher caste men tried in vain in several ways to make the converted women stop wearing jackets.

The ire against the jacket wearing Channar women continued even after the court verdict. Thus the Channar were compelled to start a rebellion. Hence in 1829, Colonel Munroe, the Diwan and the Resident of Travancore issued orders allowing the Channar women to wear jacket, but not the pinafore or Melmundu. This paved way for the wearing of jackets regularly and the pinafore occasionally by both the Hindu and the Christian Channar Women. The women demanded the right to wear the pinafore along with the jacket. They submitted, in vain, several petitions to materialize their demand. They petitioned their case before the Madras government in 1855, but it was also turned down.

Against this, the higher caste males retaliated by forcibly tearing off in public the jackets and the pinafore of the Channar women in 1859. In order to escape from this physical manhandling, the Channar women took asylum inside a church, at Neyyattinkara. The higher caste men burnt not only the church, but the entire village after looting. This incident naturally led to the rebellion by the Channars. Besides Neyyattinkara, the rebellion spread to various places of south Travancore like Nagarcoil, Kottar, Kumrapuram, Aruvamozhi, Chempavila, Mailady, Aralummude, Thittavila etc. Consequently, Lord Haris, the Governor of Madras instructed the government of Travancore to issue a favourable order. An order was issued in July 1859 permitting the Channar women to wear jacket and the Pinafore, but made of coarse cotton.

Even after this proclamation, there were attacks against the wearing of jackets and the pinafore. Even in the first half of the 20th century, social reformers and political leaders had to fight for the cause of women to wear jackets and the pinafore. Thus, with the active support and the involvement of their counterparts, the Channar women achieved the task and accomplished the right to wear jackets and the pinafore.

In Cochin also there were agitations by the women against Cochin Raja Sir Rama Varma's declaration which prevented women from entering the temple with jackets. This order was publicly repudiated by Mannath Padmanabhan who stood for the cause of women.

Kallumala Samaram

'Kallumala samaram' or 'Stone Necklace Struggle' was an agitation that took place in Kanjaveli near Kollam in 1915. It was a part of the Pulaya Community's fight against the caste elites by breaking their chains to win the right to wear ornaments of their choice. The socio-religious reform movements that took place in Kerala during the 19th century and the uprisings of the downtrodden and the marginalized sections of the society against caste discrimination also had influenced the patterns of ornaments used by the Pulaya Community. During the early days precious stones and gold ornaments were the prerogatives of the higher castes and elites. Socially marginalized sections were not permitted to wear precious stones.

The success of channar agitation was there in the air of southern Thiruvithankur and played as a catalytic agent for the other downtrodden people to fight against similar oppression. Ayyankali was making continuous agitation for the rights of the lower caste people, especially the pulayas. As a part of his reform activities Ayyankali asked the Pulaya women to throw away their ornaments made of stone and iron pieces, which were considered as the symbol of slavery in those days. A public meeting of the pulayas was convened at Perinad, Kollam under the leadership of Ayyankali in 1915. Thousands of Pulaya men and women came to attend the meeting and the women were motivated to throw away their traditional ornaments.

People at the meeting were attacked by caste elites and soon it developed into a rebellion. At the request of Ayyankali, the government provided police protection to convene another meeting. Subsequently another meeting was convened at Kollam town under police vigilance, in which hundreds of Pulaya women threw away their stone necklaces in the public. This marked a turning point in the uplift of lower castes.

Conclusion

The social reform movement acted as a catalyst in bringing women to the forefront of public sphere in Kerala. The most important aspect of the social reform movements in Kerala during the 19th century was the awakening of the lower caste people and their struggle against the evils of the Hindu community.

A large number of recorded and unrecorded agitations by the women of different strata for materializing their basic rights were a reflection of the society of the times. The society, well rooted in caste hierarchy and patriarchal values and ethics did not give identity to women, instead it articulated and strengthened the subordinate position of women even in the name of reform and social legislations.

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Temple Entry Agitation

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The origin of untouchability as an institutionalized practice cannot be located with any certainty [1]. However, only in the beginning of the twentieth century that the problem of untouchability and the evils connected therewith attracted the attention of the social reformers. Leaders like Mahatma Gandhi focused the attention of the people on the degrading effect of untouchability and brought in a revolution in the minds of the people.

The untouchables in Travancore were not allowed to enter the caste Hindu temples. If they wanted to worship in those temples, they had to stand a furlong away from the outer wall limits [2]. They were not only prohibited to enter the temples but also to use the roads around it [3]. To maintain the custom of untouchability, intact prohibition boards were put up on the approach roads to the temple gates. Those who transgressed the prohibited limits were liable to be punished [4]. The liberal minded reformers felt that the exclusion of the untouchables from the temple was a great social injustice. They advocated temple entry as one of the means of removing untouchability.

An Anti – untouchability Committee was formed with T.K. Madhavan, Karur Nilakantan Nambudiripad, T.R. Krishanaswamy Aiyar and K. Velayutha Menon as members and K. Kelappan Nair as Convener to evolve a detailed programme for the agitation [5]. The committee held a meeting on 6 February 1924 in the Swaraj Ashrama at Quilon and decided to choose Vaikom for inaugurating the satyagraha.

On 19 February 1924 a public meeting was convened at Vaikom by the committee [6]. It was attended by a large number of Ezhavas and Pulayas besides caste Hindus. Wide preparations were made for the satyagraha. T. K. Madhavan toured all over Kerala and collected a large number of volunteers and funds for the satyagraha. With all these preparations the stage was set for the satyagraha to begin on 30 March 1924. The satyagraha was started with the blessing of Gandhiji.

The immediate objective of the satyagraha was the opening of all the roads around the temple. At the genesis of the satyagraha, it was resolved to lead an organized march to the temple [7]. Four days before the satyagraha was to start, the District Magistrate instructed the Police to set up pickets to bar Avaranas from using the temple roads. His aim was to prevent clashes between the satyagrahis and the angry orthodox Hindus.

Narayana Guru warmly supported the satyagraha [8]. He visited all the camps of the volunteers in order to see to the adequacy of the arrangements. He allowed a camp to be set up in his Vellur Mutt which he visited and expressed his appreciation for the arrangements. Gandhiji advised the volunteers on their methods of satyagraha. Soon the satyagraha gained All India importance, as leaders from distant places joined it [9]. C. Rajagopalachari came to

Vaikkom to give the movement a fillip. Pandit Madan Mohan Malviya also visited Vaikkom to offer his advice.

E.V. Ramaswamy Naicker, the then President of the Tamil Nadu Congress Committee also gave his wholehearted support to this satyagraha. He came to Vaikkom at the request of the imprisoned leaders of the satyagraha. The imprisoned leaders thought that without proper leadership the satyagraha might not be as effective as they expected. They thought of an alternative leader who could carry on the agitation in a vigorous manner. E.V. Ramaswamy Naicker was their unanimous choice. So they sent a secret letter through a messenger to E.V. Ramaswamy Naicker from the prison requesting him to assume the leadership of the Satyagraha.

When E.V. Ramaswamy Naicker received the message, he came to Vaikkom with hundreds of volunteers from Tamil Nadu. His stirring appeal on the eve of his journey to Kerala had made a deep impression on the people of Tamil Nadu. His lead gave a new life to the movement. He was also arrested and imprisoned. He received very bad treatment in the jail [10]. The part played by E.V. Ramaswamy Naicker in the Vaikkom Satyagraha earned him the great title "Hero of Vaikkom".

In August 1924, Sri Moolam Thirunal, the Maharaja of Travancore passed away. Sri Chithira Thirunal, nephew of Sri Moolam Thirunal was installed on the throne in September 1924. He was only twelve years of age. The Senior Maharani, Sethu Lakshmi Bai was appointed to act as Regent. To mark the occasion of the installation ceremony, the Maharani ordered the release of all the satyagrahis. Gandhiji sent a telegraphic message of appreciation to the Maharani for having released the satyagrahis and the satyagraha was suspended during the coronation.

The satyagraha was resumed soon after the coronation. One of the important events of the satyagraha was the Savarna jatha organized under the leadership of Mannath Padmanabhan, the leader of the Nair Service Society. When the jatha started marching from Vaikkom, a similar one was organized from Suchindram under the leadership of Dr. M.E. Naidu [11]. On 7 November 1924, eighty caste Hindus including Brahmins, Vellalas and Nairs joined as volunteers in the jatha. They marched in military order from Kottar to Trivandrum. Both met at Trivandrum and a memorial was submitted to the Regent Sethu Lakshmi Bai on 12 November 1924.

In the mean time, a deputation of volunteers under the leadership of Changanacherry K. Parameswaran Pillai met the Maharani Regent Sethu Lakshmi Bai and submitted a memorial on 13 November 1924 [12]. The memorialists requested the Maharani to throw open the roads round the Vaikkom temple and the other roads in the other parts of the State to all classes without distinction of caste and creed. The memorial was signed by more than twenty two thousand caste Hindus. But the Maharani replied that it was not possible to give a satisfactory remedy to that important matter immediately.

A resolution calling for the opening of roads around the temples was introduced in the Travancore Legislative Council on 2 October 1924, by N. Kumaran, the Secretary of the S.N.D.P. Yogam. The Assembly discussed the resolution for three consecutive days and

finally rejected it by twenty two against twenty one votes. Again on 9 March 1925 a resolution in the Legislative Council on this subject was moved. This time the government agreed to open new roads for the use of public on the outskirts of the prohibited area. This offer was not accepted by the satyagrahis. The Government's moral deformity and lack of concern for the sentiment of the humbler classes were manifest when the Sirkar Vakil said in the Legislative Council, "If the Government can interfere, they can remedy. But when there is a question of religious sentiment and usage, government cannot take any action in the matter".

The leaders of the satyagraha wanted Gandhiji to visit Vaikkom as it would add prestige to the temple road entry movement. Accordingly Gandhiji reached Vaikkom on 10 March 1925 and cheered up the Satyagrahis. The Satayagrahis were impatient and they were about to resort to violence. But Gandhiji said, "To lose patience is to lose battle..... Breaking of heads will serve no purpose. To attempt force will invite the entry of stronger barricades.....

Gandhiji went to Varkala to see Narayana Guru on 13 March 1925. A Memorendum was presented to him by the Ezhavas at the Sivagiri Mutt, when he made his famous speech, '... I am free to tell you that the Maharani considers that the roads at Vaikkom and similar roads elsewhere should be open to all classes, but as the Head of the State she feels powerless, unless there is public opinion behind her [13]' He had detailed discussions with the Maharani and the Dewan and the trustees of the Vaikkom temple about the temple –road entry. He also made arrangements with the Police Commissioner W.H. Pitt to remove the barricades and pickets. The Ezhava satyagrahis were not pleased with the mere removal of the barricades and the satyagraha continued.

At last in November 1925, the Maharani announced that any road used by the Christians and Muslims could be used by all the Hindus irrespective of caste distinction, but the temple precincts were to be used only by the caste Hindus. The prohibited roads on three sides of Vaikkom temple were thrown open, keeping the one on the eastern side closed to non-caste Hindus and non –Hindus. The satyagrahis continued the fight on the road in the eastern side but withdrew on the advice of Gandhiji. The satyagraha was called off on 23 November 1925.

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Constraints of Women Entrepreneurs in Kanyakumari District

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ABSTRACT

Women entrepreneurship has a tremendous potential in empowering women and transforming society. Studies however show that a host of barriers prevent women from realizing their full potential as entrepreneurs. An important question in entrepreneurship studies is whether women entrepreneurs face any specific constraints in setting up a business that are different from those faced by men. In Kanyakumari District, many women entrepreneurs have been carrying on various businesses like manufacturing enterprises, trading enterprises and service enterprises. Despite the challenges faced by the women entrepreneurs, many of them have been found to be successful in their respective ventures. The problems which are peculiar for a particular women entrepreneur could be resolved by taking up a brief case study. However, if the constraints faced by the most of the women entrepreneurs commonly have been resolved, the rate of successful women entrepreneurs would further go up. Hence, an attempt has been made in this study to examine the constraints faced by women entrepreneurs of service industry in Kanyakumari district.

Introduction

The activity of a rational man involves the role as an organizer, as a worker and as a consumer. Of these roles, the role played by him as an organizer of the factors of production is of immense value. It is a tough job to amalgamate the available factor inputs, the skills and resources provided by nature at the right mix to transform fully into efficient production units. If this is not done, the human resources – the productive ability of the labour - will remain largely unproductive and it will have an impingement on the growth of the economy. This underlines the importance of entrepreneurship in the development of any nation. The development of indigenous entrepreneurship is imperative for a country committed to socio - economic development. The origin of the term ‘entrepreneur’ is stated out by J.R. Hicks in the following words, “In this primitive organization of business the manager and controller of the firm and the owner of the capital goods employed was one and the same person. Our ancestors originally referred to him as the ‘undertaker’ of the business. Nineteenth century economists, fearing misunderstanding preferred the French equivalent “Entrepreneur”. Undertaker is a person whose business is preparing dead bodies for burial’, Entrepreneur is ‘a hirer of labour’.

Woman as an Entrepreneur

Women constitute around half the world’s population. So it is in India too. They are, therefore, regarded as the better half of the society. In traditional societies, they were confined to the four walls of the house performing household activities. In modern societies, they have come out of the four walls to participate in all sorts of activities. Women have been performing exceedingly well in different spheres of activities like academics, politics, administration, social work and so on. They have started plunging into industry also and running their enterprises successfully. Now, women have emerged as an important part of industrial growth. To achieve equal status with men, women have to come out of their traditional roles and responsibilities and have to create an identity for themselves, assuming a

variety of functions. The women employed in unorganized and organized sectors are predominantly in unskilled and semi-skilled categories. Even newer industries like engineering, electronics and pharmaceuticals which are increasingly employing educated women as skilled workers, tend to limit their participation to a few processes where the job involves dexterity of fingers or is repetitive and monotonous in nature.

Statement of the Problem

The study aims at examining these issues among the sample women respondents selected in the district of Kanyakumari, a district which has one of the highest levels of women literacy which takes up the rank in terms of women literacy. The district has one of the highest per capita income of the state. Above all, the district is one among the few districts which have a favourable sex ratio. Even though women entrepreneurs are facing so many problems in their business world.

Objectives of the Study

- To identify the problems faced by the women entrepreneurs.
- To study the performance of the units runs by the women entrepreneurs.

Methodology of the Study

Source of Data

The prime focus of the present piece of research is to examine the problems and prospects of the women entrepreneurs in the district of Kanyakumari. To carry out this exercise, since the secondary data are not available, the study has to rely exclusively on the primary data collected.

Identification of the Population Units

The prime objective of the present piece of research is to examine the problems and prospects of the women entrepreneurship in the district of Kanyakumari. Hence, it becomes pertinent to identify the enterprises owned and managed by women. Since it was understood that the number of women enterprises operating in the district of Kanyakumari could not be identified from a single source, the researcher had to depend on multiple sources. There are innumerable units operating in the district which are both registered and unregistered units managed and run by women. These units are scattered all over the district. Hence, for the purpose of identifying the sample units, the study had to consider only the units which have registered in various financial institutions and specialized agencies. These include, the Commercial banks, District Industries Center, Khadi and Village Industries Board and Women Development Corporation. Even in the case of certain institutions, more specifically, the private commercial banks, the researcher found it difficult to obtain the details pertaining to the women entrepreneurs who have obtained loans from these or through these institutions. Hence, the study, for the purpose of selecting the sample women entrepreneurs, has to depend only on nationalized banks, District Industries Centre, Khadi and Village Industries Board and Women Development Corporation. Thus, the lists of beneficiaries obtained from

commercial banks, District Industries Centres and Khadi and Village Industries Board were only considered.

Limitations

The study concentrates only on the district of Kanyakumari.. The present study is an analysis of the problems of the women enterprises in the district of Kanyakumari and the analysis is based on the socio - economic and family environment. Hence, the conclusion of the present study is based on the present family environment and a change in the environment of the family due to changes in the attitude of the members may make the conclusions void.

Findings

It is found that 79.67 per cent of the respondents belong to the actively working age of 25-45 years, one third technically qualified and 33 per cent graduates, three fourth married, 68 per cent hailing from backward/most backward communities.

5.57 per cent of the members are belongs to joint families; 45.50 per cent of the family heads are in business, and 26.17 per cent in Government service, the former providing the platform to the respondents to engage in business.

It is found that entrepreneurs who have below SSLC or below graduation level of education, a larger proportion of them run industries - based units; those who have an educational level of graduation run business enterprises and who are technically qualified run service units.

Problems and Prospects

I. Land site

Land continues to be a problem for expansion of business sites and the growth of urbanization in the study district as pointed out by the entrepreneurs is the bottleneck in this respect.

II. Labour

Different concerns require different types of labour. In case of skilled and semi-skilled labour, 0.83 per cent and 12.50 per cent are engaged in business enterprises. In the case of unskilled labour, 52.67 per cent are engaged in service industry.

III. Capital

Capital has been the life blood of the Industry, 16.33 per cent of the respondents give first rank and 13.83 per cent give sixth rank to capital needs. 30.42 per cent of the respondents say that the interest rate is high and the non availability of funds in time is a major problem.

IV. Management

Entrepreneurs engaged in different activities view differently the nature of the problem of management 11.33 per cent of respondents engage in service industry “highly agree” and only 83 per cent of the respondents from the agriculture - centered support the view that managing the business is ‘problem’, it is found that family responsibility, lack of motivation, limited choices of ideas and low level of output: all together led to managerial constraints.

V. Marketing

52.17 per cent of entrepreneurs from service industries, sell their product at the local level. Though a larger proportion of entrepreneurs are engaged in producing manufactured products, only a meagre part of them sell their products outside the district. Smallness in size, localized operations, limited financial resources and adequate and up to date market information are found as the main reasons for the state of affairs.

VI. Competition

The women entrepreneurs face competitions from the big industrial houses who try to unsettle upcoming small scale entrepreneurs. One half of respondents experience middle level of competition, 35 per cent high level of competition and the rest low level of competition. It is found that the service industry faces the highest as well as the medium level of competition in the market.

Suggestions of the Study

- Special cells may be opened for providing easy finance to women entrepreneurs in various public financial institutions and banks..
- Encouragement and assistance should be provided to women entrepreneurs for setting up cooperatives.
- Scarce and imported raw materials may be made available to women entrepreneurs on priority basis.
- Training and skills are essential for the development of entrepreneurship. Training schemes should be so designed that women can take full advantage. .
- The attitude of the husband and family members towards the working women should change. Husband should come forward to share her burden. Women should change their attitude about themselves. They should be self-confident in their approach.
- Women should be made aware of their constitutional and legal rights both in their work and in the social sphere.
- There should be more governmental schemes to motivate women entrepreneurs to engage in small scale to large scale business.

Conclusion

The present study assessed the problems and prospects of women entrepreneurship in Kanyakumari district on the socio - economic perception and analyzed the characteristics of women entrepreneurship and offered a number of suggestions. The present study has identified that at the time of start-up phase, the women entrepreneurs suffer a lot due to poor access to finance and poor business skill. During the growth phase, the major constraints affecting the women entrepreneurs are poor access to finance, tax harassment and finding qualified labour. In respect of gender-related problems, spatial mobility and time distribution between family and business have been severely affecting the women entrepreneurs at the initial phase while time distribution between family and business and non-acceptance of women's authority have been the major problems of women entrepreneurs at the growth phase. Thus, the policy makers have to consider drafting policies to ensure easy access to finance for women entrepreneurs. Business skills could be developed through experience only and hence they could be educated to face the challenges with courage and confidence.

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Perception of the Customers on the ATM Services Rendered by the Indian Bank

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ABSTRACT

Banking in India has undergone a sea change in the past couple of decades. The changes have occurred at multiple fronts. No industry in the country has expanded as much as the banking industry. Post nationalization new branches of banks have been opened in all corners of the country. Bank license policy has been liberalised. Many private banks including payment banks and small finance banks which form a new category of banks have come up. Recognition of service quality as a competitive weapon is relatively a recent phenomenon in the banking sector. The need of the hour in the Indian banking sector is to build up competitiveness through enhanced service quality, thus making the banks more market oriented and customer friendly. The introduction of ATM helps the bank to reduce the processing time of transactions and waiting time of the customers. The Indian Bank in Kanyakumari district offers numerous services including ATM services to its customers. This research paper analyses customers' perception towards the ATM services of the Indian Bank.

1. Introduction

Today all the banks use modern information technology endorsed services like ATM, tele-banking and online banking system. Banking is essentially a high contact service industry and there is a close interaction between the service provider and the customer in the traditional banking scenario. Among the 26 public sector banks, Indian Bank has been ranked first during March 2015-'16 and its growth rate has increased by 1.47 per cent from 10.61% to 12.08%. ATM card (Automated Teller Machine) is a magnetic-stripped bank card that was primarily introduced for the purpose of allowing the customers to withdraw their cash or money from their account without human intervention. The popularity of ATM card is a clear indication of customers' preference for easy and fast way of cash withdrawal.

2. Statement of the Problem

Banks play an important role in the development of a country. Even though various services have been provided, the customers have to wait for a long time for any banking transaction. But after the introduction of ATM services they can withdraw money in one or two minutes. Hence a study was made to analyse the perception of the customers towards the ATM services rendered by the Indian Bank.

3. Objectives of the Study

The objective of the study is to analyse the perception of the customers on the ATM services of Indian Bank.

4. Methodology

This study comprises of both primary and secondary data. Primary data were collected through a well designed interview schedule, from 450 respondents. Stratified random sampling technique was used to select the respondents. These respondents include 225 employees, 150 businessmen and 75 other type of respondents including unemployed customers, students and housewives. Secondary data were collected from journals, books, news papers, magazines and websites.

5. Analytical Framework of Services

Among the various services offered, ATM services, were identified as more useful and vital in the sense that any deficiency in this service would cause many inconveniences. Data relating to the perception of the customers towards ATM facilities offered by the Indian Bank were collected with the help of a pre-determined and well structured interview schedule. Likert's five - point scaling technique was used in this study. The mean score on each statement obtained for the respective variable among the three groups were calculated separately. In order to highlight the significant difference if any among the three groups of the respondents regarding their perception towards facilities offered by the Indian bank, the one way Analysis of Variance (ANOVA) was administered.

6. Perception towards the ATM Services

ATM Card (Automated Teller Machine) is a magnetic – stripped bank card that was primarily introduced for the purpose of allowing the customers to withdraw their cash or money from their account without human intervention. As per the survey conducted, it was observed and expected that the total number of ATMs across the world would cross 2.5 million by 2013. The popularity of ATM card is a clear indication of customers preference for easy and fast way of cash withdrawal. Hence it is essential to focus on the perception of the customers' towards ATM facilities available in general. In the present study five statements were identified by the researcher to measure the perception of the respondents towards the provision of ATM services. They are smooth functioning of the machine, easy accessibility, quick withdrawal, accuracy in statements and availability of CCTV.

In order to highlight the significant difference among the three groups of respondents regarding their perception on the selected five statements, data were collected and the one way Analysis of Variance (ANOVA) was administered. The mean score on each statement obtained was calculated separately. The resulting mean score on the perception of the respondents towards ATM services and the respective "F" statistics are presented in Table – 1.

Table -1
Perception of Respondents towards ATM Services

Services	Mean Score			'F' Statistics
	Employees	Businessmen	Others	
Smooth functioning of machine	2.60	2.60	3.17	4.268**
Easy accessibility	2.52	2.98	3.26	7.741**
Quick withdrawal	2.49	2.96	3.21	7.597**
Accuracy in statement	3.06	3.04	3.21	0.360 ^{NS}
Availability of CCTV	3.00	3.11	3.10	0.301 NS

Source: Computed data

** Significant at 1 per cent level

N.S. - Not Significant.

Table -1 has revealed that the “other type of respondents” perceived highly on all the aspects of ATM services more than the “businessmen” and the “employees” since the respective mean scores on the various factors in ATM services were greater than those of others. The highly perceived factors among the “other type of respondents” were “Easy accessibility”, “Quick withdrawal,” and “Accuracy in statement” since the respective mean scores were 3.26, 3.21 and 3.21 respectively. Among the “businessmen”, the highly perceived factors were “Availability of CCTV”, “Accuracy in statement”, and “Easy accessibility,” since the respective mean scores were 3.11, 3.04 and 2.98. Among the mean score of the “employees”, except the factor “Accuracy in statement”, all other factors with less than 2.9 mean score had negative attitude. The “employees” perceived as very low on the factors namely “Availability of CCTV”, “Smooth functioning of machine”, “Easy accessibility” and “Accuracy in statement” since the mean scores were 3.00, 2.60, 2.52 and 2.49 respectively. A significant difference among the three different groups of respondents was identified regarding the perception towards various aspects especially in “Smooth functioning of machine”, “Easy accessibility”, “Quick withdrawal”, since the respective “F” statistics were significant at 1 per cent level. The aspects like “Accuracy in statement”, and “Availability of CCTV”, were found to be not significant at 1 per cent level. The analysis infers that the “employees” category is poor in their perception on the attitude towards the availability of ATM services when compared to the “other type of respondents”.

Perception towards ATM Service Index (ATMSI) among the respondents the ATMS index was prepared for further analysis. The ATMS index is calculated by

$$ATMSI = \frac{\sum_{i=1}^n SAWSVi}{\sum_{i=1}^n MSAWSVi} \times 100$$

Where,

ATMSI = ATM Service Index

SAATMSV = Score on the Attitude towards ATM Service Variable

MSAATMSV = Maximum Score on the Attitude towards ATM Service Variable

$i = 1 \dots n$ = Number of ATM Service variables included.

In the present study, ATMSI is confined to less than 25, 25 - 50, 50 – 75 and 75 – 100 per cent. The distribution of the respondents according to the ATMSI is shown in Table -2.

Table - 2
ATM Service Index among the Respondents

ATMS Index (%)	Number of Respondents			Total
	Employees	Businessmen	Others	
Less than 25	----	1 (100)	---	1 (100)
25 – 50	136 (66.99)	36 (17.73)	31 (15.28)	203 (100)
50 – 75	10 (23.38)	91 (59.09)	29 (21.80)	154 (100)
75 – 100	53 (57.61)	22 (23.91)	17 (18.98)	92 (100)
Total	225 (50.00)	150 (33.33)	75 (16.67)	450 (100)

Source: Computed data (Figures in parentheses denote percentages to total)

Table -2 shows that in total, a maximum of 203 respondents having ATMSI of 25 - 50 per cent followed by 154 who have ATMSI of 50 -75 per cent. The numbers of respondents who have ATMSI of less than 25 per cent constitute only one respondent. Out of 92 respondents having 75 – 100 per cent ATMSI 22 were businessmen. Among the employees, the number of customers who had ATMSI of 25 – 50 per cent constitutes 66.99 per cent to its total, whereas among businessmen, it constitutes 17.73 per cent. Also in the case of the other type of respondents who had ATMSI of 25 – 50 per cent constitutes 15.28 per cent to its total. At the same time, the customer having ATMSI of 50 – 75 per cent outnumbered the employees and the others 59.09 per cent. However, the number of businessmen having ATMSI of 50 – 75 per cent constitutes 59.09 per cent of the total whereas among the employees and the other type of respondents, it was 23.38 and 21.80 per cent respectively. Regarding the customers with 75 – 100 per cent ATMSI, 57.61 per cent of the employees

23.91 per cent of the businessmen and 18.98 per cent of the other type of respondents belong to this level of ATMSI. It is inferred that there prevails a poor attitude towards ATM service among the employees and better attitude among the other two categories of respondents.

7. Findings

The analysis infers that the “employees” category is poor in their perception towards the availability of ATM services when compared to the “other type of respondents”. The index inferred that there prevails a poor attitude towards ATM services among the employees and better attitude among the other two categories of respondents.

8. Suggestions

- More ATM counters can be opened by the Indian Bank in rural areas.
- The bank can increase the maximum limit of withdrawals from ATM at a time or a day.
- Timely loading of cash in ATMs is necessary to satisfy the customers especially during the holidays.

9. Conclusion

The variables relating to perception towards the ATM services were analyzed in order to reveal the significant differences among the respondents of the three categories regarding their perception. The employees had poor attitude towards the ATM services and better attitude among the other two categories of respondents. Most of the customers have an overall satisfaction towards the ATM services of the Indian Bank. The suggestions of the study will provide a broad frame work for improving the system of ATM services by providing them maximum satisfaction. These suggestions bound to pave the way for great success.

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A Study on the Prospects of Eco –Tourism in Kanyakumari District

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ABSTRACT

Ecotourism is more than a catch-phrase for nature loving travel and recreation. Ecotourism is consecrated for preserving and sustaining the diversity of the world's natural and cultural environments. Care should be taken to preserve the entire local ecosystem, just individual species, vistas or sites. Tourists should always be motivated and encouraged to favour business that minimizes pollution, waste, energy consumption, water usage, landscaping, chemicals and unnecessary night-time lighting. Hospitality providers must be trained to initiate measures like recycling, promoting energy efficiency, introducing water reuse and creating economic opportunities for local communities as an integral part of eco-tourism. Eco tourism must aim to promote respect for local culture and traditions.

Key words: Eco-tourism, environment, pollution, eco system, landscape

1. Introduction

“Ecotourism is responsible travel to natural areas that conserves the environment and sustains the well being of local people”. Tourism industry in India plays a significant role in transforming the society and economy. Pandit Jawaharlal Nehru's of quoted remark, **“welcome a tourist and send back as friend”** has been the essence of Indian tourism approach in the post independent era. Tourism as an industry has great potential to bring about social and culture development. Eco tourism is a new concept in tourism, which was originally sparked off by the idea of making harmonious co-existence with nature a reality once again. Today, ecotourism is one of the fastest-growing segments of the tourism industry. Its potential growth is virtually unlimited. Any tourism programme which is nature-based, ecologically sustainable, where education and interpretation is a major concept and where local people are benefited can be called ecotourism. A special feature of the ecotourism is that it employs a large number of women and young people in hotels, airline services, travel agencies, making handcrafts, undertaking cultural activities and other tourism related tasks. The direct employment in the sector was about 8.5 million persons, accounting for about 2.4 per cent of the total labour force. Estimates of indirect employment show that in total about 22 million persons derive their livelihood from tourism. This sector promotes the indigenous people to become leaders, employers, business entrepreneurs, employees and informal household labourers and it provides opportunities to the local people that can lead to economic, social and cultural empowerment. Eco-tourism suggests for the development of a destination through its use for tourism activities causing nominal damages to the environment of the destination. Such trails and camp sites are to be monitored in terms of soil erosion and damages to the vegetation in order to maintain the ecology of the destination. Therefore proper utilization of the resources can be made for sustainable development of eco-tourism in the destination.

2. Statement of the Problem

Any society setting itself the goal of sustainable development should be developed economically and socially in such a way that it minimizes those activities, the costs of which are borne by the future generations. Deteriorating environment and loss of natural resources represent one of the main ways by which the present generation is creating uncompensated future costs. Hence the conservation of natural resources and the environment is crucial to achieve sustainable development. Eco tourism has become the fastest growing service industry in the country with great potentials for its further, expansion and diversification. Eco tourism is the only way to maximize the economic, environmental and social benefits of the indigenous people.

3. Objectives of the Study

- To study the socio-economic profile of the respondents.
- To analyse the prospects of eco tourism in the study area.

4. Methodology

This study is based on the survey method. Both primary and secondary data are used for the study. The primary data were collected from 100 respondents through a well prepared questionnaire since the population is large in size and adopted purposive sampling method. The secondary data were collected from journals, websites, research studies, books, magazines and records.

5. Data Analysis and Interpretation

5.1 Demographic Profile

The various demographic factors considered for analysis were the age, gender, marital status, educational qualification, occupation, size of family annual income and sources of information. Table-1 shows the demographic profile of the respondents.

Table -1

Demographic Profile of the Respondents

Variables	Particulars	N=100	Percentage
Age	Below 25 years	58	58
	26 to 35 years	18	18
	36 to 45 years	14	14
	Above 46 years	10	10
Gender	Male	68	68
	Female	32	32
Marital Status	Married	38	38
	Unmarried	62	62
Educational Qualification	Up to Higher Secondary	27	27
	Under Graduate	37	37
	Post Graduate	21	21
	Professional	15	15

Occupation	Students	48	48
	Employed	27	27
	Self employed	12	12
	Professionals	13	13
Size of the Family	Up to 3 members	31	31
	4 to 5 members	57	57
	More than 5 members	12	12
Annual Income (in Rs.)	Less than 1,00,000	18	18
	1,00,001 – 2,00,000	26	26
	2,00,001 – 3, 00,000	20	20
	3,00,001 – 4,00,000	22	22
	Above 4,00,001	14	14
Sources of Information	Friends/ relatives	48	48
	T.V/Radio	12	12
	Travel agency/Tour operators	10	10
	News papers/Magazines	7	7
	Internet	23	23

Source: Primary data

Table-1 reveals 58 per cent of the respondents are in the age group of below 25 years, 68 per cent of the respondents are male, 62 per cent of the respondents are unmarried and 38 per cent of the respondents are married. Majority of the respondents are undergraduates and students are very much interested to gain more information regarding the unfamiliar areas. 57 per cent of the respondents have 4 to 5 members in their family, 26 per cent of the respondents are earning Rs. 1, 00,001 to Rs. 2, 00,000 p.a and 48 per cent of the respondents came to know about the important eco- tourist places through their friends and relatives. So word of mouth advertisement plays a vital role in giving information about the eco-tourist places.

5.2 Benefits of Eco Tourism

Eco tourism is led by motives like spirit of enquiry, love of beauty, search for knowledge and respect for nature. It aims at quality tourism, which creates minimal damage to the natural, social and cultural fabric. Eco tourism helps to educate the travellers, provide funds for conservation, benefits the economic development and political empowerment of local communities and fosters respect for different cultures and for human rights. Eco-tourism creates a number of benefits to the people as well as nations. The benefits of ecotourism identified by eighteen variables and analysed using Likerts' five point scaling technique are given in table -2.

Table - 2
Benefits of Eco-tourism

S.No	Variables	Total Score	Mean Score	Rank
1	Protects the natural areas	487	4.05	I
2	Appreciation of nature	474	3.95	II
3	Alternative employment/income	472	3.93	III
4	Earns foreign exchange	464	3.86	IV
5	Development of infrastructure	460	3.83	V
6	Protection of cultural diversity	450	3.75	VI
7	Promotes fairs and festivals	441	3.67	VII
8	Promotes art & architecture	441	3.67	VII
9	National integration	422	3.51	IX
10	Grows culture	421	3.50	X
11	Sustains ecology	418	3.48	XI
12	Generating economic benefits	400	3.33	XII
13	Improves hospitality	400	3.33	XII
14	Grows civilization	395	3.29	XIV
15	Preserves historical monuments	385	3.20	XV
16	Increasing awareness towards conservation of natural & cultural areas	335	2.79	XVI
17	Promotes international peace	332	2.76	XVII
18	Minimizes negative impact on nature	243	2.02	XVIII

Source: Computed data

Table -2 depicts the benefits of ecotourism with the mean scores and ranks. Out of the eighteen variables identified, the first important variable is 'Protect the natural areas' with the highest mean score of 4.05 followed by 'Appreciation of nature' ranked second with the mean score of 3.95. The variable 'Alternative employment /income' with the mean score of 3.93 is ranked third and 'Earn foreign exchange' is ranked fourth with mean score of 3.86. 'Development of infrastructure' is ranked fifth with the mean score of 3.83. 'Promotes international peace' and 'Minimizes negative impact on nature' are the least ranked variables identified by the respondents.

6. Suggestions

- Good sanitation and water facilities can be arranged by the local bodies.
- The government can arrange adequate transport services to link all the eco-tourist spots of Kanyakumari District.
- From the study it is understood that, male tourists are often visiting the tourist places. Hence the government should provide safety measures for the women tourists also so as to help the whole family to make the tour more fruitful and memorable.
- Government should provide a separate tourist information office to provide necessary guidance to the eco- tourists.
- People should visit the eco-tourist spots at least once a year for a stress free life.
- Tourists are also partly responsible to keep the tourism spots clean and pollution free.

- On line booking on the availability of hospitality services will help to minimize negative impact of the tourist spots.
- Plastic free areas will definitely promote health and hygiene of eco tourist spots.

7. Conclusion

Now a days people like to visit various places and so they collect information about tourism spots from many sources. The place they select depends on their income, convenience, leisure time and interest. If they enjoy a place, it will be an ever memorable place for them in their life to visit again and again. Recently eco- tourism spots have gained a lot of importance among people. Therefore Government and local bodies should take necessary steps to facilitate various facilities in the tourism spots and the tourists must be motivated to keep the tourism spots pollution free and eco friendly. If the Government and the public do this mission properly, lots of tourists both international and national will be attracted towards the tourist spots in Kanyakumari district that will not only bring sufficient foreign exchange but also earn name and fame to the nation.

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Customer Preference towards Branded Footwears with Special Reference to Nagercoil Town

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ABSTRACT

Over centuries many varieties of footwears were made in order to protect the feet. Footwear was made of leather, wool or remains of the plants. The footwear market has evolved a great deal over the past few years, as today's customers are more fashionable and style conscious. Apart from that, the growing awareness for health and fitness has led to rapid growth in the sports footwear category. However, the growth opportunities have not yet been fully leveraged, especially in the mid segment where youth are looking for aspirational products at affordable prices. This segment will provide a strong growth momentum to the domestic footwear industry over the next few years. In this study an attempt has been made by the researcher to study about the customer preference towards branded footwears.

Introduction

The history of use of footwear by human kind can be traced back to the ice age about 5 million years ago. Other evidences show that footwear came to use at the end of the Palaeolithic period, at about the same time the early humans learned the art of leather tanning. Earlier footwear was made of wrappings of dried grasses and only later on the art of making footwear from pieces of leather was developed. Until the mid-nineteenth century shoes were made as straights. There was no distinction made between the right and left shoes. The left and right footwear were identical and hence could be worn on either foot. Only prolonged usage shaped them into right and left boots. The right and left shoes were invented by a fashionable boot maker, William Young from Philadelphia in 1800. The first crafted footwear is the sandals, which are known to be the successors to these wrappings. In India these sandals were called as padukas, which were mainly worn by the saints. India is the second largest global producer of footwear after China. However, the growth opportunities have not yet been fully leveraged, especially in the mid segment where youth are looking for aspirational products at affordable prices.

Kinds of footwear in the market

Ballet flat

Ballet flats or dolly shoes are derived from a woman's soft ballet shoe, with a very thin heel or the appearance of no heel at all.

Boot

A boot is a type of footwear and a specific type of shoe. Traditionally boots are made of leather or rubber and modern boots are made from a variety of materials.

Bovver boot

A bovver boot is a type of boot that has been associated with violence. It has been considered as an offensive weapon used by hooligans for kicking opponents while street fighting.

Bunny slippers

Bunny slippers are a type of slipper in the shape of a cartoon rabbit. Past and current manufacturers and distributors of bunny slippers include run away rabbit creations of Bowling green, Kentucky, United states.

Fashion boot

A fashion boot is a boot worn for reasons of style or fashion. Fashion boots come in a wide variety of styles, from ankle to thigh-length, and are used for casual, formal and business attire.

Foot wraps

Foot wraps are rectangular pieces of cloth that are worn wrapped around the feet to avoid chafing, absorb sweat and improve the foothold.

Shoe

A shoe is an item of footwear intended to protect and comfort the human foot while doing various activities.

Sandal

Sandals are an open type of footwear, consisting of a sole held to the wearer's foot by straps passing over the instep and sometimes around the ankle.

Snow shoe

A snow shoe is footwear for walking over the snow. Snow shoes work by distributing the weight of the person over a larger area so that the person's foot does not sink completely into the snow.

Steel-toe boot

Safety footwear now comes in many styles, including sneakers and clogs. Some brands of steel-toe footwear have become fashionable within sub cultures such as skin head, punk, and rivethead.

Statement of the Problem

The preference and the purchasing pattern of customers towards foot wears varies from person to person based on the brand awareness, taste and preference, customer expectations like quality, price, taste and the like of footwears. Unless customer's expectations are fulfilled, no manufacturers may retain or increase their market potential. Thus the present study has been undertaken to identify the customers preference towards the types of footwears and ascertain the customers brand awareness and to examine the factors which induce a customer to purchase footwear.

Objectives of the Study

- ❖ To understand the demographic profile of the respondents.
- ❖ To ascertain the reasons for choosing branded footwear
- ❖ To know the various brands of footwears preferred by the respondents.

Methodology

The study comprises of both primary data and secondary data. The primary data were collected through personal interview from 100 respondents in Nagercoil. Simple Random Sampling was used to select the respondents. The collected data were analyzed with the help of percentage and Henry's Garrett ranking method. The secondary data were collected from websites.

Demographic Profile

An attempt is made to analyse the factors which contribute towards the selection of footwear. The demographic variables which are affecting brand preference of customers, such as age, gender, marital status, educational qualification, occupational status and monthly Income are analysed and presented in table 1.

Table - 1
Demographic Profile of the Respondents

Description		No. of Respondents	Percentage
Age	Below 20	22	22
	21-30	22	22
	31-40	46	46
	Above 40	10	10
Gender	Male	44	44
	Female	56	56
Marital status	Married	52	52
	Unmarried	48	48
Educational qualification	Up to HSS	6	6
	Graduate	36	36
	Post graduate	16	16
	Professional	42	42
Occupation	Student	30	30
	Business	26	26
	Professional	38	38
	Government employees	6	6
Monthly income	Below Rs. 10000	18	18
	Rs.10001-20000	28	28
	Rs.20001-30000	20	20
	Above Rs.30000	34	34

Source: Primary data

Table 1 reveals that 46 per cent of the respondents belong to the age group of 31-40 years and 56 per cent of the respondents are female. 52 per cent of the respondents are married and 42 per cent of the respondents have studied professional courses. 38 per cent of the respondents are professionals and 34 per cent of the respondents have monthly income above Rs 30000. So it is clear that high income earning people prefer to buy branded footwears.

Brand Preference of the Respondents

Product preference depends on the tastes, degree of satisfaction, and utility from the product. Consumers prefer different brands of footwear according to their will and wish. Table 2 shows the different brands of footwear preferred by consumers.

Table - 2
Brands of Footwear Preferred by the Respondents

S. No	Brand name	No. of respondents	Percentage
1.	VkC pride	22	22
2.	Cindy	4	4
3.	Paragon	4	4
4.	Solea	4	4
5.	Reebok	10	10
6.	Nexo	6	6
7.	Nike	6	6
8.	Tenzo	4	4
9.	Leed	2	2
10.	Bata	38	38
	Total	100	100

Source: Primary data

From the table 2 it is clear that 38 per cent of the respondents prefer the brand “Bata”, 22 per cent of the respondents prefer the brand “VKC pride”, 10 per cent of the respondents prefer the brand “Reebok” and only 2 per cent of the respondents prefer the brand “Leed”. So it is clear that Bata is the most preferred brand by the customer, because of its brand loyalty.

Reason for using branded footwear

Customers select the footwear after considering so many factors Table-3 shows the reasons pointed out by the respondents for selecting the particular brand of footwear.

Table - 3
Reasons for Using Branded Footwear

Reasons	Garrett ranking	Rank
Long lasting use	54.54	I
Reasonable price	51.62	II
Availability of number of layers	51.14	III
Good leather quality	46.6	IV
Comfortable base	45.02	V

Source: Primary data

Table 3 shows that among the reasons listed out by the respondents, first rank is given to the reason “long lasting use” with the highest mean score 54.54 followed by “Reasonable price”. Third and fourth ranks are given to the “Availability of number of layers”, Good leather quality. Last rank is given to the “Comfortable base” with the least mean score of 45.02.

Suggestions

- ❖ As most of the customers are motivated by advertisements, the manufacturers should be ready to spend more money for advertisements to popularise their brand of footwears.
- ❖ Footwear manufacturers may produce various types of foot wears and efforts should be made to reduce the price of the foot wears according to the competitors in the market.
- ❖ Manufacturers may advertise their product in face book, twitter, and online websites in order to attract a large number of people of all age groups.
- ❖ Manufacturers should produce new type of foot wears instead of the old one, as per the changing taste of the customers.

Conclusion

From the present study, it is understood the majority of the respondents prefer Bata brand of footwear. This shows that Bata manufactures spent their precious time and money to popularise their brand among people. Other manufacturers should follow these strategies, so that they may gain new customers and retain their existing customers.

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A Study on Brand Preferences towards Wristwatch- With Special Reference to T. Kallikulam

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ABSTRACT

A wristwatch is designed to be worn on a wrist, attached by a watch strap or other type of bracelet. Modern watches often display the day, date, month and year, Electronic watches may have many other functions. Some watches include alarms also. Other elaborate and more expensive watches, both pocket and wrist models also incorporate striking mechanisms, so that the wearer could learn the time by the sound emanating from the watch. In this paper, the researcher has made an attempt to assess the brand preferences of customers towards wristwatches and consumer awareness with regard to different brands of wristwatches.

Introduction

The wristwatches are something that is beyond description. A watch is more than a time keeper. Besides, it makes a person punctual. It is also really an important part of tradition and culture. It is designed to be worn on a wrist, attached by a watch strap or other type of bracelet. Modern watches often display the day, date, month and year. Electronic watches may have many other functions. Time related features such as timers, chronographs and alarm functions are common. Some modern designs incorporate calculators and Bluetooth technology and having heart-rate monitoring capabilities. Wristwatches were first worn by military men towards the end of the 19th century. During World War I, soldiers were given wristwatches called 'trench watches', in order to view the time easily with their hands full. These watches were made with pocket watch movements, so they were large and bulky and the crown at the twelve o' clock position like pocket watches.

Kinds of Wristwatches

1. Clock-watch

These 'clock watches' were fastened to clothing or worn on a chain around the neck. They had only an hour hand. The face was not covered with glass, but usually had a hinged brass cover, often decoratively pierced with grillwork, so that the time could be read without opening. Still later there was a trend for unusually-shaped watches, and clock-watches shaped like books, animals, fruit, stars, flowers, insects, crosses, and even skulls were made.

2. Pocket watch

Styles changed in the 17th century and men began to wear watches in pockets instead of as pendants. Service watches produced during the war were specially designed for the rigours of trench warfare, with luminous dials and unbreakable glass.

3. Electric watch

The first generation electric powered watches came out during the 1950s. The hands were still moved mechanically by a wheel train. In mechanical watches the self winding

mechanism, shockproof balance pivots, and break resistant ‘white metal’ mainsprings became standard.

4. Quartz watch

The first quartz watch to enter production was the Seiko 35SQ Astron, which hit the shelves on 25 December 1969, which is the world’s most accurate wristwatches to date. The introduction of quartz watch in 1969 was a revolutionary improvement in watch technology.

5. Radio-controlled wristwatch

In this type, the watch’s quartz oscillator is set to the correct time daily by coded radio time signals broadcast by government-operated time stations. Recent models are capable of receiving synchronization signals from various time stations worldwide.

6. Atomic wristwatch

In 2013 Bathys Hawaii introduced their Cesium 133 Atomic watch, the first watch to keep time with an internal atomic clock. Unlike the radio watches, which achieve atomic clock accuracy with quartz clock circuits which are corrected by radio time signals received from government atomic clocks, this watch contains a tiny cesium atomic clock on a chip. It is reported to keep time to an accuracy of one second in 1000 years.

7. Scuba diving

The international organization for standardization issued a standard for water resistant watches which also prohibits the term “waterproof” to be used with watches, which many countries have adopted.

8. Speech synthesis

Talking watches are available, intended for the blind or visually impaired. They speak the time out loud at the press of a button. This has the disadvantage of disturbing others near by, or at least alerting the non-deaf that the wearer is checking the time.

9. Handedness

Wristwatches with Ana log displays generally have a small knob, called the crown, that can be used to adjust the time. Almost always, the crown is located on the right-hand side of the watch so it can be worn on the left wrist for a right handed individual. This makes it inconvenient to use if the watch is being worn on the right wrist.

TITAN

Titan was established in the year 1984, becoming the third Indian manufacturer after HMT&ALLWYN. TITAN is the world’s fifth largest wristwatch manufacturer & export watches to nearly 32 countries around the world. Some of the well-known brands of TITAN include Fast track, Sonata, Raga, Edge, Octane, Xylys, Nebula, Zoop, Titan eye+, Tanishq, Gold plus, Zoya and skin.

HMT

Hindustan Machine Tools (HMT) was incorporated in 1953 by the government of India as a machine tool manufacturing company. HMT comprises six subsidiaries under the ambit of a holding company, which also manages the tractors business directly. Sonata, Titan, Fast

track, Timex, Maxima, Rolex, Casio, Citizen, Swatch, Omega are the top most watch brands available in India. Titan and HMT are the Indian watch manufacturers.

Statement of the Problem

A customer tends to purchase a brand which they can instantly recall at the thought of buying a product. In general, Indian customers are indifferent in choosing the brand, since lot of close substitutes are available in the market. A customer will make a purchase without paying enough attention to his needs and desires. Since the brand names of products play a major role while taking decision to buy a product, the researcher has made an attempt to assess the brand preferences towards wristwatches and the consumer awareness about the existing brands.

Objectives of the Study

- ❖ To study the demographic profile of the respondents.
- ❖ To find out the buying behaviour of the respondents.
- ❖ To identify the brand preference of the respondents.

Methodology

The study comprises both primary data and secondary data. The primary data were collected through personal interview from 50 respondents in T. Kallikulam. Convenience random sampling technique was used to select the respondents. The collected data were analyzed with the help of percentage, Henry's Garrett ranking technique. The secondary data were collected from websites.

Data Analysis and Interpretation

In this study, an attempt is made to analyse the brand preference of customers towards wristwatches. Before that it is necessary to know the demographic profile of the sample respondents. In the present study, demographic variables such as gender, age, occupation, marital status, educational qualification, monthly income are analysed and are presented in table-1.

Table - 1
Demographic Profile of the Respondents

S.No	Description		No. of Respondents	Percentage
1.	Gender	Male	13	26
		Female	37	74
2.	Age	Below 20 years	12	24
		20-30 years	28	56
		30-40 years	4	8
		40-50 years	6	12
3.	Occupation	Government employees	4	8
		Professional	10	20
		Home maker	5	10
		College student	24	48
		Business man	7	14
4.	Marital status	Married	12	24
		unmarried	38	76
5.	Educational qualification	SSLC	3	6
		Up+2	8	16
		UG	23	46
		PG	12	24
		Professional	4	8
6.	Monthly income	Below 10000	9	18
		10001-20000	25	50
		20001-30000	4	8
		30000 above	12	24

Source: Primary data

Table 1 shows that 74 per cent (37) of the sample respondents are female and 56 per cent (28) of the respondents belong to 20-30 years age category. 48 per cent (24) of the respondents are college students. Among those who are using wristwatches 48 per cent are college students. 76 per cent (38) of the respondents are unmarried and 24 per cent (12) of the respondents have studied PG. 50 per cent (25) of the respondents monthly income is between Rs. 10001 and 20000.

Buying Behaviour of the Respondents

Influencing factors

The buyers are influenced by various factors. Some are influenced by friends while some others are influenced by others. Table-2 show the factors that influence the buyers towards wristwatches.

Table - 2
Factors Influencing the Sample Respondents

S. No	Influencing factor	No. of Respondents	Percentage
1.	Friends	23	46
2.	Relatives	10	20
3.	Colleagues	2	4
4.	Family members	15	30
	total	50	100

Source: Primary data

The above table shows that 46 per cent of the respondents are influenced by their friends, 30 per cent of the respondents are influenced by their family members, 20 per cent of the respondents are influenced by their relatives, and only 4 per cent of the respondents are influenced by their colleagues.

Models of Wristwatches

Customers wear different models of wristwatches according to their tastes. Table 3 shows the models of wristwatches preferred by the respondents.

Table - 3
Models of wristwatches preferred

S.No	Models	No. of Respondents	percentage
1.	Ana log	37	74
2.	digital	13	26
	total	50	100

Source: Primary data

Table 4 shows that 37 respondents 74 per cent prefer Ana log model watches and 13 respondents (26 per cent) prefer digital model. This reveals that majority of the respondents prefer Ana log model.

Types of strap

Customers like to use different types of straps. Some may prefer leather straps while some others may prefer metal types. Table 4 shows the type of strap preferred by the users.

Table - 4
Type of Strap Used by the Respondents

S. No	strap	No. of Respondents	Percentage
1.	Leather strap	16	32
2.	Metal strap	34	68
	total	50	100

Source: Primary data

Table-5 shows that, out of 50 sample respondents. 34 respondents (68 per cent) prefer metal straps while 16 respondents (32 per cent) prefer leather strap. From the above table it is concluded that most of the respondents prefer metal strap.

Shapes of Wristwatches Preferred

Different customers prefer different shape of wristwatches. Table 5 shows the shape of wristwatches preferred by the respondents.

Table - 5

Shapes of Wristwatches Preferred by the Respondents

S. No	Shape	No. of Respondents	Percentage
1.	Round	20	40
2.	Oval	12	24
3.	Semi circle	3	6
4.	Square	8	16
5.	Rectangle	7	14
	total	50	100

Source: Primary data

The above table shows that 20 respondents 40 per cent prefer the round shape, 12 respondents 24 per cent prefer oval shape, 8 respondents 16 per cent prefer square shape, 7 respondents 14 per cent prefer rectangle shape, and 3 respondents 6 per cent prefer semi circle shape.

Place of Purchase

Different customers prefer different place of purchase of wristwatches. Table 6 shows the place of purchase of the customers.

Table - 6

Place of Purchase

S. No	Place of Purchase	No. of Respondents	Percentage
1.	showroom	27	54
2.	Retail shop	16	32
3.	online	7	14
	total	50	100

Source: Primary data

Table 7 shows that 27 respondents (54 per cent) prefer to buy the wristwatches from the company showroom, 16 respondents (32 per cent) prefer to buy them from the retail shops, and 7 respondents (14 per cent) prefer to buy online. Most of the respondents prefer to buy wristwatches from the company showroom.

Brands Preference by the Respondents

Different customers prefer different brands of wristwatches according to their tastes and preferences. Table no.7 shows the brands of wristwatches preferred by the customers.

Table - 7

Brands of Wristwatch Preferred by the Respondents

S. No	Brands	No. of Respondents	Percentage
1.	Titan	20	40
2.	Sonata	10	20
3.	Fast track	4	8
4.	Citizen	6	12
5.	Rolex	2	4
6.	Casio	7	14
7.	Maxima	1	2
	Total	50	100

Source: Primary data

Table 7 shows that out of the 50 sample respondents, 20 respondents (40 per cent) prefer Titan watches, 10 respondents (20 per cent) prefer Sonata, 4 respondents (8 per cent) prefer Fast track, 6 respondents (12 per cent) prefer Citizen watches, 2 respondents (4 per cent) prefer Rolex model, 7 respondents (14 per cent) prefer Casio and only one respondent (2 per cent) prefer Maxima watches.

Brands preferred by the respondents are proved by using Garrett Ranking Techniques

Table - 8

Brand Preference of the Respondents

S.No	Brand Name	Average score	Rank
1.	Titan	59.92	I
2.	Sonata	53.82	II
3.	Fast track	46.86	V
4.	Citizen	47.62	IV
5.	Rolex	46.26	VI
6.	Casio	50.70	III
7.	Maxima	44.82	VII

Source: Primary data

This table shows the Garette score and ranks. First rank is given to Titan watch with the mean score of 59.92. Second rank and third ranks are given to the brands “Sonata” and “Casio”Seventh rank goes to Maxima. So it is clear that Titan is the most preferred brand among the customers in the study area.

Suggestions

- ❖ Number of showrooms and service centres are very limited in the study area. So, the company should take necessary steps to open many showrooms and service centres through authorized dealers.
- ❖ Most of the people are influenced by their friends. So the company should take necessary steps to motivate all segments of customers by offering discounts.
- ❖ Since most of the respondents prefer Ana log model of wristwatches, the company should influence the customers to use the digital watch and motivate them to buy digital watches through advertisements.

Conclusion

From the study, it is very clear that in the study area T. Kallikulam, majority of the customers prefer TITAN brand wristwatches. In order to promote the sale of other brands, the manufacturers of those brands should motivate the customers to buy their brands through effective advertisements, so that they achieve their targeted sales.

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A Study on the Pros and Cons of an Entrepreneurship

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ABSTRACT

The success of a business depends on the entrepreneur's economic knowledge and the ability to anticipate and take correct decisions at critical moments. A potential entrepreneur can easily discern on what type of business to focus its capital, being able to make effective decisions in a rapidly changing economic environment. This paper is based on the secondary data collected from research article, monographs, cases and various published materials on this subject. The findings indicated that there is new scope and existing opportunities for entrepreneur from the government, socio-cultural perspective, and natural deposit. The outspread list of constraints and problems of entrepreneurship development include personal, environmental-situational, judicial, economic and political. The study also gives some suggestions for utilizing the opportunities and to overcome those constraints for entrepreneurship development in India. This paper aims to outline the Pros and Cons of Entrepreneurship, factors affecting entrepreneurship and to explore the opportunities created by the Government which encourages the people to become entrepreneurs.

Keywords: *entrepreneurship, government, entrepreneur, business, factors...*

Introduction

Many people dream of running their own business. One can work from any location, dictate his own hours, create his “company policies” that make sense, and follow his passions. But before he creates a side business he must make sure the pros and cons of entrepreneurship.

On the onset of the business, each day brings up unique challenges. Being creative and adaptable and becoming a successful entrepreneur is a great way to wear a variety of hats. One of the major positive aspects of being an entrepreneur is that he can start his own business wherever he deems it to be more profitable. The five places which welcome an entrepreneur with open arms are no income tax, offer a reasonable cost of living, hold plenty of professional, social opportunities for networking and expansion.

According to the U.S. Small Business Administration (SBA), “entrepreneurs are business owners or managers of a corporation, enterprise or small company”. “Entrepreneurs use personal initiative, engage in calculated risk-taking, and create new business ventures by raising resources to apply innovative new ideas that solve problems, meet challenges, or satisfy the needs of a clearly defined market”.

- Entrepreneur is an individual who takes moderate risks and brings innovation.
- Entrepreneur is an individual who takes risks and starts something new.
- Entrepreneur is a person who organises / manages the risks in his or her enterprise.
- Entrepreneur is one who undertakes an enterprise, especially a contractor, acting as intermediary between capital and labour.

Some facts about entrepreneur

Examines the needs, wants, and problems to see how they can improve the needs and wants to meet and overcome the problems
 Narrows the possible opportunities to specific “best” opportunity.
 Thinks of innovative ideas and select a “best” idea
 Researches the opportunity and idea
 Enlists the best sources of advice and assistance that
 Plans their ventures and look for possible problems
 Ranks the risk and the possible rewards
 Evaluates the risks and possible rewards and make their decision
 Never bang to an idea, if research doesn’t support it
 Employs the resources for the venture to succeed
 Understands he should work for a long time and hard to make the venture succeed
 Realizes the failures so happened, to help them achieve success in the near future.

Characteristics of successful Entrepreneurs

Each entrepreneur is different from the other, but successful entrepreneurs have some common characteristics. Those common characteristics of successful entrepreneurs are as follows:

Entrepreneurs tend to have

- **Independence:** Most entrepreneurs know how to work within the framework for the sake of profits; they enjoy being their own boss.
- **Self confidence:** Entrepreneurs demonstrate self-confidence in order to cope with all the risks while operating the business.
- **Discipline:** Successful entrepreneurs resist the temptation to do what is unimportant but have the ability to think what is most essential to do.
- **Ability to accept change:** Change occurs frequently while running the business, the entrepreneur thrives on changes and the business grows.
- **Make stressful work:** to the success of the business, the entrepreneur often focuses on the end result and not the process of getting there.

Opportunities Rendered by the Government in Supporting the Entrepreneurship

Owing to their private ownership, entrepreneurial spirit, their flexibility and adaptability as well as their potential to react to with the challenges and changes in the environment contribute to sustainable growth and employment generation.

Entrepreneurship plays an important role in the national economy due to a wide range of reasons. Logically the government shows much interest in supporting and financing entrepreneurship. There is no other way to increase GDP and raise the standard of living of the people than supporting and encouraging people who dare to start their own business.

Therefore designing a comprehensive, coherent and consistent approach of the Council of Ministers and the entities framed by the government for the entrepreneurship strategy is an absolute priority given by the government. A comprehensive government

approach to entrepreneurship would provide a full co-ordination of activities through numerous governmental institutions and NGO^s dealing with entrepreneurship is one of the major factors which contribute for the success. Some other facilities which are offered by the government to the entrepreneurs are as follows:

- **Training**

Basic training differs from person to person but necessarily involve sharpening the entrepreneurial skills. Need based technical training is provided by the Central Govt. and the State Govt. Technical institutions to the general public.

- **Marketing Assistance**

There are Governmental and non-governmental specialized agencies which provide marketing assistance to entrepreneurs. Besides promoting the entrepreneurship, the products are sold through exhibitions, trade fairs, open markets in the domestic and overseas markets.

- **Promotional schemes**

The Government accords the highest preference to the development of entrepreneurship by framing and implementing suitable policies and promotional schemes. They provide developed lands and sheds to the entrepreneurs on actual cost basis with appropriate infrastructure. Special schemes have been designed for specific purposes like quality up gradation, common facilities, entrepreneurship development and consultancy services at reasonable charges.

- **Credit Facility to Entrepreneurship**

Credit to entrepreneurship sector has been covered under priority sector lending by banks. Various nationalised banks have been established as the apex institution for financing. Specific schemes have been designed for the implementation.

- **Concession on excise duty**

Entrepreneurship units with a turnover of Rs.1 crore or less in a year have been exempted from the payment of excise duty, by the Ministry of Finance.

Qualities of an Entrepreneur

An entrepreneur has certain attitudes and skills to succeed in business. All the successful entrepreneurs have more or less a similar way of thinking and possess several personal qualities that make their business flourish.

All the successful entrepreneurs have the following common qualities:

➤ **Inner Drive to succeed**

Entrepreneurs are driven to succeed and expand their business. They see the bigger picture and are very ambitious. Entrepreneurs set bigger goals for themselves and stay committed to achieve them by overcoming the obstacles on the way.

➤ **Strong Belief in themselves**

Successful entrepreneurs have a healthy opinion about them and often have a strong and assertive personality. They are focused to achieve their goals and believe in their ability to achieve them.

➤ **Search for New Ideas and Innovation**

All the entrepreneurs have a passion to do things better and to improve their products or services. They are looking for the ways and means to improve their products and services. They are creative, innovative and resourceful.

➤ **Competitive by Nature**

Successful entrepreneurs like to be competitive. The only way to achieve their goals and live up to their self-imposed high standards is to compete with other successful business men.

➤ **Highly Motivated and Energetic:**

Entrepreneurs are always on the way to business because, they are full of energy and highly motivated. They are driven to succeed and have an abundance of self-motivation.

PROS

- **CONTROL:** You choose the work you like to do and that makes the most of your strengths and skills. The result can be more job satisfaction.
- **EXCITEMENT:** Entrepreneurship is very exciting and many entrepreneurs enjoy their work. Each day is filled with new opportunities to challenge your abilities, skills, and determination. It makes them more adventurous.
- **FLEXIBILITY:** Entrepreneurs can schedule their work hours around other commitments, including spending quality time with their families. They are more flexible compared to other workers.
- **FREEDOM:** The freedom to work whenever they want, wherever they want, and however they want draws many young people to entrepreneurship. Most entrepreneurs don't consider their work as actual work throughout day and night because they are doing something they love.
- **RATIONAL SALARY:** As an entrepreneur, your income is directly related to your efforts and the success of your business. This can be considered as a marvellous gift in their life.

CONS

- **ADMINISTRATION:** While making all the decisions it may be considered as a benefit, and a burden. Being an entrepreneur comes with a lot of paperwork that can take up time and energy. So an entrepreneur is a person who have high administrative skill
- **COMPETITION:** If the entrepreneur is a small business owner, he needs to differentiate his business from others in order to build a solid customer base and to be profitable.
- **LONELINESS:** It can be lonely and scary to be the sole responsible person for the success or failure of your business.
- **NO REGULAR SALARY:** Being an entrepreneur means giving up the security of a regular pay check. If business slows down, his personal income can be at risk. If only he earns profit, he will be paid fruitfully.
- **WORK SCHEDULE.** The work schedule of an entrepreneur can be unpredictable. A major disadvantage of being an entrepreneur is that he requires more work and longer hours than being an employee.

Factors affecting Entrepreneurship growth:

Economic factors

The economic factors that prominently affect the growth of entrepreneurship are lack of adequate basic facilities, non-availability of raw materials and finished goods, the risk involved in business and the unavailability of skilled labour.

Social factors

Social factors which affect the growth of entrepreneurship are the customs and traditions followed by the society, rationality of the society, social system, social set-up, community etc.,

Personality factors

Suspicious personality, emergence of planning, risk taking, need for achievement, need for independence are the few personal factors which affect the flourish of the entrepreneurship.

Cultural factors

This factor is an external version of family environment which includes individualism, uncertainty, materialism, dynamism etc.,

Conclusion

At this juncture effective steps are needed to provide entrepreneurial awareness, orientation and skill development programmes to women. The institutions available at present are very limited. Moreover, their functions and opportunities available with them are not popularised much. The Government should provide re-enforcement package for failed

entrepreneurs by arranging required finance for new start ups, granting tax relief, facilitating quality testing, help in re-engineering products or services in additional market, offering management consultancy etc. The Non-government organizations should implement their actions by increasing research publication on entrepreneurship. Both the government and the non-government organization should ensure investment consultancy with counselling, seminar, workshop, camping to influence new entrepreneurs etc. Entrepreneurial forums should enrich the collaboration of existing potential entrepreneurs with young innovators to expand knowledge on business.

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Recent Trends in Women Entrepreneurship

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ABSTRACT

Women in India have come a long way from being just 'homemakers'. The world now sees them with a different eye and a new respect. Women Entrepreneur is a person who accepts challenging role to meet her personal needs and become economically independent. Normally they were involved in beauty product business, or beauty parlor business, or boutiques, or even restaurants. However, this trend is changing and they are diversifying into more technical businesses such as computers, software, technical equipment, etc. The growth and development of women entrepreneurs required to be accelerated because entrepreneurial development is not possible without the participation of women. The Government of India has also formulated various training and development cum employment generations programmes for the women. Efforts are made to increase their efficiency and productivity through appropriate technologies, equipments and practices. The Government of India devised special programmes to increase employment and income-generating activities for women in rural areas. Entrepreneur Trainer-Motivators are involved in promoting women to take up entrepreneurship as a career option.

Key words: Women Entrepreneurs, employment, development programmes

Introduction

Women are treated as less than equal to men in almost all the poor and developing countries. Women entrepreneurs are defined as an enterprise owned and controlled by women having a minimum financial interest of 51 percent of the capital and giving at least 51 percent of the employment. Half of the world population consists of women but for centuries women are considered only as home makers, who have take care of children, but now women are more interested than men in business. Recent developments in business also help the women entrepreneurs to develop their business. The role of Women entrepreneur in economic development is inevitable. Now-a-days women enter not only in selected professions but also in professions like trade, industry and engineering. They take up business and contribute to the nation's growth.

Women entrepreneurs may be defined as a woman or a group of women, who initiate, organize and run a business enterprise, and those who innovate, initiate or adopt a business activity. A strong desire to do something positive is an inbuilt quality of entrepreneurial women, who are capable of contributing values both in family and social life.

Objectives of the study

1. To study the developmental strategies of women entrepreneurs.
2. To enlighten the supportive measures and schemes for women entrepreneurs.

Methodology

The present study is based on secondary data collected from journals and websites. The researcher exhibits the developmental strategies of women entrepreneurs. This study also helps the readers to know about the supportive measures and schemes for women entrepreneurs given by the government.

Statement of the Problem

Women are goal oriented, independent, flexible, tolerant, creative, realistic, enthusiastic and energetic because of which the management style differs from their male counterpart. The challenges and opportunities provided to the women of the digital era are growing rapidly that the job seekers are turning into job creators. In such a situation it is necessary to know about the recent trends in women entrepreneurship. Hence the researcher has selected the title “Recent trends in Women Entrepreneurship”.

Present Position of Women Entrepreneurs

Women entrepreneurs who accept the challenging role to meet their personal needs become economically independent. The challenges and opportunities provided to the women of the digital era are growing rapidly that the job seekers are turned into job creators. They are flourishing as designers, interior decorators, exporters, publishers, garment manufacturers and still exploring new avenues of economic participation. Women in the advanced nations are recognized and are more prominent in the business world.

It is only from the Fifth Five Year Plan (1974-78) onwards women role has been explicitly recognized with a marked shift in the approach from women welfare to women development and empowerment. Out of the total 940-48 million people in India in the 1990's the female population comprise of 465 percent of the total population. There are 126.48 million women work force (representing 28.9 percent of the female population) but as per the 1991 census only 185900 women accounting for only 4.5 percent of the total self employed persons in the country were recorded. Majority of them are engaged in the unorganized sectors like agriculture, agro based industries, handicrafts, handloom and cottage based industries. As per the 2001 census report, there are women workers of the total working population including formal as well as informal sector. At present, women involvement in economic activities is marked by a low work participation rate, excessive concentration in the unorganized sector and employment in less skilled jobs.

Supportive Measures and Schemes for Women Entrepreneurs in India

Supportive Measures and Schemes for Women Entrepreneurs in India are discussed below:

Direct and indirect Financial Support are provided through

- Nationalized banks
- State Finance Corporation (SFC)
- State Industrial Development Corporation (SIDC)

- District Industries Centres (DIC)
- Small Industries Development Bank of India (SIDBI)
- State Small Industrial Development Corporations (SSIDC)
- Mahila Udyan Nidhi (MUN)

Yojna Schemes and Programme

- Training of Rural Youth for Self- Employment (TRYSEM)
- Development of Women and Children in Rural Areas (DWCRA)

Federations and Associations

- Indian Council of Women Entrepreneurs, New Delhi
- National Alliance of Young Entrepreneurs (NAYE)
- Self Employed Women's Association (SEWA)
- World Association of Women Entrepreneurs(WAWWE)
- Association of Women Entrepreneurs of Karnataka (AWEK)
- Associated Country Women of the World (ACWW)

Women Entrepreneur Trainer-Motivators (ETMs) Programme

Entrepreneur Trainer-Motivators are involved in promoting women to take up entrepreneurship as a career option. The component of such programme is to bring about an attitudinal change and noticeable improvement. The major objectives of the programmers are

1. To train the participants to identify and analyse constraints and barriers to women entrepreneurship development and devise appropriate strategies
2. To train them to initiate, plan and implement entrepreneurship development activities for creation of small enterprises. If support is required for establishment of small business ventures, they give effective counseling to the women entrepreneurs.

The participants are equipped with new tools and techniques to lead women to new enterprise creation and growth of existing small enterprises. The course curriculum focuses on subjects such as; entrepreneur, enterprise and entrepreneurship, women and entrepreneurship, analysis of competencies and assessment of women entrepreneurs, business opportunity identification & plan preparation, small business management information technology, effective business counseling and designing and managing support services for women entrepreneurs.

Training Programmes

The following training schemes especially for the self employment of women are introduced by the Government:

- Support for Training and Employment Programme of Women (STEP)
- Development of Women and Children in Rural Areas (DWCRA)
- Small Industry Service Institutes (SISIs)
- State Financial Corporations (SFCs)

- National Small Industries Corporations (NSICs)
- District Industrial Centres (DICs)

Steps taken by Government during Ninth Five-Year Plan

The Government of India has introduced the following schemes for promoting women entrepreneurs, because the future of small scale industries depends upon the women-entrepreneurs:

- a) Trade Related Entrepreneurship Assistance and Development (TREAD) scheme was launched by Ministry of Small Industries to develop women entrepreneurs in rural, semi-urban and urban areas by developing entrepreneurial qualities.
- b) Women Component Plan, a special strategy adopted by the Government to provide assistance to the women entrepreneurs.
- c) Swarna Jayanti Gram Swarozgar Yojana and Swarna Jayanti Sekhari Rozgar Yojana were introduced by the government to provide reservations for women and encouraging them to start their ventures.
- d) New schemes named Women Development Corporations were introduced by the government to help the women entrepreneurs in arranging credit and marketing facilities.
- e) State Industrial and Development Bank of India (SIDBI) has introduced the following schemes to assist the women entrepreneurs. These schemes are:
 - i. Mahila Udyam Nidhi
 - ii. Micro Credit Scheme for Women
 - iii. Mahila Vikas Nidhi
 - iv. Women Entrepreneurial Development Programmes
 - v. Marketing Development Fund for Women

Successful Women Entrepreneurs in India

Priyanka Malhotra- a successful woman entrepreneur in India. She is operating the business of book publishing and also devotes her time in cafe business.

Bhawana Kakkar - a young graduate woman in Painting and Arts. She is a successful woman entrepreneur in India and she had many tricks to success in business.

Manju Bharatram – a single child for whom school wasn't a happy experience just like many others. And the day she saw her own children feeling the same as well, she became a social entrepreneur.

Rajashree Birla - a successful woman entrepreneur and chairperson of Aditya Birla Centre for Community and Rural Development.

Shruti - a degree holder in Chemistry from the University of Pennsylvania. She came back to India after her study in the USA and started her own hotel business and became a successful woman entrepreneur in India.

Developmental Strategies of Women Entrepreneurs

Following efforts are taken into account for effective development of women entrepreneurs.

- All developmental programmes consider women as a specific target group.
- Better educational facilities and schemes should be extended to womenfolk from the part of the government.
- Adequate training programme on management skills to be provided to women community.
- Encourage women's participation in decision-making.
- Vocational training to be extended to women community that enables them to understand the production process and production management.
- Women's development corporations have to gain access to open-ended financing.
- The financial institutions should provide more working capital assistance both for small scale venture and large scale ventures.
- Making provision of micro credit system and enterprise credit system to the women entrepreneurs at local level.
- Industrial estates could also provide marketing outlets for the display and sale of products made by women.
- Women Entrepreneur's Guidance Cell set up to handle the various problems of women entrepreneurs all over the state.

Conclusion

The modern trend shows that women join hands in enhancing the income of the family. The Indian government also takes more efforts to develop the women entrepreneurs. The challenges and opportunities provided to the women of the digital era are growing rapidly that the job seekers are turning into job creators. In the recent days more women are willing to start business and give more employment to others. So the government and other associations should extend support to the entrepreneurs for development.

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Problems Faced by the Flower Cultivators with Special Reference to Thovalai Taluk

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ABSTRACT

Floriculture is the fast emerging and high competitive industry with the continuous introduction of new cultivators and new cultivation techniques. New products and new technologies are developing with new challenges regarding production and marketing of flowers. The flower cultivators struggle a lot to bring them up. At the time of producing and selling the flowers, the cultivators face a lot of hurdles and obstacles such as lack of finance, high cost of inputs, water resources, plough and seed the plants, competition and transportation. The present research was carried out with the aim of finding the problems faced by the flower cultivators in Thovalai Taluk.

1. Introduction

Floriculture is an important branch of horticulture which involves the cultivation of flowers and it also includes ornamental gardening and landscaping. Floriculture is an age old farming activity in India having immense potential for generating gainful self-employment among small and marginal farmers in the recent years. It has been emerged as a profitable agribusiness in India and world wide. Improved standards of living and growing consciousness among the citizens across the globe to live in environment friendly atmosphere has led to an increase in the demand of floriculture products in developed countries. Maharashtra, Karnataka, West Bengal, Andhra pradesh, Haryana have emerged as major floriculture production centres in India.

2. Floriculture in Thovalai Taluk

In Thoivali Taluk flowers are cultivated in many places. Variety of flowers are grown by farmers with the aim of gaining profits. Thovalai Taluk has favourable climate condition that is suitable for the cultivation of flowers. The farmers from Arupukottai, Koilpatti and Madurai regions market their flowers at Thovalai. Flower cultivation is the primary occupation of Thovalai village and more than 80per cent of the people are actively involved in activities such as cultivation, harvesting, distribution and garland making. Places such as Aralvaimozhi, Azhagiyapandipuram, Boothapandi, Erachakulam and Kadukkarai are cultivating flowers on a large scale. Floriculture research station was established on 24th July 2008 in Thovalai. It is located in the national highway 47B at a distance of 2.5km from Thovalai flower market.

Kinds of flowers and their flowering months in Thoivalai

Month	Name of flowers
January	Nerium,Tuberose,Lotus
February	Pitchi,Tulasi,Globe Amarantha
March	Jasmine,Nerium,Lotus,Marigold,Crossandra
April	Jasmine,Tuberose,Nerium,Rose
May	Jasmine,Crossandra,Nerium,Tulasi,Lotus
June	Jasmine,Pitchi,Mullai,Rose,Tulasi,Tuberose
July	Jasmine,Pitchi,Tuberose,Chrysanthemum
August	Jasmine,Pitchi,Chrysanthemum
September	Jasmine,Pitchi,Tuberose,Chrysanthemum
October	Jasmine,Pitchi,Tuberose,Chrysanthemum,Rose,Nerium
November	Jasmine,Pitchi,Marigold
December	Pitchi,Chrysanthemum,Marigold

Source: Floriculture Research Station, Thoivalai

3. Statement of the Problem

Even though Thoivalai has been considered as the renowned centre for flower cultivation, this market still remains underdeveloped. Land owners who are interested in gaining lot of money are not interested in cultivation of flowers and ready to sell their farms to the real estate owners. The flower cultivators also do not have opportunities for updating their knowledge on the scientific handling of flowers. At this juncture a number of questions arise in the mind of the researcher related to the problems faced by the flower cultivators before and after cultivation. To know answers for these questions the study has been undertaken by the researcher.

4. Objectives

- To know the demographic profile of the sample respondents.
- To study the problems faced by the respondents before and after flower cultivation.

5. Methodology of the Study

This study comprises of both primary and secondary data. Primary data were collected through personal interview from 50 cultivators in Thoivalai Taluk. Convenience Random Sampling Technique was used to select the respondents. The collected data were analyzed with the help of percentage, Henry's Garrett ranking technique and Likert's five point scale method. The secondary data were collected from websites.

6. Data Analysis and Interpretation

Data analysis and interpretation is the process of assigning meaning to the collected data and determining the results obtained from it.

7. Demographic Profile

In a developing country like India a favourable socio-economic environment could help people to enter into the field of flower cultivation and marketing opportunities. The most important social profile of the respondents is age, gender, education, marital status and experience in flower cultivation. Education determines the level of understanding, tolerance, imagination, and dedication towards the work. Table – 1 shows the demographic profile of the respondents.

Table – 1
Demographic Profile of the Respondents

Description		No. of Respondents	Percent
Gender	Male	42	84
	Female	8	16
Age	Below 30 years	4	8
	31-40 years	14	28
	41-50 years	14	28
	Above 50 years	18	36
Education	Illiterate	12	24
	Primary	20	40
	SSLC	14	28
	HSS & above	18	8
Marital status	Married	44	88
	Unmarried	6	12
Experience	Up to 10 years	30	60
	11-30 years	14	28
	Above 30 years	6	12
Land	Less than 3acres	28	56
	More than 3acres	22	44

Source: Primary Data

Table - 1 shows that 84 per cent (42) of the respondents are male cultivators and 36 per cent (18) of the respondents belong to above 50 years of age category. 40 per cent (20) of the respondents have completed primary education. 88 per cent (44) of the respondents are married and 60 per cent (30) of the respondents have 10 years experience in this job. It is clear that 56 per cent (28) of the respondents have less than 3 acres of land.

8. Problems Faced During Cultivation

In any business problems are common. The respondents of the study area face a lot of problems while cultivating and selling the flowers since flower cultivation is highly management oriented. While performing the production activities like weeding, irrigation, manuring, plant protection, plucking of flowers, applying micro nutrients they face problems. The risk oriented problems during cultivation are analysed and given in Table – 2.

Table - 2
Problems faced during cultivation

Problems	Garrett's Mean Score	Rank
Competition	27.2	VII
Shortage of Manure	33.7	VI
Shortage of Water	69.4	I
Shortage of Labour	60.7	II
High Wages	52.6	IV
Lack of money	48.8	V
Failure of Monsoon	60.6	III

Source: Primary Data

Table - 2 reveals the problems faced by the sample respondents during cultivation. Among these problems first rank is given to the problem 'shortage of water' with the mean score of 69.4 and second rank is given to 'shortage of labour' with a mean score of 60.7. It is observed that majority of the cultivators are not getting sufficient water for flower cultivation.

9. Problems Faced After Cultivation

Goods once produced or manufactured must be immediately sold. Selling the right product in the right time at the right place creates place utility, time utility and possession utility. Any constraint in marketing will lead to heavy loss. In the study area the respondents are encountered with the problems after cultivation of flowers. The causes for such problems were ranked and given in Table – 3.

Table - 3
Problems faced after cultivation

Problems	Mean Score	Rank
Financial Problem	4.56	I
Competition	4.52	II
Increase in Price	2.96	VI
Change in Demand	3.32	V
Climate Changes	3.52	IV
Seasonal Changes	3.60	III

Source: Primary Data

Table - 3 shows that among the six problems pointed out by the respondents the first rank is given to 'financial problem' with the mean score of 4.56 and the second rank is given to 'competition' with the mean score of 4.52.

10. Flowers Cultivated by the Cultivators

The flowers produced in and around Thovalai include Jasmine (Pitchi and Malligai), Rose Batchers Button (Vadamalli), Marigold (Krenthi), Nerium (Arali), Crossandra (Kankambaram), Chrysanthemum (Chevanthi), Sacred Basil (Tulsi), Globe amaranth (Kolikondai), Tuberose (Champanki). Among these flowers Jasmine, Rose, Marigold, Chrysanthemum, Crossandra and colobe Amaranth are the flowers that are taken for the study are presented in Table – 4.

Table – 4
Mostly Cultivated Flowers

Flowers	Garrett's Mean Score	Rank
Rose	44.4	V
Jasmine	71.4	I
Marigold	59.2	II
Chrysanthemum	44.7	IV
Crossandra	33.2	VI
Colobe Amaranth	44.9	III

Source: Primary Data

Table - 4 shows that among the flowers chosen for the study cultivators prefer to cultivate Jasmine which is ranked first with mean score 71.4 followed by Marigold, Colobe Amaranth, Chrysanthemum, Rose and Crossandra ranked second, third, fourth, fifth and sixth respectively. It depends on the climatic conditions of the place for cultivation.

11. Suggestions

- There is an urgent need for the intervention of government and private agencies for the introduction of new and innovative methods in the cultivation and marketing of flowers with the ultimate goal of boosting up net gains.
- Government must help the cultivators by arranging water facilities and providing machinery needed for cultivation.
- Open auction systems should be introduced in the flower market at Thovalai so that national participation could be ensured in the purchase and sale of flowers through the available local resources.
- Loan facilities can be extended to cultivators to improve and encourage their flower cultivation.

12. Conclusion

Thovalai is the hub for flower cultivation and sale in Kanyakumari District. Flowers are cultivated in abundance since the situation and atmospheric conditions are more favourable. Flowers are exported to various places both in India and abroad. Most of the cultivators and sellers of flowers are educated and self employed. By way of cultivating and selling flowers they earn a lot. The eco-system should be scientifically protected from environmental hazards. If the government makes arrangement for sale and export of a variety of flowers, the flower cultivation will flourish in Thovalai Taluk.

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The Edge-to-vertex Geodetic Number of some snake Graphs

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ABSTRACT

A set $S \subseteq E$ is called an edge-to-vertex geodetic set of G if every vertex of G is either incident with an edge of S or lies on a geodesic joining some pair of edges of S . The minimum cardinality of an edge-to-vertex geodetic set of G is $g_{ev}(G)$. Any edge-to-vertex geodetic set of cardinality $g_{ev}(G)$ is called an edge-to-vertex geodetic basis of G . In this paper we study the edge-to-vertex geodetic number of some path related graphs called snake graphs which are obtained from the path P_n by replacing its edges by cycles C_3 .

Keywords: geodesic, edge-to-vertex geodetic set, edge-to-vertex geodetic number.

AMS Subject Classification: 05C12.

1. Introduction

By a graph $G = (V, E)$, we mean a finite undirected connected graph without loops or multiple edges. The order and size of G are denoted by p and q respectively. We consider connected graphs with at least three vertices. For basic definitions and terminologies we refer to [1, 5]. For vertices u and v in a connected graph G , the distance $d(u, v)$ is the length of the shortest $u - v$ path in G . A $u - v$ path of length $d(u, v)$ is called a $u - v$ geodesic. The geodetic number $g(G)$ of G is the minimum order of a geodetic set and any geodetic set of order $g(G)$ is called a geodetic basis of G . The geodetic number of a graph was studied in [1, 2, 3, 4]. For subsets A and B of $V(G)$, the distance $d(A, B)$ is defined as $d(A, B) = \min\{d(x, y) : x \in A, y \in B\}$. A $u - v$ path of length $d(A, B)$ is called an $A - B$ geodesic joining the sets A, B where $u \in A$ and $v \in B$. A vertex x is said to lie on an $A - B$ geodesic if x is a vertex of an $A - B$ geodesic. For $A = \{u, v\}$ and $B = \{z, w\}$ with uv and zw edges, we write an $A - B$ geodesic as $uv - zw$ geodesic and $d(A, B)$ as $d(uv, zw)$. A set $S \subseteq E$ is called an edge-to-vertex geodetic set if every vertex of G is either incident with an edge of S or lies on a geodesic joining a pair of edges of S . The edge-to-vertex geodetic number $g_{ev}(G)$ of G is the minimum cardinality of its edge-to-vertex geodetic sets and any edge-to-vertex geodetic set of cardinality $g_{ev}(G)$ is called an edge-to-vertex geodetic basis of G . The edge-to-vertex geodetic number of a graph was introduced by Santhakumaran and John and the same was further studied by various authors in [6]. A vertex v is an extreme vertex of a graph G if the subgraph induced by its neighbors is complete. A vertex v is an end vertex of a graph G if $d(v)=1$. A cut-vertex (cut-edge) of a graph G is a vertex (edge) whose removal increases the number of components. Two vertices u and v of G are antipodal if $d(u, v) = \text{diam } G$ or $d(G)$. For any real number n , $[n]$ denotes the smallest integer not less than n and $\lfloor n \rfloor$ denotes the greatest integer not greater than n . The triangular snake T_n is obtained from the path P_n by replacing every edge of a path by a triangle C_3 . The double triangular snake DT_n consists of two triangular snakes that have a common path. The alternate triangular snake AT_n is obtained from a path P_n by

replacing every alternate edge of a path P_n by a cycle C_3 . The double alternate triangular snake $DA(T_n)$ consists of two alternate triangular snakes which have a common path. The quadrilateral snake Q_n is obtained from a path P_n by replacing every edge of a path P_n by a cycle C_4 . Throughout this paper G denotes a connected graph with at least three vertices. The following theorems are used in sequel.

Theorem 1.1. [6] If v is an extreme vertex of a connected graph G , then every edge-to-vertex geodetic set contains at least one extreme edge that is incident with v .

Theorem 1.2. [6] Let G be a connected graph and S be a g_{ev} -set of G . Then no cut edge of G which is not an end-edge of G belongs to S .

Theorem 1.3. [6] Every end-edge of a connected graph G belongs to every edge-to-vertex geodetic set of G .

2. Main Results

Theorem 2.1. For the triangular snake $G = T_n$, $g_{ev}(G) = n-1$.

Proof. Consider the path $P_n : v_1, v_2, v_3, v_4, \dots, v_{n-1}, v_n$. Let the triangular snake T_n in Figure 2.1 be obtained by replacing each edge $v_i v_{i+1}$ of P_n to triangle C_3 by adding the new vertices $u_1, u_2, u_3, u_4, \dots, u_{n-1}$. The triangular snake T_n consists of $2n-1$ vertices, $3(n-1)$ edges and $n-1$ triangles. Moreover, it consists of $2n$ extreme edges. (Each $C_i, i=2, 3, \dots, n-2$ has two extreme edges and C_1 and C_n have three extreme edges) By Theorem 1.1, every edge-to-vertex geodetic set contains at least one extreme edge from each C_3 , we have $g_{ev}(G) \geq n-1$. Suppose that $g_{ev}(G) = n$. Then there exists a minimum edge-to-vertex geodetic set S such that $|S| = n$. Without loss of generality, let us take $S = \{u_1 v_1, u_2 v_2, u_3 v_3, \dots, u_{n-1} v_{n-1}, u_{n-1} v_n\}$. Clearly S is an edge-to-vertex geodetic set of G . But $S - \{u_{n-1} v_{n-1}\}$ is an edge-to-vertex geodetic set of G and is contained in S . So S is not a minimum edge-to-vertex geodetic set. Therefore, $g_{ev}(G) \leq n-1$. Hence $g_{ev}(G) = n-1$.

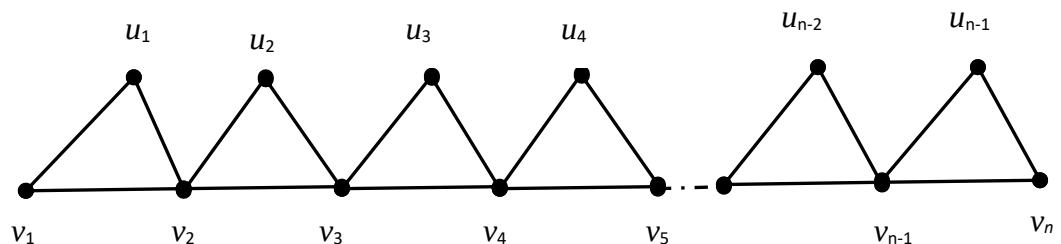


Figure 2.1 - Triangular snake T_n

Theorem 2.2. For the double triangular snake $G = DT_n$, $g_{ev}(G) = 2(n-1)$.

Proof. Consider the path $P_n : v_1, v_2, v_3, v_4, \dots, v_{n-1}, v_n$. The double triangular snake DT_n in Figure 2.2 is obtained by replacing each edge $v_i v_{i+1}$ of P_n to two triangles C_3 in which the path is common for both the triangles and the new vertices are $u_1, u_2, u_3, u_4, \dots, u_{n-1}$ and $w_1, w_2, w_3, w_4, \dots, w_{n-1}$. The double triangular snake consists of $3n-2$ vertices, $5(n-1)$ edges and $2(n-1)$ triangles. Clearly DT_n has $4(n-1)$ extreme edges. By Theorem 1.1, every edge-to-vertex geodetic set contains at least one extreme edge from each C_3 , we have $g_{ev}(G) \geq 2(n-1)$. Let $S = \{u_1 v_1, v_1 w_1, u_2 v_3, v_3 w_2, u_3 v_4, v_4 w_3, \dots, u_{n-1} v_n, v_n w_{n-1}\}$ be a subset of the set of all extreme

edges of G . It is easily observed that S is a minimum edge-to-vertex geodetic set of G , and $|S| = 2(n-1)$. Therefore, $g_{ev}(G) \leq 2(n-1)$. Hence $g_{ev}(G) = 2(n-1)$.

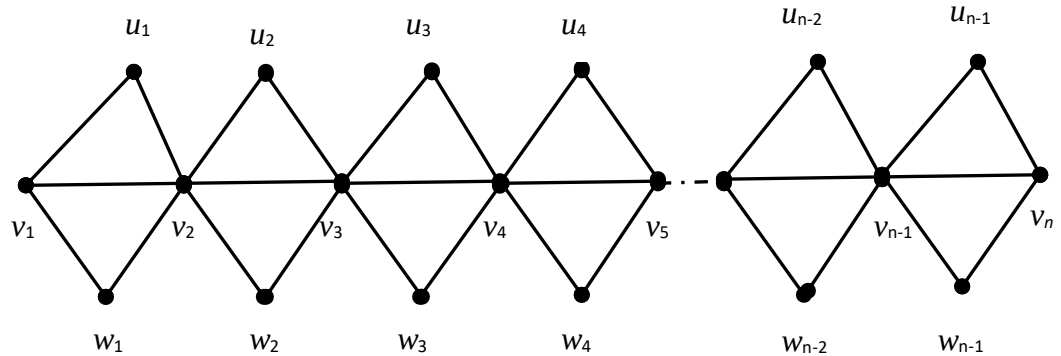


Figure 2.2 - Double Triangular snake DT_n

Remark 2.3. For the above two theorems, we can see that the edge-to-vertex geodetic number of T_n and DT_n depends on the number of triangles in the corresponding snake graph.

Theorem 2.4. For an alternate triangular snake $G = AT_n$,

$$g_{ev}(G) = \begin{cases} \frac{n}{2} & \text{if the path } P_n \text{ is even} \\ \left\lceil \frac{n}{2} \right\rceil & \text{if the path } P_n \text{ is odd} \end{cases}$$

Proof. Case (i) n is even and $n \geq 4$.

Consider the path $P_n : v_1, v_2, v_3, v_4, \dots, v_{n-1}, v_n$ where n is even. The alternate triangular snake AT_n , in Figure 2.3 is obtained by replacing the alternate edges of P_n by triangle C_3 . Clearly AT_n contains $\frac{n}{2}$ triangles in which $u_1, u_2, u_3, u_4, \dots, u_{n/2}$ are the new vertices. Note that AT_n has n extreme edges and $\frac{n}{2} - 1$ cut edges. By Theorem 1.1, every edge-to-vertex geodetic set contains at least one extreme edge from each C_3 , and hence $g_{ev}(G) \geq \frac{n}{2}$. Also by Theorem 1.2, no cut edge of G which is not an end-edge of G belongs to every edge-to-vertex geodetic set of G . Let $S = \{u_1v_1, u_2v_4, u_3v_6, \dots, u_{\frac{n}{2}}v_n\}$. Clearly S is a subset of the set of all extreme edges of $G = AT_n$. Since every vertices of AT_n is either in S or lies in a geodesic joining of some pair of edges of AT_n , we get S is an edge-to-vertex geodetic set of $G = AT_n$. Also it is seen that S is a minimum edge-to-vertex geodetic set of AT_n . Therefore $g_{ev}(G) = |S| = \frac{n}{2}$.

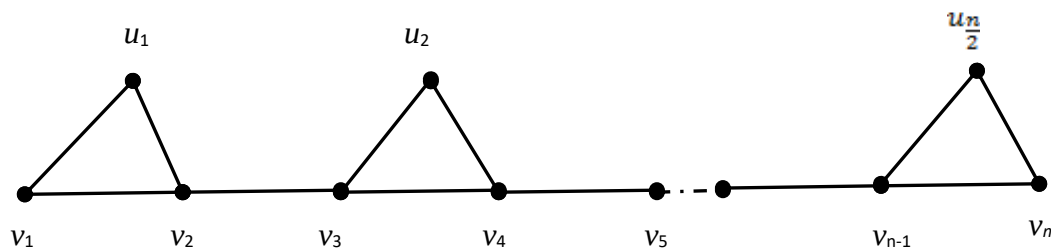


Figure 2.3 - Alternate Triangular snake AT_n

Case (ii) n is odd and $n \geq 3$.

In this case the alternate triangular snake AT_n in Figure 2.4 contains an end edge, $\frac{n-1}{2}$ triangles and $\frac{n-3}{2}$ cut edges. It is easily observed that AT_n has n extreme edges. By Theorem 1.3 & 1.1, every edge-to-vertex geodetic set S of AT_n contains an end edge and at least $\frac{n-1}{2}$ extreme edges and hence $g_{ev}(G) \geq \frac{n-1}{2} + 1 = \frac{n+1}{2}$. Consider the set $S = \{u_1v_1, u_2v_4, u_3v_6, \dots, u_{\frac{n-1}{2}}v_{n-1}, v_{n-1}v_n\}$. Clearly S is a minimum edge-to-vertex geodetic set of AT_n . Hence $g_{ev}(G) = \frac{n+1}{2} = \left\lceil \frac{n}{2} \right\rceil$.

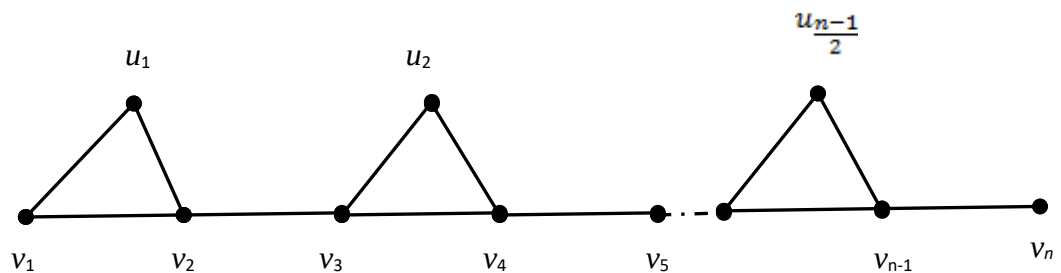


Figure 2.4 - Alternate triangular snake AT_n

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Synthesis and Characterization of L-Alanium Oxalate Crystal

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ABSTRACT

L-Alanium Oxalate single crystals are grown from aqueous solution by slow evaporation technique. The grown crystals were subjected to powder X-ray diffraction analysis, confirming the crystalline nature of the crystal. The optical properties of the grown crystals have been studied using spectrophotometer.

1. Introduction

Nonlinear optics is playing a major role in the emerging photonic and optoelectronic technologies. Efforts have been taken to synthesize new materials for a variety of nonlinear optical (NLO) applications such as optical signal processing, parametric amplification, optical phase conjugation, etc [1, 2]. Organic crystals have large nonlinear susceptibilities compared to inorganic crystals. Most organic NLO crystals have usually poor mechanical and thermal properties and are susceptible to damage during processing. It is difficult to grow large optical quality crystals of these materials for device applications [3-5]. In order to keep the merits and overcome the short comings of organic materials, some new classes of NLO crystals such as metal organic or semiorganic crystals have been developed [6]. Combining the high optical nonlinearity and chemical flexibility of organics with the temporal and thermal stability and excellent transmittance of inorganics, semiorganic materials have been proposed and are attracting a great deal of attention in the nonlinear optical field [7-8]. NLO material L-histidine tetrakisfluoroborate single crystal has been grown [9]. Recently the growth and characterization of NLO material L-histidinium bromide, L-histidine perchlorate and L-histidine hydrofluoride dehydrate crystals were also reported [10,11,12]. In this work we report the growth of L-Alanium Oxalate single crystal. The grown crystals were characterized by PXRD, UV studies.

2. Experimental Procedures

L-Alanium Oxalate crystals are prepared by simple slow evaporation method. 1M of L-Alanine was dissolved completely in 20 ml of deionised water. Similarly, 1M of Oxalic acid is dissolved in 20 ml of deionised water. The two solutions are mixed together and stirred well using the magnetic stirrer for about 4 hours. Then the solution was filtered using whatmann filter paper. After filtering the beaker containing the solution is covered using plastic paper with some holes on the paper. The nucleation begins after 7days. After 15 days a well transparent L-Alanium Oxalate critical size single crystal is obtained.

2.1 Characterization Studies

Powder X-ray diffraction (PXRD) data were collected by employing a XPERT-PRO diffractometer with $\text{CuK}\alpha$ radiation ($\lambda=1.54056\text{\AA}$) scanned over the 2θ range of $0^\circ - 80^\circ$ at the rate of $1^\circ/\text{min}$ to understand the crystallization of the crystals grown and characterized structurally. The UV analysis of the prepared L-Alanium Oxalate crystal was done by using double beam spectrophotometer.

3. Results and Discussion

3.1. Powder XRD Result

The grown crystal belongs to orthorhombic system. The observed PXRD pattern recorded are shown in Figure 1. The well defined peaks at specific 2θ values show high crystallinity of the grown crystal. All the reflections of powder XRD pattern of the crystal of this work were indexed using unit cell software.

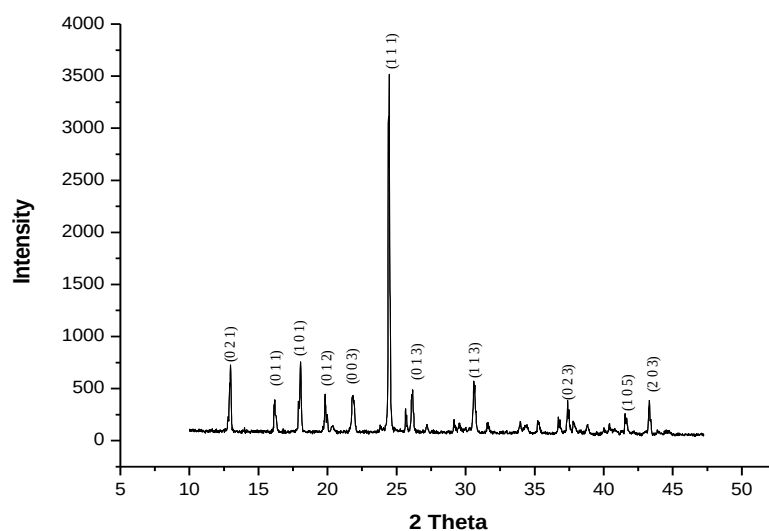


Fig: 1.The XRD spectrum for L-Alaninium Oxalate crystal

3.2. UV Result

From the absorption Spectrum the L-Alaninium Oxalate crystal shows the optical absorption maximum value of 2.551% at wavelength 236 nm. From UV spectra it was found that the crystal has a wide optical transmission window. It has a good transparency which is used for laser applications.

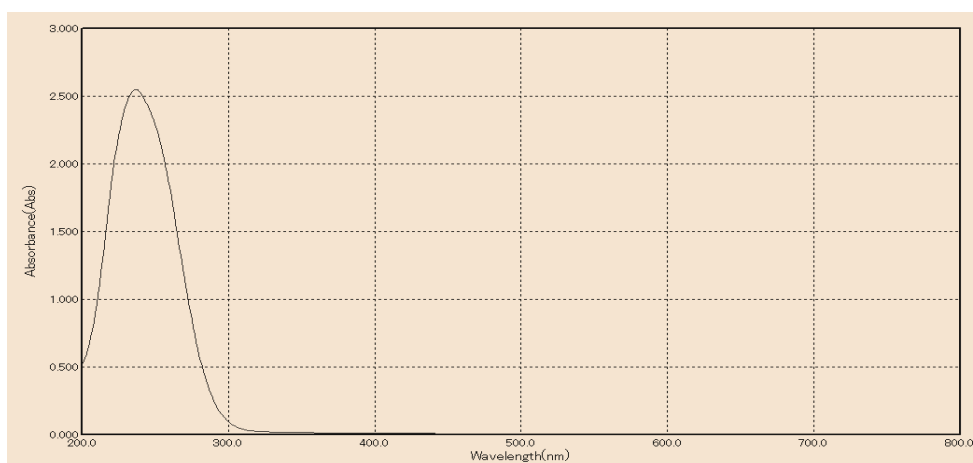


Fig:2. The UV absorption spectrum for L-Alaninium Oxalate crystal

The optical band gap of the as prepared sample was calculated using the formula $E_g = hc/\lambda$

Where h is the plank's constant (6.626×10^{-34} J/s), c is the velocity of light (3×10^8 m/s), λ is the wavelength. The cut-off wavelength was estimated as 236 nm and the forbidden energy gap calculated is about 5.26 eV.

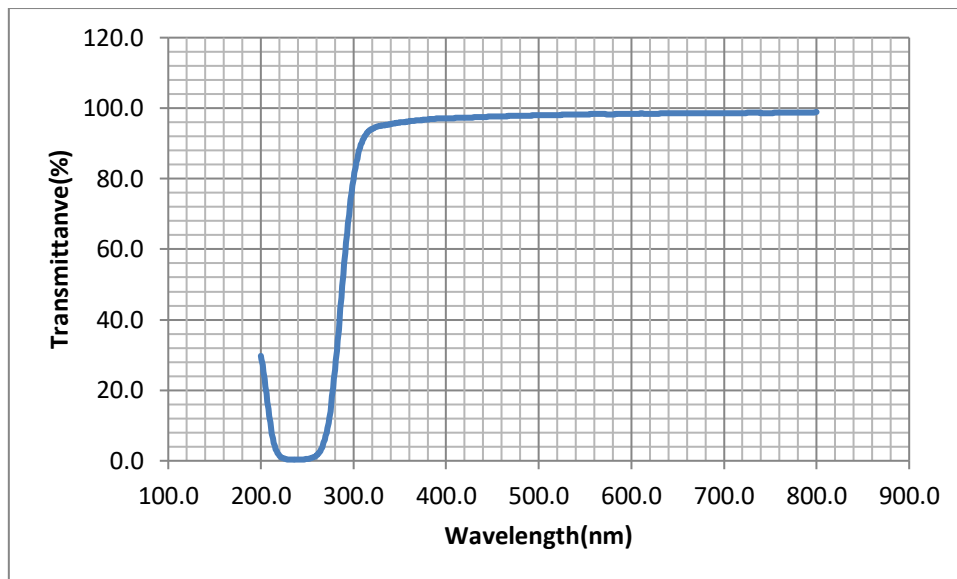


Fig: 3.The UV transmittance spectrum for L-Alaninium Oxalate crystal

The L-Alaninium Oxalate crystal shows maximum transmittance of 98% between the wavelength range of 500-800 nm.

3.2.1. Tauc Plot

A Tauc plot is used to determine the optical band gap, or Tauc gap, in semiconductors. The Tauc gap is often used to characterize practical optical properties of amorphous materials. The band gap calculated from Tauc plot is about 5.4 eV.

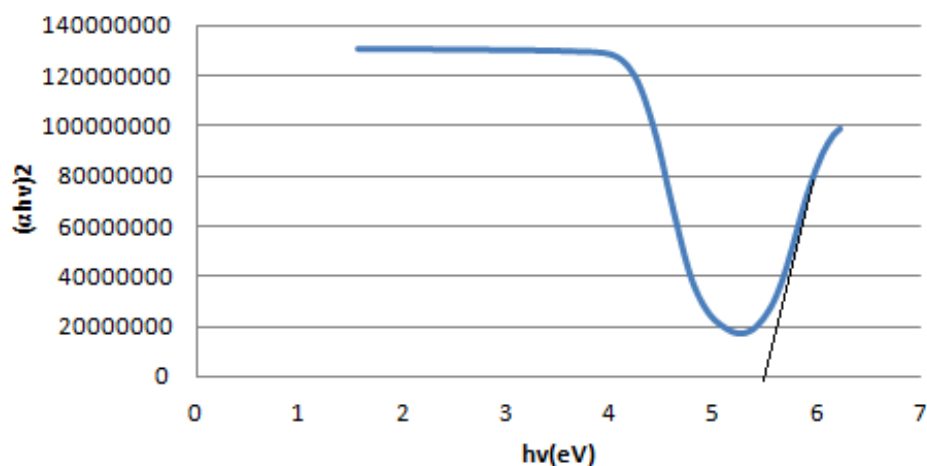


Fig: 4. Tauc plot for L-Alaninium Oxalate crystal

4. Conclusion

The L-Alanium Oxalate crystal (LAOA) was grown by slow evaporation method and characterized from aqueous solution at room temperature. The XRD spectrum shows that, all the diffraction peaks in L-Alanium Oxalate crystal patterns correspond to the orthorhombic structure. The sharp peaks in XRD pattern indicate the good crystallinity of the grown crystal. The UV spectrum shows that, L-Alanium Oxalate crystals are highly transparent in nature. They have Non Linear Optical (NLO) property. L-Alanium Oxalate crystals are mainly used as optical windows and lasser applications. Because of NLO property they are used in Telecommunication, Optical computing and Optical data storage etc.

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Growth, Optical and Magnetic Studies of Semiorganic NLO Crystal: L-Alanine Cadmium Chloride

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ABSTRACT

L-alanine cadmium chloride (LACC), a semiorganic nonlinear optical (NLO) crystal has been grown from solution by slow evaporation at ambient temperature. The growth of the crystal has been carried out at pH 5.4. The crystalline nature of the grown crystal was observed using powder XRD analysis. The lattice parameters of the crystal obtained from SXRD analysis was verified with the theoretical values using unit cell software. EDAX analysis confirms the grown LACC crystal. The transmittance of the crystals was studied by UV-Visible spectrophotometer and it reveals that there is good optical transparency for the crystal. Using Nd-YAG laser the NLO property of the crystal is studied. The magnetic properties of the crystal were reported using Vibrating Sample Magnetometer (VSM) analysis.

Keywords: Semiorganic NLO crystal, EDAX, Band gap, Magnetic properties.

1. Introduction

With the development of solid state laser devices, investigations of nonlinear optical (NLO) crystals become a hotspot of materials science in the past two decades. Most of the organic NLO crystals are constituted by weak vanderwalls and hydrogen bonds with conjugated π electrons [1]. Organic materials are attractive due to their nonlinearities; ultra fast response time and relative ease of device processing. Despite some special properties of large optical nonlinearity and low cutoff wavelength in UV-region, the organic crystals have certain limitations such as poor mechanical and thermal stability. To overcome these limitations, researchers have found the most promising candidates among metal-organic compounds due to their various properties such as NLO response, magnetism, and luminescence, as well as applications in photography and drug delivery [2]. The study of amino acid crystals with other organic and inorganic molecules, which present a high nonlinear optical coefficient, has gained much attention in the last few years because of the possibility of using them in technological devices [3–6]. Studies on some complexes of L-Alanine with inorganic salts such as LA acetate, LA cadmium chloride, LA sodium nitrate, Thiourea L-alanine acetate were reported [7-10].

In these, L-Alanine cadmium chloride (LACC) is a promising NLO compound. Its structural and thermal properties were studied by Danushkodi et. al. [11]. Linear and nonlinear properties of LACC were reported by P.Kalaiselvi et.al.[12]. The electrical parameters and the corresponding activation energies have been reported by Bright and Freeda [13]. The results of magnetic studies on compounds reveal that the low value of coercivity is suitable for security, switching and sensing applications [14, 15].

Hence this paper reports the investigation of optical properties which includes band gap energy (Eg), and magnetic effects of LACC crystal. This paper also deals about the growth and structural studies with the help of XRD and EDAX analysis.

2. Growth Process

L-Alanine and cadmium chloride monohydrate (E. Merck) were mixed in a stoichiometric ratio of 1:1 in doubly distilled water. The solution is stirred well for about 2 hours using a magnetic stirrer to obtain a homogeneous mixture. The mixture was then subjected for heating below an optimum temperature of 60°C in temperature controlled water bath to dry the sample. It was completely dissolved in double distilled water to form a saturated solution. The solution was filtered well to remove the suspended impurities and allowed to crystallize by slow evaporation of solvent at room temperature of about 303 K at a pH of 5.4. Good quality transparent crystals of pure L-Alanine cadmium chloride with regular shape and size was harvested within 20 days. The image of the as grown crystal is shown below in Fig.1.

3. Characterization Studies

For the present study, powder X-ray diffraction spectra were recorded in PANalytical X'pert-pro instrumentation. Continuous scanning was applied with a slow scanning speed (step size = 0.05 °) and small time constant (step time = 10.138 s). Single Crystal X-ray Diffraction (SXRD) analysis was observed using ENRAF NONIUS CAD4-MV31 Bruker Kappa APEX11 diffractometer. The EDAX analysis was done with Bruker Nano German. The UV-Vis spectrum analysis has been measured using a Systronics Double Beam UV-Vis Spectrophotometer 2201. NLO studies have been performed using Kurtz and Perry powder technique. VSM analysis was carried out using Lakeshore: model: 7404.

4. Results and Discussion

4.1 Powder XRD

The PXRD pattern of pure L-alanine cadmium chloride is shown in Fig.2. Well defined Bragg peaks are obtained at specific 2θ angles as indicated in Fig.2. The strong peaks at 2θ confirm the crystalline nature of the grown crystal. The single crystal XRD analysis of LACC crystal reveals that the crystal belongs to monoclinic system with non-centrosymmetric space group C_2 and the lattice parameters obtained are shown in Table 1. The hkl values for prominent peaks were identified using the 'TREOR' index software package. From the hkl values generated the lattice parameters of the crystal were calculated using unitcell software and is tabulated in Table 1. The obtained lattice parameters for L-Alanine Cadmium Chloride are in good agreement with the reported values [16]. The space group C_2 is recognized as non-centro-symmetric so that it satisfies the basic requirements for the SHG activity of the crystal.



Fig.1. As grown pure LACC crystal

Table 1. Lattice parameters of pure LACC crystal

Theoretical		h k l	EXPERIMENTAL		Lattice parameters
2 θ	d- spacing		2 θ	d- spacing	
12.06	7.3308	2 0 0	12.15	7.3174	From SXRD analysis a= 16.351 Å, b = 7.303 Å, c = 8.083 Å $\alpha = \gamma = 90.00^\circ$ $\beta = 116.544^\circ$ V= 855 Å ³
12.83	6.8942	-2 0 1	12.89	6.8745	
20.81	4.2627	2 0 1	20.89	4.2609	
24.36	3.6500	0 2 0	24.39	3.6500	
24.80	3.5871	0 0 2	24.96	3.5796	
25.82	3.4476	-1 1 2	25.97	3.4345	
27.39	3.2532	0 2 1	27.36	3.2517	
27.63	3.2258	-2 2 1	27.80	3.2161	
32.29	2.7701	2 0 2	32.38	2.7627	Theoretical values a= 16.39 Å, b = 7.31 Å, c = 8.02 Å $\alpha = \gamma = 90.00^\circ$ $\beta = 116.55^\circ$ V= 859 Å ³
32.99	2.7126	-6 0 1	33.03	2.7125	
34.65	2.5864	4 2 0	34.78	2.5782	
35.80	2.5061	-4 2 2	35.87	2.4997	
36.74	2.4436	6 0 0	36.96	2.4329	
41.41	2.1783	3 3 0	41.12	2.1988	
41.44	2.1772	-6 2 1	41.55	2.1693	
42.37	2.1313	4 0 2	42.42	2.1321	
45.29	2.0003	0 2 3	45.40	1.9946	

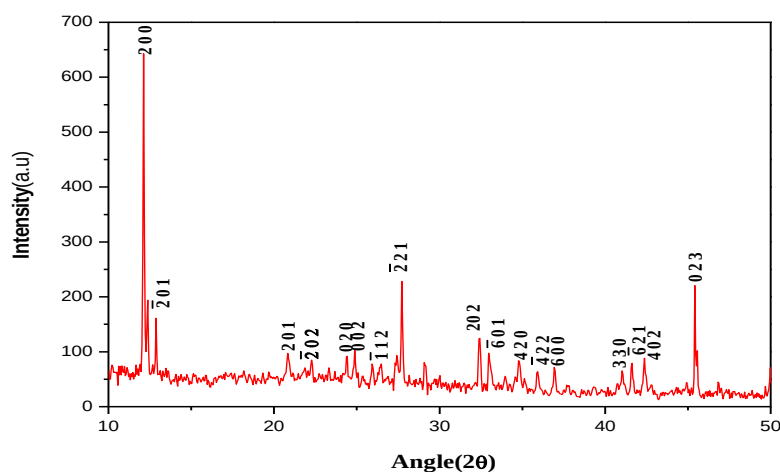


Fig.2. PXRD pattern of pure LACC crystal

4.2 EDAX Analysis

The sample has been subjected to EDAX analysis. Elements are recognized and presented as atomic percentage. Energy peaks corresponding to the various elements present in LACC crystal are shown in the Fig.3. Thus it was confirmed the grown crystal is LACC single crystal. The elemental composition as observed is given in the Table 3.

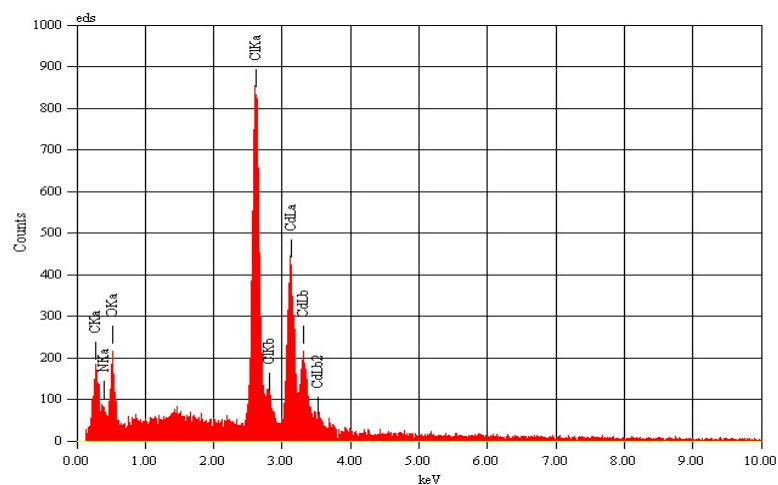


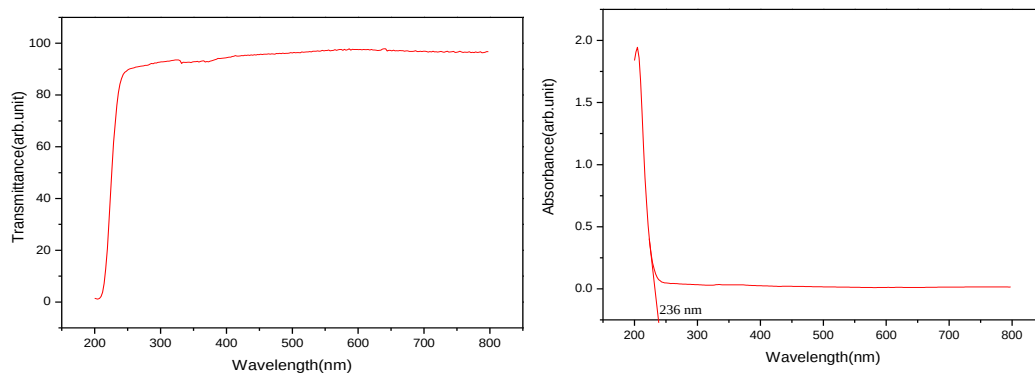
Fig.3 EDAX plot of pure LACC crystal

Table 2. Elemental composition of LACC crystal

Element	(keV)	Mass%	Atom%	K
C K	0.277	10.03	32.15	2.6026
N K	0.392	1.91	5.24	1.4316
O K	0.525	4.82	11.6	0.9902
Cl K	2.621	30.22	32.83	1
Cd L	3.133	53.03	18.17	3.3683
Total		100	100	

4.3 UV Analysis

The recorded UV-visible transmittance spectra of LACC crystal is shown in Fig.4. As observed in the spectrum, the percentage of transmission in the visible region is high which is a required property for NLO material. The lower cut-off wavelength as observed is 236 nm. The lower cut-off wavelength for the grown crystals in the transmittance spectra lies between 200 nm and 400 nm which is the desired requirement for crystals capable of generating blue light by SHG from diode lasers [17]. The lower cut-off wavelength combined with high transparency, attests the usefulness of this materials for different applications such as the generation of the second and third harmonics of the Nd:YAG laser fundamental and for the generation of the higher harmonics of the GaAlAs diode lasers. The energy gap as calculated is 5.25 eV. The higher band gap energy shows that the defect concentration in the grown crystal is very low [18]. From the results, it is clear that the sample has good optical transparency in the complete visible region and it could be used for Opto-electronic applications.

**Fig.4. The UV-Visible transmittance and absorbance spectra of LACC crystal**

4.4 SHG Efficiency

NLO study has been performed using Kurtz and Perry powder technique, since this is the most widely used technique for confirming the SHG efficiency from prospective second order NLO material [19]. A Q-switched high energy Nd:YAG laser beam of wavelength 1064 nm with an input power of 4.2 mJ was used. The SHG signal generated in the sample was confirmed from the emission of green light from the sample. The powder SHG efficiency of

the grown crystal was compared with KDP (8.8 mV). A second harmonic signal of 4.75 mV was obtained from pure LACC. Hence it was found that the SHG conversion efficiency of LACC crystal was found to be 0.54 times that of reference KDP crystal

4.5 VSM Analysis

To understand the magnetic properties of the grown crystal, it is characterized using vibrating sample magnetometer (VSM). The magnetic properties of the as grown LACC are measured at room temperature and are shown in Fig.6.

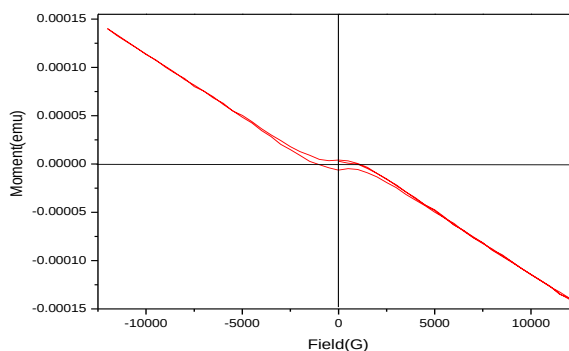


Fig.6. The magnetic field versus magnetic moment curve of pure LACC crystal

The M-H curve for pure LACC crystal shows a negative magnetic moment with increasing fields indicating a diamagnetic behavior. Such materials tend to move from a stronger to a weaker part of a magnetic field. Further in diamagnetic compounds all the electron spins are paired. The transition element cadmium tend to give low spin complexes, that it is more favorable in terms of energy to pair electrons in the lower energy d levels rather than use the higher levels. Further, the orbital contribution is significant [20]. The values of the saturation magnetization (MS), coercivity (HC) and retentivity (MR) are obtained and are tabulated in Table 3.

Table 3. The Magnetic parameters of pure LACC crystal

Sample Code	Coercivity(HC) (G)	Magnetization(MS) (emu)	Retentivity(MR) (emu)
LACC	1081.9	140.02E-6	5.1949E-6

5. Conclusion

Single crystal of L-Alanine cadmium chloride grown by slow evaporation solution growth technique has been subjected to various characterization techniques. Powder X-ray diffraction pattern reveals the crystalline nature of the grown crystal. The unit cell parameters

and the space group were obtained from SXRD data. EDAX analysis confirms the LACC crystal. UV analysis showed that the samples have good optical transparency in the entire visible region and it could be used for Opto-electronic applications. SHG efficiency is confirmed by the emission of green light from the sample crystal. Optical transmission studies and Second Harmonic Generation (NLO) studies justified the device quality of the grown crystals. The VSM analysis of the sample crystal reveals that the crystal is diamagnetic in nature.

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Thermal Studies on Epoxy/ZrO₂ Nanocomposites

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ABSTRACT

Polymers are used in many areas such as automotive, electronics and different construction equipments. Generally, they are used after being reinforced with various nano fillers to provide unique properties such as aspect ratio, low weight, and easy formability. Nanocomposites are new materials made with fillers having nanosize. The purpose of this study is to analyse the thermal properties of epoxy resin with zirconium dioxide nanoparticles. In this present work, Zirconium dioxide nanoparticle is prepared by precipitation method, zirconium oxychloride (ZrOCl₂.8H₂O) and ammonia (NH₃) as starting materials. The synthesized Zirconium dioxide nanoparticles were characterized by XRD and the grain size in nanoscale is confirmed. The sheets of neat epoxy resin and epoxy with addition of ZrO₂ are primed by solution casting method. The thermal properties were analyzed using Thermo Gravimetric Analysis (TGA) and Differential Thermal Analysis (DTA). Thermo gravimetric analysis has been employed to investigate the thermal characteristics and their mode of thermal degradation. Differential thermal analysis has been used to determine the glass transition temperature of epoxy nanocomposites.

Keywords: Epoxy, Nanocomposites, Polymer nanocomposites, XRD, FTIR, Thermal Analysis

1. Introduction

Polymer nanocomposites are polymers that have been reinforced with small quantities (less than 10%) of nanosized filler particles. The dispersed phase can be inorganic particles, minerals, modified clays etc. Particles filled polymer composites have been extensively studied because of their wide spread applications in the automobile, household and electrical industries. Recently nanocomposites generate much interest among the various scientists, because of their potential they offer for applications in high performance coatings, catalysis, electronics, magnetic and biomedical fields. In polymer nanocomposites research, the primary goal is to enhance the strength and toughness of polymeric components using molecular or nanoscale fillers. Most notable are increased modulus, increased gas barrier, increased heat distortion temperature, resistance to small molecule permeation, improved ablative resistance, increase in atomic oxygen resistance and retention of impact strength. Interestingly, these performance improvements are achieved without increasing the density of the base polymer[1].

2. Experimental Details

2.1 Synthesis of ZrO₂ nanoparticles

The ZrO₂ nanoparticles were prepared by the precipitation method. Zirconium oxychloride (ZrOCl₂.8H₂O) and ammonia (NH₃) were used as starting materials. Zirconium hydroxide precipitation (Zr(OH)₄) was obtained by adding an NH₃ solution drop-wise in to the aqueous solution of 0.2M ZrOCl₂.8H₂O at room temperature until the desired pH of 10 was reached. Zirconium hydroxide mixture was then dried in an oven at 100°C overnight. Zirconium oxide nanoparticle was obtained through calcination at 600⁰ C for 2 hours [2].

2.2 Preparation of epoxy/ ZrO_2 nanocomposites

ARALDITE Epoxy resin (LY 556) and hardener (HY-951) were used in this study to develop pure ZrO_2 nanofiller imposed epoxy nanocomposites for different ZrO_2 weight percentage (1wt %, 3wt %, 5wt %, 7wt %). Epoxy resin of 60g and hardener of 6g were poured separately in two beakers. To remove the air bubbles, both were need to be ultrasonicated for 30 minutes. After the completion of this process, the hardener was added to the epoxy resin and it was mixed by hand stirring. Finally it was ultrasonicated to remove air bubbles generated during the mixing process. After degassing, the mixture was poured into the metal mould. The metal mould was kept undisturbed for 1 hour at room temperature. Finally the sample was cured by keeping the mould in an oven at 100°C for 2 hours. Thus neat epoxy sheet was obtained. For epoxy/ ZrO_2 nanocomposites 1 wt% ZrO_2 nanofillers are added with the epoxy resin and the same procedure was repeated for 3wt %, 5wt % and 7wt % ZrO_2 added epoxy nanocomposites. The photograph of developed polymer sheets is shown in Fig.1.

3. RESULTS AND DISCUSSION

3.1 Powder X- ray diffraction Analysis

X-ray diffraction (XRD) of ZrO_2 nanoparticles are carried out on a XPERT – PRO diffractometer system with monochromated CuK_α ($1.5406 \text{ \AA}$) radiation. PXRD pattern of synthesized zirconia nanoparticles is reported in Fig.2. The XRD pattern of ZrO_2 nanoparticles are found to exhibit many diffraction peaks and of that, $(\bar{1}11)$ reflection plane is very predominant and has high intensity. The crystallite size of synthesized ZrO_2 is found to be 36.21nm and this confirms that the prepared ZrO_2 particle is in nanoscale. The X-ray diffraction spectrum confirms that the pure ZrO_2 nanopowder is in monoclinic crystalline phase. The data obtained is in good agreement with standard JCPDS file no 89-9066.



Fig –1: Photograph of pure and ZrO_2 imposed nanocomposites

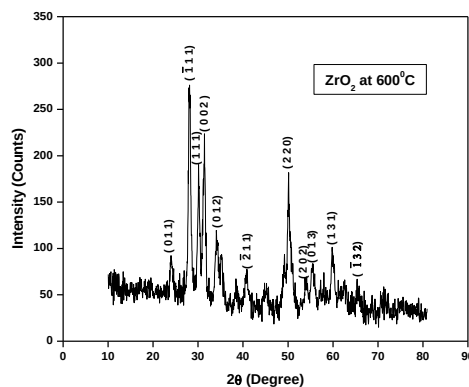
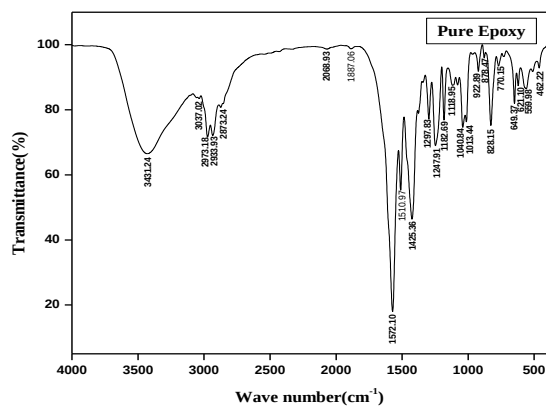


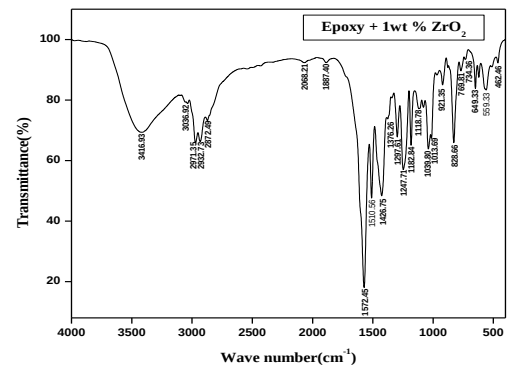
Fig -2: XRD pattern of ZrO_2 nanoparticles calcined at 600°C

3.2 Fourier Transform Infrared Analysis

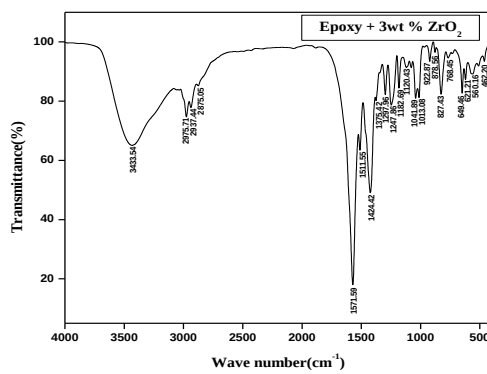
FTIR measurements for the samples are performed in SHIMADZU type IR Affinity-1 FTIR spectrophotometer in the range of $4000 - 400 \text{ cm}^{-1}$. The mode used in the FTIR characterization is transmission. The FTIR spectra for all the prepared samples are shown in Fig-3.



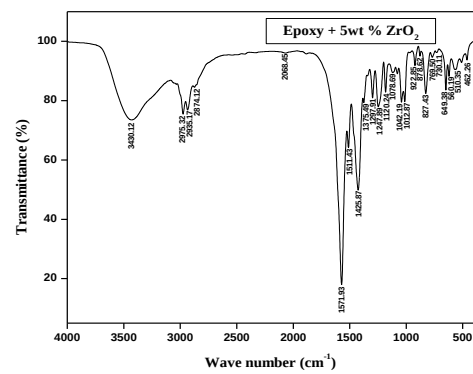
(a)



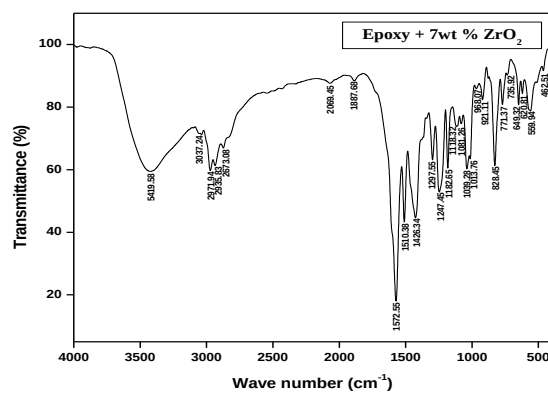
(b)



(c)



(d)



(e)

Fig-3: FTIR spectra of (a) pure (b) 1wt% (c) 3wt% (d) 5wt% (e) 7wt% ZrO_2 nanocomposites

Table - 1 : Frequency assignments of pure and ZrO₂ nanofiller imposed epoxy nanocomposites

Wave Number(cm ⁻¹)					Assignments
Pure Epoxy	Epoxy + 1wt % ZrO ₂	Epoxy + 3wt % ZrO ₂	Epoxy + 5wt % ZrO ₂	Epoxy + 7wt % ZrO ₂	
3431	3416	3433	3430	3419	O-H Stretching
3037	3036	3035	3032	3037	C-H Stretching in Aromatics
2973	2971	2975	2975	2971	Asymmetric C-H Stretching of CH ₃ group
2933	2932	2937	2935	2935	Asymmetric C-H Stretching of CH ₂ group
1572	1572	1571	1571	1572	C-C Stretching vibration in aromatic
1510	1510	1510	1511	1510	
1425	1426	1424	1425	1426	
1297	1297	1297	1297	1297	Asymmetric CH ₂ deformation
1247	1247	1247	1247	1247	Asymmetric aromatic C-O Stretching
1182	1182	1182	1182	1182	Asymmetric aliphatic C-O Stretching
1040	1039	1041	1042	1039	Stretching vibration of C-O-C
922	921	922	922	921	Epoxide ring vibrations
828	828	827	828	828	C-H out of plane deformation in aromatic
649	649	649	649	649	Bending vibration of NH
559	559	560	560	559	Bending vibration of C-H

The structures of LY 556 epoxy resin and HY 951 hardner were confirmed by FTIR spectral analysis. In the FTIR spectrum of pure epoxy the band at 3431 cm⁻¹ corresponds to the vibration of hydroxyl (OH) group. The band at 3037 cm⁻¹ corresponds to the CH stretching vibration in aromatic ring. The peaks at 2973 cm⁻¹ and 2933 cm⁻¹ indicates the asymmetric C-H stretching of CH₃ and CH₂ groups respectively. The strong peaks at 1572 cm⁻¹, 1510 cm⁻¹ and 1425 cm⁻¹ indicate the C-C stretching vibration in aromatic ring. The asymmetric deformation of CH₂ produces absorption band at 1297 cm⁻¹. The asymmetric stretching of C-O in aromatic and aliphatic groups produce absorption bands at 1247 cm⁻¹ and 1182 cm⁻¹ respectively. The asymmetric stretching mode of C-O-C vibration appears at 1040 cm⁻¹. Absorption peak at 922 cm⁻¹ corresponds to epoxide ring vibrations. The strong absorption peak at 828 cm⁻¹ indicates C-H out of plane deformation in aromatic rings. The appearance of the bands at 649 cm⁻¹ and 559 cm⁻¹ indicates the bending vibrations of N-H and C-H respectively [3]. The sharpness and intensity vary for different weight percentage ZrO₂ nanofiller added epoxy nanocomposites. A slight shift in absorption bands are observed for ZrO₂ nanofiller added epoxy systems. This is due to strong attraction of ZrO₂ nanoparticles with epoxy [4].

3.3 Thermal Analysis

3.3.1 Thermo Gravimetric Analysis (TGA)

The thermal stability of the nanocomposites was studied using thermogravimetric analysis (TGA). TGA measurements were carried out using SIINT 6300 thermogravimetric analyzer from 25°C to 1000°C with the heating rate of 10°C/min.

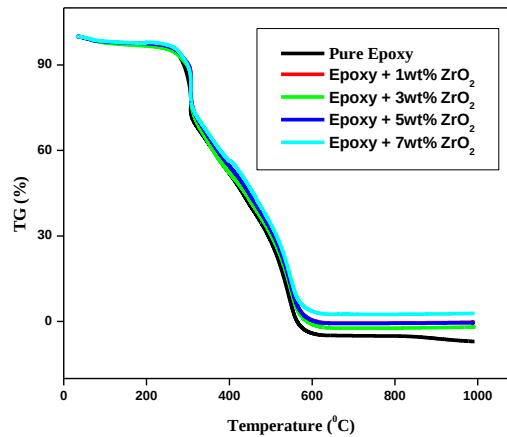


Fig -4: Thermogravimetric curve of pure and ZrO₂ added epoxy nanocomposites

Table-2: TGA data of pure and ZrO₂ nanoparticles imposed nanocomposites

Sample	Heating rate (°C/min)	T ₁ on set (T _{d1} °C)	T ₂ on set (T _{d2} °C)
Pure Epoxy	10	281	507
E + 1wt%	10	275	500
E + 3wt%	10	273	489
E + 5wt%	10	271	509
E + 7wt%	10	268	504

Both Neat Epoxy and ZrO₂/Epoxy systems have similar decomposition profiles and the degradation takes place in two stages. Initial weight loss (weight started at 100°C) was observed in the thermograms corresponding to evaporation of water molecules from polymer samples [5]. The second step weight loss occurs due to the decomposition of polymer itself. As evident from thermograms, the nano-fillers have significant effect on thermal stability of polymers. Table.2 shows the TGA data of pure and ZrO₂ added nanocomposites.

The first (T_{d1}) and second (T_{d2}) on set decomposition temperature are summarized in table 2. The relative thermal stability of epoxy nanocomposites have been evaluated by comparing the decomposition temperatures at different percentage weight losses. The thermal stability of the ZrO₂ nanofiller added nanocomposites are observed to be slightly decreased as compared to that of neat epoxy. This may result from the spatial obstruction of nanoparticles

on the formation of high cross-linked molecular structure of epoxy or increased free volume fractions in the polymer nanocomposites [6].

3.3.2 Differential Thermal Analysis (DTA)

The DTA curves of the pure and ZrO_2 imposed nanocomposites are presented in figure 5. It shows the effect of ZrO_2 nanoparticles on the glass transition temperature of the nanocomposites.

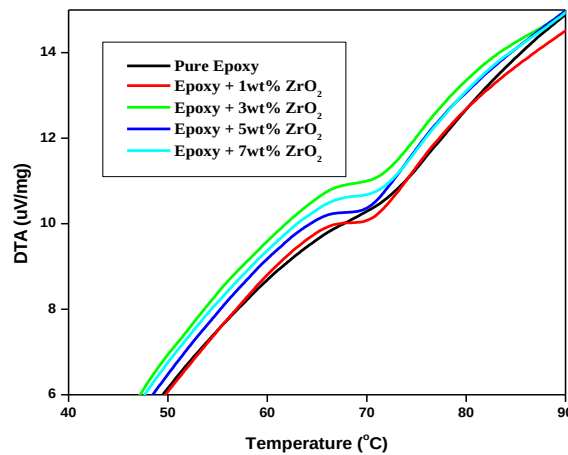


Fig - 5: DTA curve of pure and ZrO_2 added epoxy nanocomposites

Table – 3: Glass transition temperature of Epoxy/ ZrO_2 polymer nanocomposites

Sample	Glass Transition temperature (T_g °C)
Neat Epoxy	71.5
E+1wt%	69.7
E+3wt%	70.7
E+5wt%	69.3
E+7wt%	70.2

It can be ascertained from Figure 5 that for the filler loadings, the glass transition temperature is lower than that of unfilled epoxy. The changes in T_g are due to the effect of nanoparticles only. Few studies in polymer nanocomposites have suggested that polymer nanoparticle interactions actually lead to the formation of more than one nanolayer around the nanoparticle [7].

In addition to the formation of the immobile polymer close to the particle, another polymer layer with a thickness slightly more than that of the immobile layer forms over this. The polymer segments in this extended layer are reported to be loosely bound and they relax faster causing a reduction in the nanocomposites glass transition temperature [8].

4. Conclusion

ZrO₂ nanoparticles were prepared by precipitation method. The prepared ZrO₂ nanoparticle is subjected to XRD characterization. The grain size of ZrO₂ is calculated by De-Bye Scherrer formula. The grain size of synthesized ZrO₂ is found to be 36.21nm and this confirms that the prepared ZrO₂ particle is in nanoscale. Neat and ZrO₂ nanoparticle imposed composites are synthesized by solution casting method. FTIR study proved the occurrence of epoxy and amine hardener and its interaction with ZrO₂ nanoparticles. The sharpness and intensity vary for different weight percentage ZrO₂ nanofiller added epoxy nanocomposites. Thermo gravimetric analysis has been employed to investigate the thermal characteristics and their mode of thermal degradation. The TGA thermograms of Epoxy/ZrO₂ nanocomposites system exhibits lower decomposition temperature behaviours compared to that of neat epoxy. The glass transition temperature was determined using DTA curve and it was observed that the glass transition temperature of Epoxy/ZrO₂ polymer nanocomposite decreases when compared with that of neat Epoxy. The thermal stability was not enhanced in Epoxy/ZrO₂ polymer nanocomposites when compared with neat epoxy.

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Structural, Spectral, Optical and Mechanical Properties of Manganese Doped L-Alanine Sodium Sulphate Single Crystals at Different Concentrations

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ABSTRACT

L-Alanine sodium sulphate crystals are doped with manganese(II) sulphate has been synthesized by slow evaporation technique. The growth has been carried out for various concentration of dopants in the mother solution like 1%, 2% and 3%. Structural property of the grown crystals is characterized by X-ray powder diffraction method, FT-IR spectral analysis conforms all the functional groups. The NLO activity of the crystals has been analysed by second harmonic generation (SHG) test. Microhardness was measured at different applied load to understand the mechanical stability of the crystal.

1. Introduction

Non linear optical materials are used in several practical applications in telecommunication, optical computing, optical data storage processing, laser technology and in many other fields. The semiorganic nonlinear optical (NLO) materials, share the advantages of both the inorganic (high thermal and mechanical stability) and the organic (broad optical frequency range and second harmonic conversion efficiency) materials. The complexes of amino acids and salts are promising materials for optical second harmonic generation (SHG). The amino acid L-alanine is an efficient organic NLO material under the amino acid family as they contain proton donar carboxyl acid (-COO) group and the proton acceptor amino (NH₂) group in them[1]. Recently the optical, spectral and second harmonic generation studies were carried out on L-Alanine based materials [2-5]. The present paper describes the effect of Mn²⁺ ions on the structural, spectral and optical properties of L-Alanine sodium sulphate crystals. Characterization studies such as PXRD, FT-IR were done. Kurtz and Perry SHG test confirms the NLO property of the grown crystals.

2. Synthesis and Growth of the Crystal

Analytical reagent (AR) grade L-alanine, sodium sulphate(Na₂SO₄)and manganese sulphate heptahydrate (MnSO₄.7H₂O) were used along with double distilled water (as a solvent) for the growth of single crystals by the slow evaporation method. L-alanine, sodium sulphate and MnSO₄.7H₂O in different molar ratios (1:1:0.01, 1:1:0.02, 1:1:0.03). Mn²⁺ doped LASS crystals of 11x8x4 mm³, 17x15x4.3 mm³, 13x12x5.2 mm³ were grown in a period of about 27 days similarly under identical conditions with the pure LASS crystal. Figure1 shows the photographs of pure and Mn²⁺ doped LASS crystals with the ratios1:1:0.01,1:1:0.02 and 1:1:0.03 respectively.



Fig 1: Photographs of grown Mn^{2+} (1%, 2%, 3%) doped LASS crystals

3. Results and Discussion

3.1. Powder XRD analysis

The purified samples of grown crystals are crushed to a uniform powder and subjected to the powder X-ray diffraction study using a XPERT-PRO advance powder X-ray Diffractometer. The $K\alpha$ -radiations ($\lambda=1.5406 \text{ \AA}$) from a copper target are used for the diffraction studies. The powdered sample is scanned in the range 10° – 70° at a scan rate of $2^\circ/\text{min}$. The well defined sharp peaks reveal the good crystalline nature of doped LASS crystals and the intensity varied due to the dopant. The XRD pattern of the grown crystals are shown in figures 2-4.

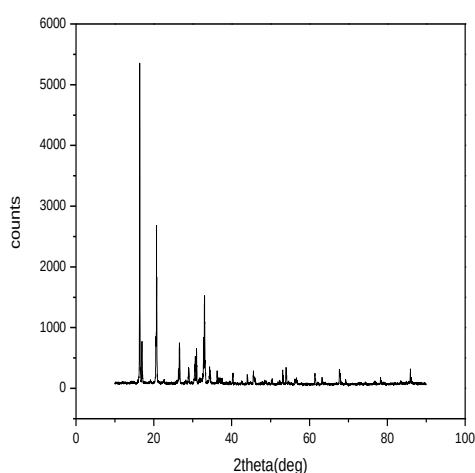


Fig.2: PXRD patterns of 1% Mn^{2+} doped LASS

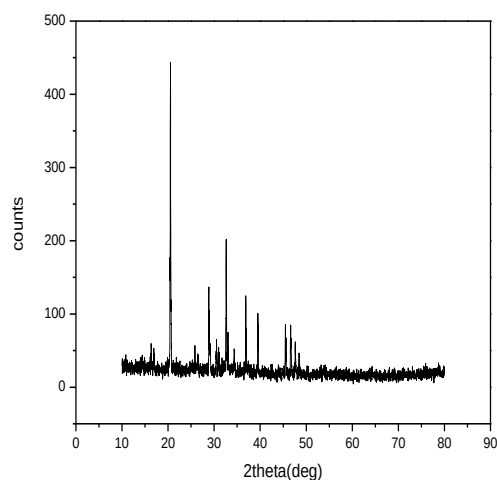


Fig.3: PXRD patterns of 2% Mn^{2+} doped LASS

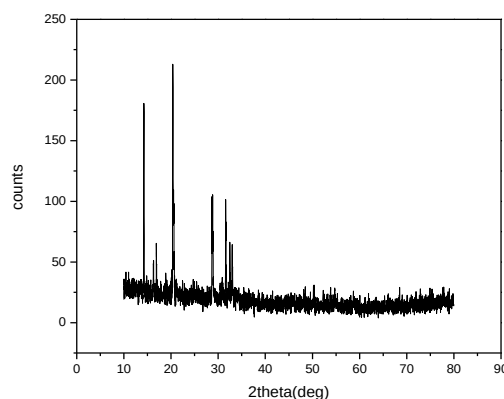


Fig.4: PXRD patterns of 3% Mn^{2+} doped LASS

3.2.FT-IR spectral analysis

The FT-IR spectrum of doped L-alanine sodium sulphate was recorded using FT-IR spectrometer in the region 4000-400 cm^{-1} . In the spectra of Mn^{2+} doped LASS, the regions 3081 cm^{-1} , 3084.93 cm^{-1} and 3084.14 cm^{-1} refer C-H asymmetric stretching. The peaks at 2804 cm^{-1} , 2814.34 cm^{-1} and 2813.79 cm^{-1} represent O-H stretching. The peaks 540.8 cm^{-1} , 540.06 cm^{-1} and 539.39 cm^{-1} refer metal oxides bonding [6-10]. The FT-IR spectrum of LASS and Mn^{2+} doped LASS single crystals are shown in figures 5-7. The corresponding band assignments are given in table-1.

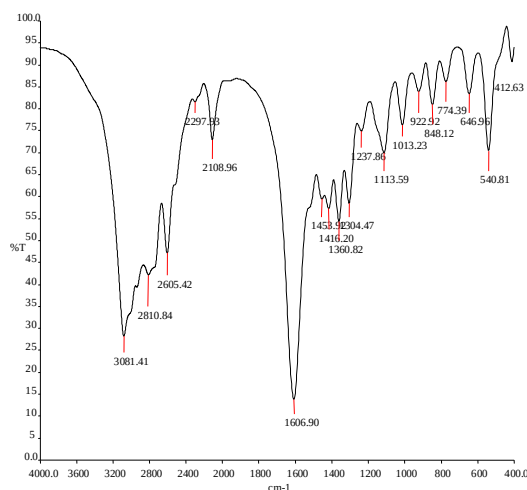


Fig-5: The FTIR spectra of 1% Mn^{2+} doped LASS

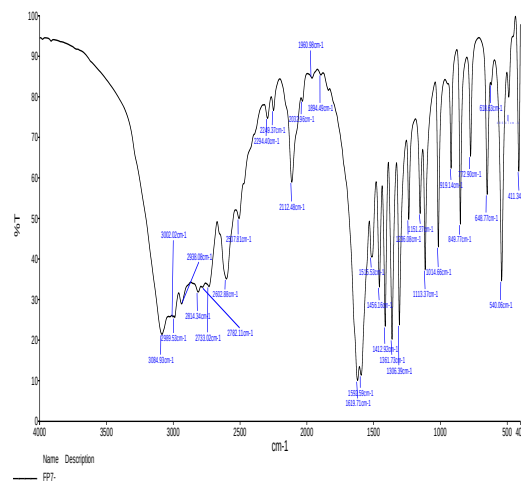


Fig-6: The FTIR spectra of 2% Mn^{2+} doped LASS

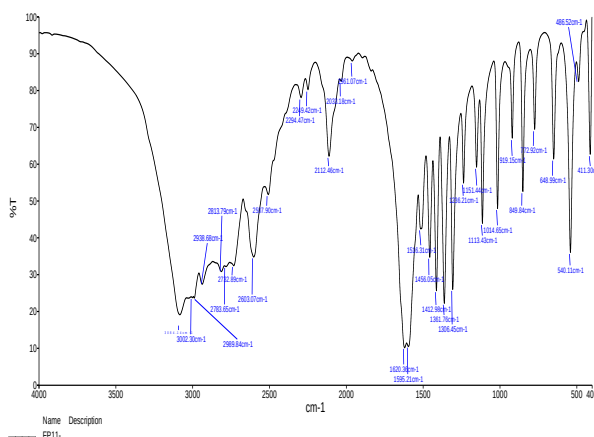


Fig.7: The FTIR spectra o 3% Mn^{2+} doped LASS

Table1: Characteristic absorption frequencies of various functional groups

Wavenumber cm ⁻¹			Mode of vibration
Mn ²⁺ doped LASS			
1%	2%	3%	
3081	3084.93	3084.14	C-H stretching
2810	2814.34	2813.79	OH stretching
2108	2112.48	2112.46	C≡O stretching
1606	1619.71	1620.36	N-H in plane bending
1360	1361.73	1361.76	S=O streching
774	772.90	772.92	C-H out of plane bending
540.8	540.06	539.39	Metal oxides bonding

3.3. Optical Analysis

The NLO property of the crystal is confirmed by the Kurtz and Perry technique. The fundamental beam of 1064nm from Qswitched Nd:YAG laser is used to test the second harmonic generation (SHG) property of the doped L-alanine sodium sulphate anhydrous crystals. The output power from the pure LASS and doped LASS crystals were compared to that of KDP crystal and the results are presented in table2.

Table 2: SHG efficiency of pure LASS and doped LASS crystals

Sl. No	Name of the crystal	Output Energy (milli joule)	Input Energy (joule)	SHG efficiency (compared with KDP)
1	Mn^{2+} doped LASS(0.01)	10.01	0.68	0.77
2	Mn^{2+} doped LASS(0.02)	6.6	0.68	1.18
3	Mn^{2+} doped LASS(0.03)	6.23	0.68	1.25

The result obtained for Mn^{2+} doped LASS shows that SHG efficiency is about 1.25 times that of KDP crystal. The SHG efficiency of KDP crystal is 8.7. The efficiency increases by increasing the molar concentrations of the dopant. This increase in the efficiency indicates that the crystals can be used for applications in non-linear optical devices.

3.4. Vicker's Micro hardness study

The mechanical property of grown crystals was studied by Vicker's hardness test. The applied loads were 25, 50 and 100 grams. The measurement was done at different points on the crystal surface and the average value was taken as H_v for a given load. The Vicker's micro hardness was calculated using the relation,

$$H_v = 1.8544 P / d^2 \quad \dots\dots\dots(1)$$

Where, P - is the applied load and d- is the diagonal length of the indentation impression.

The plots of the load p and H_v values are shown in figure 8. It is observed that the Vicker's hardness number increases with the increasing load. Above 100g cracks developed on the surface of the crystals due to the increase in the hardness value. Figure 9 shows that the plots of log d against log P for the Mn^{2+} doped LASS crystals. The work hardening exponents were calculated from the slopes of the straight lines. The work hardening coefficients are found to be 3.07, 3.1 and 4.2 respectively for Mn^{2+} doped LASS crystals. According to Onitsch, $1.0 \leq n \leq 1.6$ for hard materials and $n > 1.6$ for soft materials. Since the value of 'n' is greater than 1.6, the grown crystals belong to soft material category [11-12].

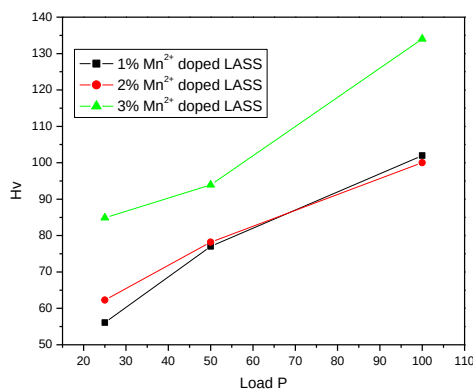


Fig. 8: Hardness behavior of doped LASS

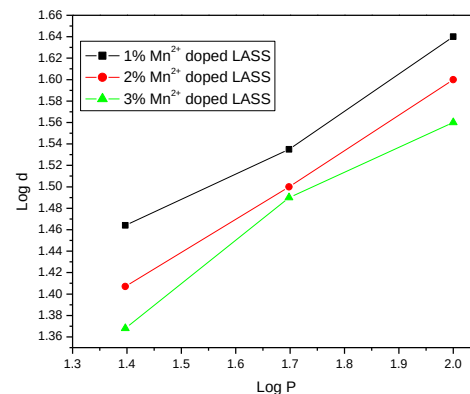


Fig.9: Plots of log d versus log P of doped LASS

Conclusion

Good optical quality NLO transparent crystals of pure and doped L-Alanine sodium sulphate are successfully grown by slow evaporation technique. Structural characterization was carried out by Powder X-ray diffraction method. The FT-IR analysis shows the bands belonging to spectrum of pure and Mn^{2+} doped L-Alanine sodium sulphate. The SHG efficiency of doped L-Alanine sodium sulphate was found to be 1.25 times greater than that of KDP. The efficiency increases by increasing the molar concentrations of the dopant. The good second harmonic generation efficiency indicates that the doped L-Alanine sodium sulphate crystals can be used for various applications in nonlinear optical devices. The Vicker's hardness number of the grown crystals increases with load and the work hardening coefficients are found to be 3.07, 3.1 and 4.2 respectively for 1% Mn^{2+} , 2 % Mn^{2+} and 3% Mn^{2+} doped LASS crystals. Since the value of 'n' is greater than 1.6, the grown crystals belong to soft material.

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Characterization Studies of Pure Cerium Oxide Nanoparticles by Co-Precipitation Method

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ABSTRACT

Pure CeO₂ nanoparticles were synthesized using chemical co-precipitation method. The size of pure CeO₂ nanoparticles was estimated by Powder X-ray Diffraction (PXRD) pattern which revealed that the pure CeO₂ nanoparticles crystallize into cubic phase. The prepared samples were characterized by UV-DRS spectrophotometer, Field Emission Scanning Electron Microscopy (FESEM) and EDAX. The calculated optical band gap is 3.32 eV and the sample is composed of spherical nanoparticles.

Keyword: Co-Precipitation method, PXRD, UV -DRS, FESEM, FTIR.

1. Introduction

Nanoscience is the study of phenomena and manipulation of materials at atomic, molecular and macromolecular scales, in order to understand and exploit properties that differ significantly from those on a larger scale [1]. Rare earths are the fourteen lanthanides along with scandium and yttrium. Of the rare earths, cerium is arguably the most exciting for researchers in the field of catalysis. Cerium oxide also known as ceria is produced by various methods chosen by the desired properties of the product [2]. Cerium oxide with different valence states and various crystalline structures have been explored for various applications such as electrical, electronic, catalytic, adsorption, optical, electrochemical, batteries, functional materials, energy storage, magnetic data storage and sensing properties [3-7]. Decrease in the particle size enhances the conductivity, electrical properties, sensing and catalytic properties of nanomaterials [8-10]. High abundance combined with excellent catalytic activity for a variety of reactions makes cerium the element of choice for the automotive industry enabling the catalytic conversion of the exhaust system of automobiles. Common precursors are cerium sulfate (Ce₂(SO₄)₃), cerium nitrate (Ce(NO₃)₃) ammonium cerium nitrate (NH₄Ce(NO₃)₄) and cerium chloride (CeCl₃). Cerium hydroxide is a common intermediate of many solvothermal and hydrothermal synthetic processes of cerium oxide [11]. In the present work pure CeO₂ (cerium oxide) nanoparticles are synthesized and studied using various characterization techniques. The objectives of the work are,

- a) To determine the
 - ❖ Structural properties using XRD.
 - ❖ Optical absorbance and band gap using UV-DRS spectrometer.
- b) To study the
 - ❖ Morphology of the pure CeO₂ nanoparticles using FESEM.
 - ❖ Purity of the samples from EDAX.

2. Materials and Methods

All the chemicals used in the experiments were analytical reagent grade and used without further purification. All the aqueous solutions were prepared using double distilled

water. In this present work, pure CeO_2 nanoparticles are synthesized by chemical co-precipitation method.

2.1 Experimental Details

0.01M CTAB was dissolved in 50 ml of distilled water and stirred for half an hour thoroughly using magnetic stirrer. 1M of cerium nitrate was dissolved in 50 ml of double distilled water and the solution was kept under constant stirring at room temperature using magnetic stirrer for one hour. Cerium nitrate solution was added dropwise in the CTAB solution using the burette. 2 M of sodium hydroxide was dissolved in 50 ml of distilled water and was heated upto 60 °C. After completely dissolving the solution of cerium nitrate and CTAB, this solution was added dropwise to the beaker containing the hot NaOH solution and immediately white precipitates of CeO_2 nanoparticles were formed. The produced nanoparticles were washed out for 10 times using distilled water and ethanol. Washing was carried out to remove the unwanted by products and the excessive CTAB that were bound with the nanoparticles. Then it was dried in hot air oven for about 100 °C for a few hours until the water evaporates. Then the dried sample was finely powdered using agate motor and used for the characterization purposes. The synthesized CeO_2 nanoparticle sample was pale yellow in color.

3. Results and Discussion

3.1. Powder X-ray Diffraction Analysis

The powder X-ray diffraction pattern of pure Cerium oxide nanoparticles were carried out with a XPERT-PRO diffraction system using the $\text{CuK}\alpha$ radiation of wavelength 1.5406 Å. The type of the scan used is continuous and range from 20° to 80° and the rate is 0.05.

The XRD characterization was carried out on the synthesized CeO_2 by simple co-precipitation method. The XRD pattern shows that the crystal structure of pure CeO_2 nanoparticles is cubic (face centered), polycrystalline in nature and the diffraction data are in good agreement with the JCPDS file No: 81-0792. The X-ray diffractogram of the pure CeO_2 is depicted in Fig.1. The high intensity peaks observed at (111), (200), (220), (311), (400), (331) corresponding to $2\theta = 28.59^\circ, 33.21^\circ, 47.44^\circ, 56.27^\circ, 76.92^\circ$.

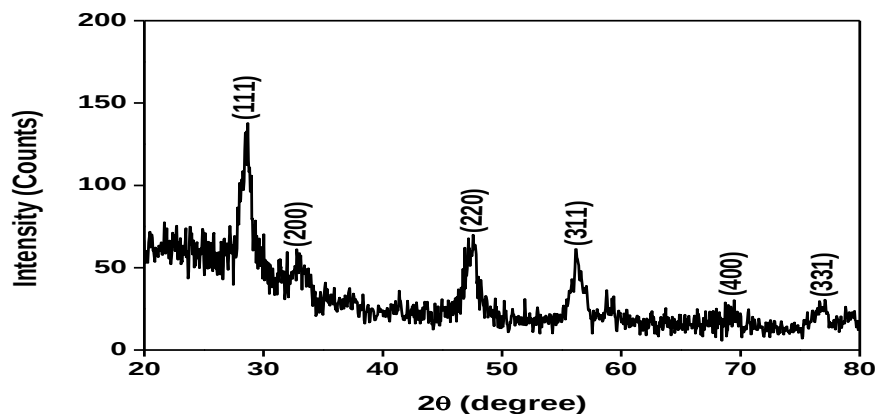


Fig.1. PXRD pattern for pure CeO_2 nanoparticles

The d-spacing values obtained from XRD data of the as-prepared for pure CeO₂ nanoparticles are identified with the JCPDS file No: 81-0792 and their respective h k l and relative intensity values are presented in Table.1.

Table.1. d-spacing values for pure CeO₂ nanoparticles

S.No	2θ (degree)	d-spacing (Å)		h k l	Relative intensity (%)
		Observed	JCPDS		
1.	28.5979	3.1214	3.1248	1 1 1	100
2.	33.2117	2.6976	2.7062	2 0 0	15.98
3.	47.4497	1.9161	1.9135	2 2 0	49.54
4.	56.2732	1.6348	1.6319	3 1 1	46.82
5.	76.9211	1.2395	1.2416	3 3 1	16.04

3.2 UV-DRS Studies

Optical responses of the ceria nanoparticles have been investigated using Hitachi U-2900 Spectrophotometer. The absorbance spectra and Tauc plot of the as-prepared pure CeO₂ nanoparticles with a maximum of 0.9 at 317 nm are shown in Fig.2 (a).

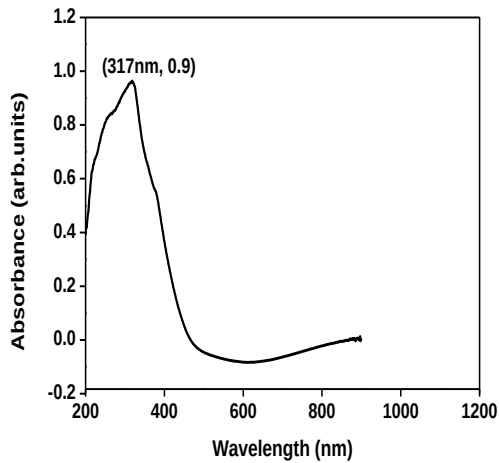


Fig. 2(a) Optical absorbance spectra for CeO₂ nanoparticles

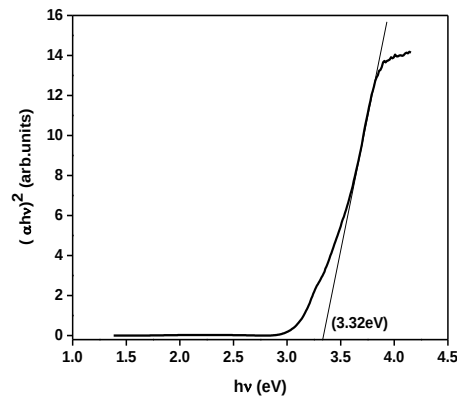


Fig. 2(b) Tauc plot for CeO₂ nanoparticles

Fig.2 (b) shows the Tauc plot for the pure CeO₂ nanoparticles in which the curves of (αhν)² versus photon energy (hν) are drawn. The optical band gap for the pure CeO₂ nanoparticles has been calculated as 3.32 eV by extrapolating the curve with zero axes.

The sample distinctly exhibits a strong absorption bands below 400 nm in wavelength at the UV region. Also the spectrum of each sample shows that most of the UV light (315nm - 320nm) is blocked allowing ceria nanoparticles to be used as a UV blocker as suggested by Elahesh K.Goharshadi et al. [12]. The absorbance spectra of the sample show blue shift which is due to quantum confinement effect as reported by Masoud Negahdary [13].

3.3 EDAX Analysis

The chemical compositions of the synthesized pure CeO_2 nanoparticles were investigated by EDAX analysis. The energy dispersive X-ray analysis of the as synthesized pure CeO_2 nanoparticles showed the presence of Cerium (Ce) and Oxygen (O) elements. No other impurities are added. It showed the purity of the samples.

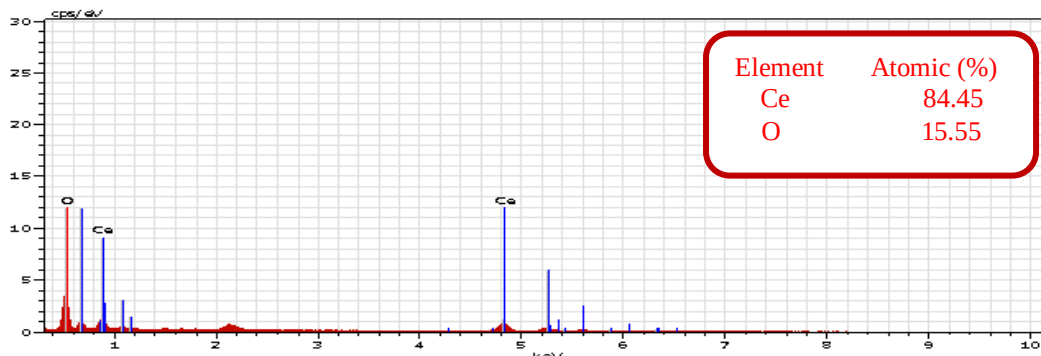


Fig.3. EDAX spectra for pure CeO_2 nanoparticles

3.4 Studies on Morphology using FESEM

The morphology of CeO_2 nanoparticles have been investigated by FEI QUANTA – 200 microscopes. To know the morphology, the as-prepared pure CeO_2 nanoparticles were scanned using FESEM.

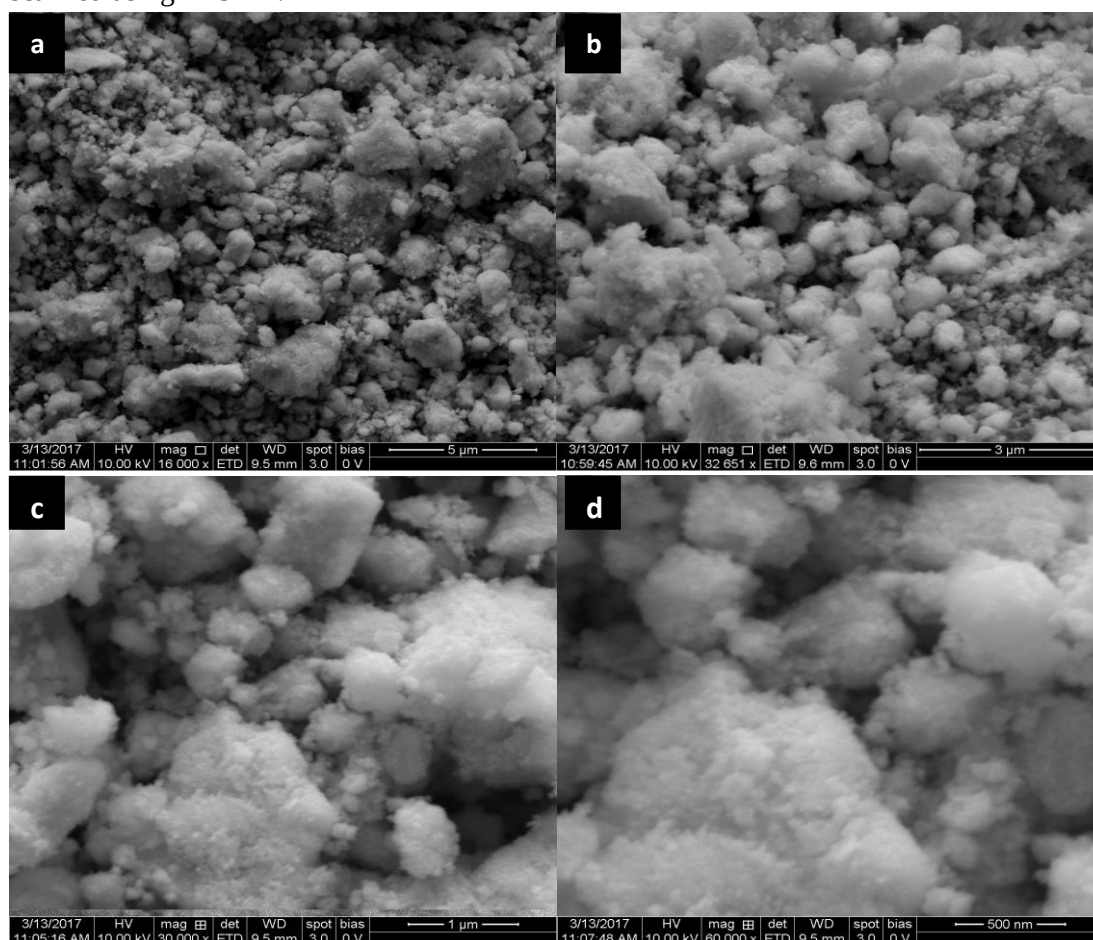


Fig.4. FESEM image of pure CeO_2 nanoparticles with magnification at a) 5 μm , b) 3 μm , c) 1 μm , d) 500 nm

Fig.4 represents the morphology of the as-synthesized pure CeO₂ nanoparticles. Typical FESEM images of the CeO₂ nanostructures at different magnifications are shown. It is clear that for 500 nm magnification, the synthesized pure CeO₂ nanoparticles are spherical like structure.

4. Conclusion

CeO₂ nanoparticles have been successfully synthesized using chemical co-precipitation of cerium nitrate hexahydrate and NaOH. XRD spectra showed cubic structure of CeO₂ identified using the standard data. The absorbance characteristics of the as-prepared samples are studied from the UV-DRS spectrometer. The Tauc plot shows that the optical band gap for the pure CeO₂ nanoparticles has been calculated as 3.32 eV. The FESEM images show that the sample is composed of spherical nanosized particles. EDAX spectrum confirms the purity of the samples.

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Binding of ruthenium(II)-polypyridyl complexes with gallic acid and quercetin in Triton X-100

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ABSTRACT

The binding of $[Ru(bpy)_3]^{2+}$ ($bpy = 2,2'$ -bipyridine), $[Ru(dmbpy)_3]^{2+}$ ($dmbpy = 4,4'$ -dimethyl-2,2'-bipyridine) and $[Ru(dtbp)_3]^{2+}$ ($dtbp = 4,4'$ -di-*tert*-butyl-2,2'-bipyridine) complexes with polyphenols (gallic acid and quercetin) have been studied in Triton X-100 at pH 11 by means of absorption spectral techniques. The absorption and emission maximum of these complexes are in the range of 449–457 nm and 612–639 nm respectively. The excited state lifetime of $[Ru(bpy)_3]^{2+}$, $[Ru(dmbpy)_3]^{2+}$ and $[Ru(dtbp)_3]^{2+}$ complexes are 600, 350 and 654 ns. The binding constant (K_b) of these complexes with gallic acid and quercetin are determined from the Benesi-Hildebrand equation using absorption intensity data. The observed binding constant values are sensitive to the nature of the ligand, medium and the structure of gallic acid and quercetin. Quercetin binds strongly with Ru(II) complexes than that of gallic acid owing to the presence of more phenolic–OH groups. The ground-state interactions between the polyphenols and the bipyridyl rings of Ru(II) complexes are hydrophobic in nature. Structural effect, hydrophobic effect and the medium seem to play a vital role on the binding of the gallic acid and quercetin with Ru(II) complexes.

Keywords: Ruthenium(II)-polypyridyl complexes; Polyphenols; Benesi-Hildebrand equation; Binding constant; Structural effect

1. Introduction

Polyphenols have considerable interest in the field of food chemistry, pharmacy and medicine due to a wide range of favourable biological effects including antioxidant properties. Phenolic acids and flavonoids constitute one of the most common and widespread groups of substances in flowering plants, occurring in all vegetative organs and fruits. The antioxidant property of polyphenols is mainly due to their redox properties. They act as reducing agents (free radical terminators), hydrogen donors, singlet oxygen quenchers and metal chelators [1]. The antioxidant activity of polyphenols depends on the number of hydroxyl groups that are strengthened by steric hindrance [2]. In addition to antioxidant and free-radical scavenger properties, polyphenols have numerous other biological activities, such as antihistamine activity, as well as anti-inflammatory, protecting against cardiovascular diseases and anticancer activity [3].

Gallic acid (3,4,5-trihydroxybenzoic acid) is a basic structural unit of hydrolysable tannins widely distributed in the plant kingdom especially in tanniferous plants. Gallic acid is a strong chelating agent and forms stable complexes with iron [4]. The degree of chelation increases as the pH increases. The pK_a values of gallic acid are 4 (carboxylic acid), 8.7, 11.4 and > 13 (phenolic - OH groups) [5]. Quercetin (3,3',4',5,7-pentahydroxy flavone) is particularly interesting because it is one of the most biologically active and common dietary flavonols. Quercetin has two different pharmacophores, the catechol group (ring B) and the benzo- γ -pyrone derivative (ring A and C), of which the catechol moiety is the most reactive one where deprotonation occurs easily [6]. The pK_{a1} and pK_{a2} values of quercetin are 5.87 and 8.48 [7].

The development of transition metal complexes that target and interact non-covalently with proteins and antioxidants is an emerging field that links inorganic chemistry with chemical and synthetic biology [8]. Metal complexes play an essential role in agriculture, pharmaceutical and industrial chemistry. The metal complexes as therapeutic agents for treatment of different diseases have been extensively studied [9]. As they generally have different mechanism of activity from the organic compounds, the development of metal complexes provides an alternative route of novel drug [10]. Among the transition metal complexes ruthenium(II)-polypyridyl complexes ($[\text{Ru}(\text{NN})_3]^{2+}$) have particularly drawn significant interest for developing new diagnostic and therapeutic agents that can recognize and cleave DNA. Ru(II)-polypyridyl complexes undergo binding with DNA, RNA and proteins and act as therapeutic agents [11]. Polyphenols with gallol or catechol groups are generally the most potent antioxidants, primarily because of the large iron-binding stability constants for these groups. Polyphenols containing catechol (quercetin) and gallol (gallic acid) groups have very different activities, depending on the metal ion [12].

The $[\text{Ru}(\text{NN})_3]^{2+}$ complexes have been extensively used as probes in micellar media and the photophysical properties vary enormously with the nature of the surfactant and concentration [13]. Many researchers [14,15] have attempted a systematic investigation of binding, partitioning and photosensitization of these $[\text{Ru}(\text{NN})_3]^{2+}$ complexes in homogeneous and micro-heterogeneous media. The electron transfer reactions in micellar medium can be either enhanced or slowed down compared to the reactions in aqueous solutions. The presence of hydrophobic groups like alkyl and aryl in the ligands of Ru(II) lead to strong binding of $[\text{Ru}(\text{NN})_3]^{2+}$ with micelles through hydrophobic interaction. The strength of binding depends on the combination of electrostatic attractions or repulsions and hydrophobic effects. Bowers et al. [16] studied the surface and aggregation behaviour of aqueous solutions containing Ru(II) metallosurfactants. Based on the literature survey, the present study concentrates on the binding studies of gallic acid and quercetin on $[\text{Ru}(\text{NN})_3]^{2+}$ complexes in Triton X-100 at pH 11. In order to know the role of Triton X-100 in this binding reaction, the observed results are compared with the results obtained from aqueous medium at pH 11.

2. Experimental Section

$\text{RuCl}_3 \cdot 3\text{H}_2\text{O}$, ligands (2,2'-bipyridine (bpy), 4,4'-dimethyl-2,2'-bipyridine (dmbpy), 4,4'-di-tert-butyl-2,2'-bipyridine (dtbpy)) and the polyphenols (gallic acid and quercetin) were procured from Sigma–Aldrich. HPLC grade solvents were used throughout the study for the synthesis of complexes as well as for binding studies. The double-distilled deionized water was used for the binding studies. The three $[\text{Ru}(\text{NN})_3]^{2+}$ complexes {where NN = 2,2'-bipyridine (bpy), 4,4'-dimethyl-2,2'-bipyridine (dmbpy), 4,4'-di-tert-butyl-2,2'-bipyridine (dtbpy)} were synthesized by reacting $\text{RuCl}_3 \cdot 3\text{H}_2\text{O}$ with the corresponding ligands according to the procedure previously described [17].

The absorption spectral measurements were carried out using SYSTRONICS 2203 double beam spectrophotometer. Emission intensity measurements were carried out and the emission spectra were recorded using ELICO SL 174 spectrofluorometer. Excited state lifetime of the complex was made with laser flash photolysis technique using an Applied Photophysics SP-Quanta Ray GCR-2(10) Nd:YAG laser as the excitation source. The binding

of $[\text{Ru}(\text{NN})_3]^{2+}$ complexes with various concentrations (2×10^{-5} - 1.4×10^{-4} M) of gallic acid and quercetin in Triton X-100 at pH 11 has been studied by absorption spectral technique. Phenolate ions of the gallic acid and quercetin for the binding studies were prepared by mixing the corresponding polyphenols with NaOH and the pH of the solution was maintained at 11 to confirm that the quencher was present as phenolate ions. The binding constant (K_b) of the $[\text{Ru}(\text{NN})_3]^{2+}$ complex with gallic acid and quercetin was determined from the Benesi-Hildebrand equation using absorption intensity data.

$$1/\Delta A = 1/K_b \Delta \epsilon [\text{H}] + 1/\Delta \epsilon [\text{G}]$$

where ΔA is the change in absorption of the complex with different concentrations ($[\text{G}]$) of polyphenols. The plots of $1/\Delta A$ versus $1/[\text{G}]$ give a straight line, K_b can be obtained from the ratio of Y-intercept to the slope of the straight line.

3 Results and Discussion

The structure of the ligands and the polyphenols used in the present study are shown in **Fig. 1**. The photophysical properties like absorption and emission spectral data and the excited state lifetime of $[\text{Ru}(\text{NN})_3]^{2+}$ complexes in aqueous and Triton X-100 at pH 11 are given in **Table 1**. The photophysical properties of the $[\text{Ru}(\text{NN})_3]^{2+}$ complexes change from homogeneous to microheterogeneous medium.

Table 1 Absorption, emission spectral data and excited state lifetime of $[\text{Ru}(\text{NN})_3]^{2+}$ complexes in aqueous and Triton X-100, at pH 11.

Complex	Absorption maximum (nm)		Emission maximum (nm)		Excited state lifetime (ns)	
	Aqueous	Triton X-100	Aqueous	Triton X-100	Aqueous	Triton X-100
$[\text{Ru}(\text{bpy})_3]^{2+}$	451	449	612	613	614	600
$[\text{Ru}(\text{dmbpy})_3]^{2+}$	457	456	625	625	380	360
$[\text{Ru}(\text{dtbpy})_3]^{2+}$	457	456	626	639	510	654

The absorption spectral studies of $[\text{Ru}(\text{NN})_3]^{2+}$ complexes with the incremental addition of gallic acid and quercetin showing a slight increase in the MLCT absorption maximum, indicates the formation of ground state complex (**Fig. 2**). Gallic acid and quercetin have weak absorption at 454 and 426 nm [18]. Gallic acid and quercetin bind with the $[\text{Ru}(\text{NN})_3]^{2+}$ complexes in aqueous and Triton X-100 medium, since gallic acid and quercetin have weak absorption close to the region where Ru(II) complex have strong MLCT absorption. The absorption spectra of $[\text{Ru}(\text{NN})_3]^{2+}$ complexes with gallic acid and quercetin shows a hypsochromic shift of 2 to 3 nm, due to the formation of ground state complex. The association of gallic acid and quercetin with $[\text{Ru}(\text{NN})_3]^{2+}$ complexes in the ground state may be due to the static nature of quenching. The association constant (K_a) of $[\text{Ru}(\text{NN})_3]^{2+}$ complexes with gallic acid and quercetin calculated from the Benesi-Hildebrand plot (**Fig.3**) using the Benesi-Hildebrand equation for the absorption spectral data in aqueous and Triton X-100 medium at pH 11 is given in **Table 2**. The K_a obtained for gallic acid and quercetin with $[\text{Ru}(\text{NN})_3]^{2+}$ complexes is in the order of 10^2 – 10^4 M^{-1} .

Table 2 Association constant, $K_a(M^{-1})$ calculated from absorption spectral data for gallic acid and quercetin with $[Ru(NN)_3]^{2+}$ complexes in aqueous and Triton X-100, at pH 11

Complex	Aqueous		Triton X 100	
	Gallic acid	Quercetin	Gallic acid	Quercetin
$[Ru(bpy)_3]^{2+}$	2.9×10^3	4.0×10^4	2.5×10^2	2.4×10^3
$[Ru(dmbpy)_3]^{2+}$	8.2×10^3	5.7×10^4	4.7×10^2	5.2×10^3
$[Ru(dtbpy)_3]^{2+}$	8.9×10^3	9.0×10^4	6.4×10^2	6.8×10^3

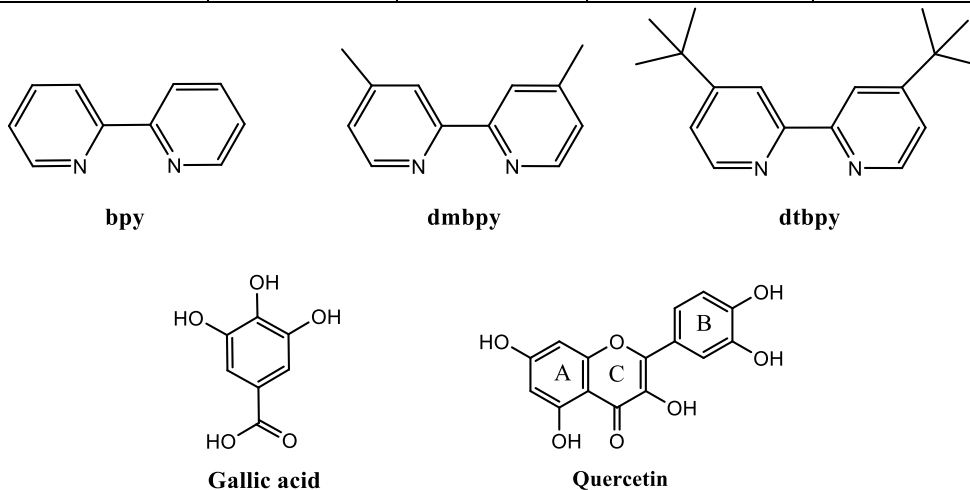


Fig.1 Structure of the ligands and the polyphenols

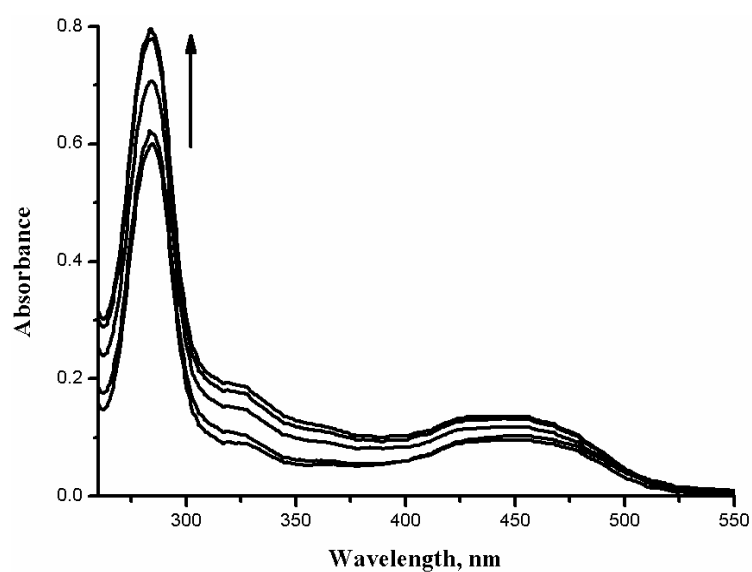


Fig.2 Absorption spectrum of $[Ru(bpy)_3]^{2+}$ with incremental addition of quercetin in Triton X-100 at pH 11

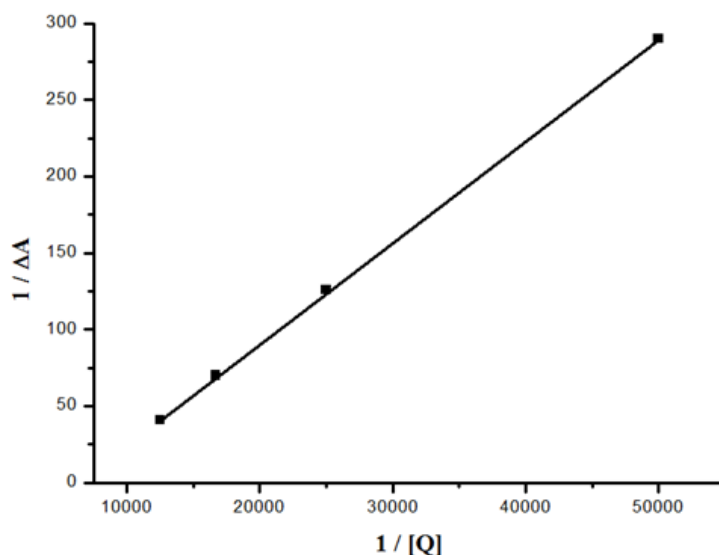


Fig.3 Benesi-Hildebrand plot on MLCT absorption of $[\text{Ru}(\text{dmbpy})_3]^{2+}$ complex with incremental addition of gallic acid in Triton X-100 at pH 11

The ground-state interactions between polyphenols and the bipyridyl rings of $[\text{Ru}(\text{NN})_3]^{2+}$ complexes are hydrophobic or π -stacking in nature [19]. To the extent that π - π stacking interactions exist between the ligands of Ru(II)- complexes and the polyphenols, the binding becomes stronger. The hydrophobic nature of Ru(II)-polypyridyl complexes increases from $[\text{Ru}(\text{bpy})_3]^{2+}$ to $[\text{Ru}(\text{dtbpy})_3]^{2+}$ complexes due to the presence of bulky alkyl substituted ligands. As the hydrophobic nature of the ligands increases K_b also increases. Hence the binding constant values of $[\text{Ru}(\text{NN})_3]^{2+}$ complexes with gallic acid and quercetin aqueous medium and Triton X-100 increase from $[\text{Ru}(\text{bpy})_3]^{2+}$ to $[\text{Ru}(\text{dtbpy})_3]^{2+}$ complexes. This results show that K_b is sensitive to the hydrophobic nature of the ligands.

The K_b calculated for gallic acid and quercetin from the absorption spectral data shows that quercetin undergoes strong binding with the $[\text{Ru}(\text{NN})_3]^{2+}$ complexes than that of gallic acid. Gallic acid consists of 3 phenolic-OH groups and at pH 11 almost all the phenolic-OH are converted into phenolate ions whereas quercetin consists of 4 phenolic-OH groups. The binding constant depends on the number of phenolic-OH groups. As the number of phenolic -OH groups increases the binding constant also increases. Hence quercetin shows higher binding constant than gallic acid with $[\text{Ru}(\text{NN})_3]^{2+}$ complexes in both media. This indicates that the K_b is not only sensitive to the nature of the ligand but also depends on the structure of the polyphenols. The change in medium from homogeneous to microheterogeneous strongly affects the K_b due to the presence of the hydrophobic interactions of the complexes with neutral micelle. Thus, the K_b values are sensitive to the nature of the ligand, medium and the structure of gallic acid and quercetin.

Conclusion

The binding of gallic acid and quercetin with $[\text{Ru}(\text{NN})_3]^{2+}$ complexes in Triton X-100 at pH 11 has been studied by absorption spectral techniques. The K_b of the $[\text{Ru}(\text{NN})_3]^{2+}$ complexes with gallic acid and quercetin is determined from the Benesi-Hildebrand plot. The K_b depends on the medium, hydrophobic nature of the ligands and the number of phenolic-OH groups of the polyphenols. As the number of phenolic-OH groups increases the binding

constant also increases. Quercetin shows higher binding constant than that of gallic acid due to the presence of more number of phenolic–OH groups. This study confirms the structural and hydrophobic effects and the effect of medium on the binding of biologically important phenolate ions with $[\text{Ru}(\text{NN})_3]^{2+}$ complexes.

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Synthesis and Spectral studies of novel Cd(II) complex with Glutaraldehyde and L-Alanine

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ABSTRACT

A new Schiff base has been synthesized from Glutaraldehyde and L-alanine and its complex was characterized by conductance measurement, elemental analyses, UV-Visible, IR, $^1\text{H-NMR}$ spectral studies, powder XRD, SEM and TGA. The spectroscopic studies indicate an octahedral geometry for the complex. On the basis of elemental and spectral studies, six coordinated geometry was assigned to the complex. The antimicrobial activities of ligand and its complex were screened by Disc Diffusion method. The activity data shows that the metal complex to be more potent than the parent Schiff base ligand against one or more bacterial and fungal species.

Key words: Schiff base; Metal complex; Spectral studies; Antimicrobial activity

1. Introduction

A large number of Schiff bases and their coordination compounds have been investigated for their interesting and important properties such as their ability to reversibly bind oxygen[1], catalytic activity in the hydrogenation of olefins [2], photochromic properties[3] and complexing ability towards some toxic metals [4]. Schiff bases are a special class of ligands with a variety of donor atoms exhibiting interesting coordination modes towards various metals. The azomethine linkage in Schiff bases is responsible for various biological activities[5]. Metal Schiff base complexes have been well known for their easy synthesis, stability and wide application[6]. Studies of new kinds of chemotherapeutic Schiff bases has now attracted the attention of biochemists[7]. Schiff base ligands are considered “privileged ligands” because they are easily prepared by the condensation between aldehydes and amines [8]. Schiff bases are characterized by $-\text{N}=\text{CH}-$ (imine) group which is important in elucidating the mechanism of transamination and racemisation reactions in biological systems and their metal complexes play an important role in the development of coordination chemistry. During the past two decades, considerable attention has been paid to the chemistry of the metal complexes of Schiff bases containing nitrogen and other donors. These investigations emphasised the great relevance of these systems in basic and applied chemistry, catalysis, molecular materials, microelectronics, sensors and so on. Studies of new kinds of chemotherapeutic Schiff bases has now attracted the attention of biochemists.

In continuation of the earlier work on Schiff base complexes, the present study was undertaken on the chelation behaviour of novel Schiff base ligand derived from Glutaraldehyde and L-alanine. The ligand has both oxygen and nitrogen donor sites. It coordinates with the metal ion in a tetradentate manner.

2. Materials and Methods

All the chemicals and solvents used in the present work were of analytical grade. The metal is used as its nitrate salt. The percentage compositions of the elements in the compound were determined using a Vario EL III elemental analyzer at Sophisticated Analytical

Instruments facility, CUSAT, Kochi. Ultraviolet spectra were recorded using Shimadzu double beam visible spectrophotometer in the visible region. Conductance of the metal complex was determined in DMSO on SYSTRONICS digital conductivity meter. IR spectra of the Schiff base and its complex in the range of 4000 to 400 cm^{-1} were recorded on a Perkin Elmer FT-IR spectrometer MODEL 1600 as KBr discs. ^1H NMR spectra of the complex in DMSO-d_6 were recorded by employing TMS as internal standard at NIIST Trivandrum. Powder XRD was recorded on a computer controlled X-ray diffractometer system JEOL JDX 8030. Double distilled water was used throughout the experimental work. The In vitro and invivo antimicrobial study of the compounds were tested against the bacteria *Klebsiella sps*, *Escherichia coli*, *Staphylococcus aureus* and fungi *Candida sps*, *Aspergillusniger* and *Aspergillus fumigates* by Kirby-bauer Disc diffusion method. Standard discs of chloramphenicol served as positive controls for antimicrobial activity but filter disc impregnated with solvent were used as a negative control.

2.1 Synthesis of Schiff base

The Schiff base ligand was prepared by reacting Glutaraldehyde and L-alanine in 1:2 molar ratio by refluxing in distilled methanol. The mixture was refluxed for 1 hour. The reaction was examined by TLC with time to time till completion. The solvent was partially evaporated and the yellowish mass product was precipitated by cooling and filtered off, washed with distilled water, dried, recrystallised and finally preserved in a desiccator.

2.2 Synthesis of Schiff base complex

Metal (II) nitrate was dissolved in 200 cm^3 of methanol. The filtered solution was added dropwise into 20 cm^3 methanol solution of the Schiff base ligand, the resulting mixture was refluxed and stirred for 8 hours. After refluxing, the volume of the solution was reduced to one third and the concentrate was cooled at 0°C . The precipitated complex was filtered off, washed several times with cold ethanol and dried in vacuo over anhydrous CaCl_2 .

3. Results and Discussion

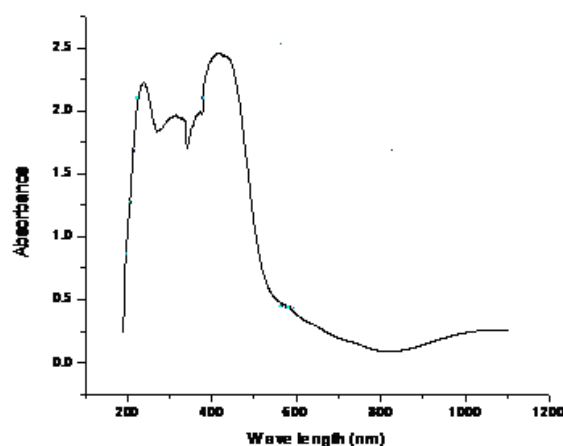
Cadmium nitrate reacts with Schiff base ligand in 1:1 molar alcoholic medium to afford pale yellow coloured complex. Cd(II) complex is normally stable at room temperature and hygroscopic in nature. It is soluble in common organic solvents like ethanol and methanol. The corresponding complex is soluble in DMSO. The Schiff base and its complex were subjected to elemental analysis. The results of elemental analysis with molecular formula are presented in **Table 1**. The results obtained are in good agreement with those calculated for the suggested formulae. The Cd(II) complex is non-electrolytic in nature[9] as the molar conductivity measurements in DMSO is $0.071 \text{ ohm}^{-1}\text{cm}^2 \text{ mol}^{-1}$.

Table 1: Analytical and physiochemical data of Schiff base and its complex

Ligand/ Metal Chelate	Empirical Formula	Colour	M:L ratio	Molar Cond. ($\text{Ohm}^{-1}\text{cm}^2\text{mol}^{-1}$)	Elemental analysis % Found (cal)			
					C Found (Cal)	H Found (Cal)	N Found (Cal)	M Found (Cal)
Glu-ala ligand	$\text{C}_{11}\text{H}_{18}\text{N}_2\text{O}_4$	Yellow	-	-	52.32 (52.5)	6.12 (6.26)	7.14 (7.58)	-
[Cd-glu- ala.2H ₂ O]	$\text{C}_{11}\text{H}_{22}\text{N}_2\text{O}_6\text{Cd}$	Pale yellow	1:1	0.071	51.89 (52.68)	6.29 (6.49)	7.98 (8.19)	17.98 (18.58)

3.1 UV–Visible Spectra

The UV-Visible spectra are often very useful in the evaluation of results furnished by other methods of structural investigation. The electronic spectral measurements were used for assigning the stereochemistry of metal ions in the complex based on the positions and number of d-d transition peaks. The electronic absorption spectra of the Schiff base ligand and its complex were recorded in DMSO solution in the range of 200 to 800 nm regions is given in **Fig.1**. It is usually recorded as a plot of absorbance (A) versus wavelength (cm^{-1}). The absorption spectrum of free ligand consist of an intense band centered at 275 nm which is assigned to $\pi - \pi^*$ transition of the $\text{C}=\text{N}$ chromophore. On complexation, this band was shifted to lower wavelength region at 238 nm suggesting the coordination of azomethine nitrogen with Cd(II) ion. The spectrum also shows other transitions in the range of 335 to 345 nm which can be assigned to $n - \pi^*$ transition. Cd(II) complex does not exhibit d-d electronic transition due to the completely filled 'd' orbital in Cadmium (II) ion and so it is found to be diamagnetic in nature.

**Fig. 1.** UV Spectrum of Cd(II) Schiff base Complex

3.2 Infra red spectra

The Schiff base ligand shows ν (C=N) azomethine band observed at 1648 cm^{-1} . On complexation, this band was shifted to 1598 cm^{-1} region due to the coordination of azomethine to the Cd (II) ion [10]. New bands observed at 546 cm^{-1} and 486 cm^{-1} which are not seen in the spectrum of the free ligand can be attributed to the ν (M-O) and ν (M-N) vibrations respectively. The spectra of the complex illustrate broad band in 3044 cm^{-1} region assigned to the presence of water molecules in the complex. The IR spectrum of Cd(II) Schiff base complex is given in Fig.2.

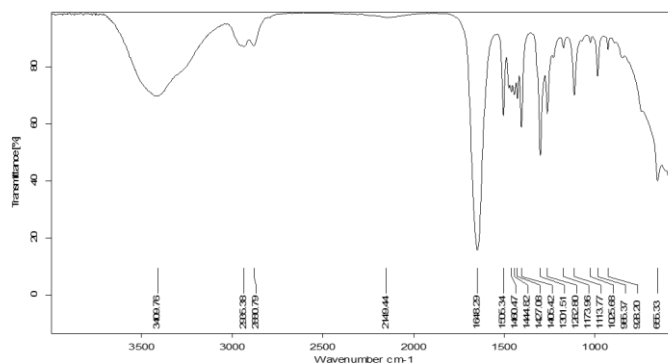


Fig. 2. IR spectrum of Cd(II) Schiff base Complex

3.3 ^1H NMR Spectrum

^1H NMR Spectrum of the ligand recorded in DMSO solution shows a multiplet at 2.6, 1.7 ppm due to the methyl protons. The ^1H NMR Spectrum of the Schiff base complex exhibit signals at 8.3 and 7.7 ppm attributed to CH=N- and -NH protons respectively. The azomethine proton signal in the spectrum of the complex is shifted downfield compared to the free ligand, suggesting the deshielding of the azomethine group due to the coordination with the metal ion[11]. There is no appreciable change in all other signals of the complex. The ^1H NMR spectrum of Cd(II) Schiff base Complex is given in Fig.3.

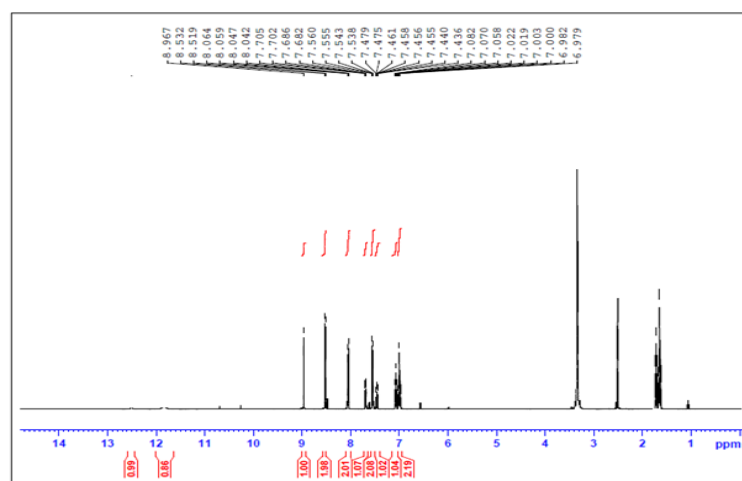


Fig. 3. ^1H NMR spectrum of Cd(II) Schiff base Complex

3.4 XRD Study

X-ray diffraction pattern of Cd(II) complex shows sharp crystalline peaks. The crystallite size of the complex could be estimated from XRD pattern by the Scherer's formula,

$$D_{\text{XRD}} = 0.9 \lambda / \beta \cos \theta$$

Where λ is the wavelength, β is the full width at half maxima and θ is the diffraction angle. The XRD shows that Cd(II) complex has the crystallite size of 48 nm and so it is microcrystalline in nature. The XRD pattern of Cd(II) Schiff base Complex is given in **Fig.4**.

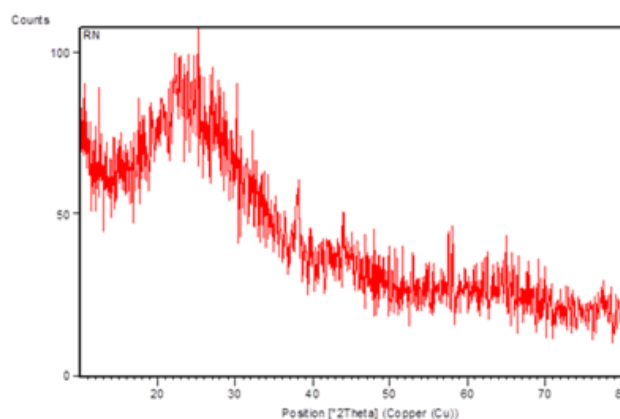


Fig. 4.XRD pattern of Cd(II) Schiff base Complex

3.5 SEM Study

The scanning electron micrographs taken at 20kV accelerating voltage with magnification from 150x to 1000x reveal the morphology of the compounds. The morphology showed that the surface was spongy and soft with large macroscopic phase separation. The phase separation and the spongy nature was reduced due to the introduction of metal ion. From SEM image, it is clear that there is a strong change in morphology of Schiff base on complexation. The SEM image of Schiff base complex is given in **Fig.5**.

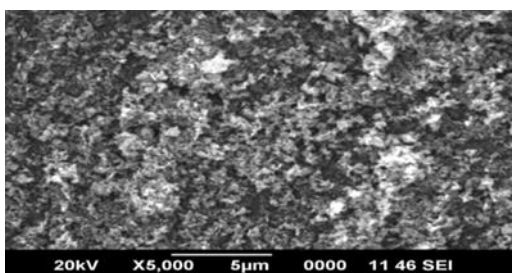


Fig. 5. SEM image of Cd(II) Schiff base Complex

3.6 TGA Study

Thermal stability of the complex was studied in the range of 50-1000°C by controlling heating rates 15°C/minute. The dynamic TGA with the percentage mass loss at different steps have been recorded. The complex lose its weight in the temperature range 160-250 °C corresponding to two coordinated water molecules with an endothermic peak in DTA curve [12]. Thus TGA provides information regarding the presence of water molecules in the coordination sphere of the complex. After the total loss of water molecules, the

decomposition occurs at 560-640°C that indicates the decomposition of the ligand. Chemical analysis of the black final residue corresponds to the metallic oxide.

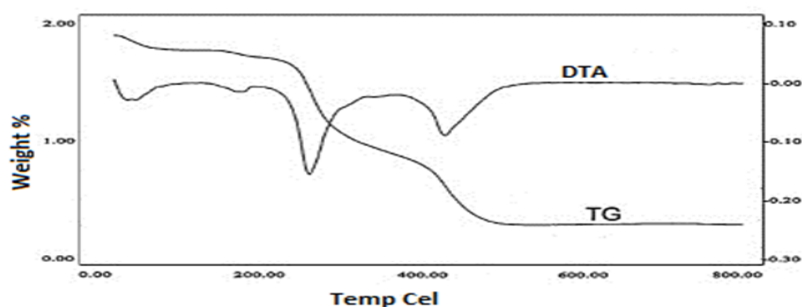
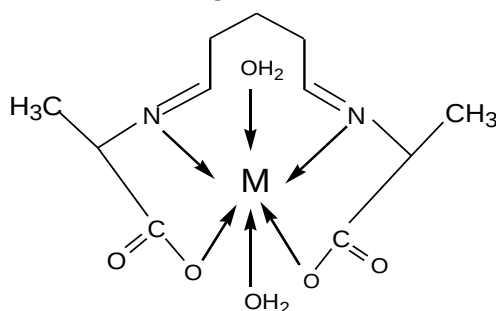


Fig. 6. TG/DTA of Cd(II) Schiff base Complex

Based on the spectral and analytical characterization studies the expected geometry for the $[\text{Cd}(\text{gln})(\text{ala})2\text{H}_2\text{O}]$ complex is shown in **Fig.7**.



where M is Cd

Fig. 7. Structure of $[\text{Cd}(\text{gln})(\text{ala})2\text{H}_2\text{O}]$

3.7 Antimicrobial Study

The *In vitro* antimicrobial study of the compounds was tested against the bacteria *Klebsiella* sps, *E.coli*, *Staphylococcus aureus* and fungi *Candida* sps, *Aspergillus niger* and *Aspergillus fumigates* by Disc diffusion method. From the MIC values obtained it was found that the complex exhibit higher activity than the free ligand (**Table 2**). This may be ascribed to the increased lipophilic nature of the complex arising due to chelation[13]. Tweedy's chelation theory offers an explanation for the increased antimicrobial activity of the metal complex. In the chelated complex, the positive charge of the metal ion is partially shared with the donor atoms of the ligand and electron delocalization occurs over the whole chelate ring. In this way, the lipophilic character of the metal chelate is increasing and favouring its permeation through the lipid layers of the bacterial membranes and blocking the metal binding sites in the microorganism.

Table.2: Antimicrobial activities of Cd(II) Glutaraldehyde-alanine Schiff base complex by disc diffusion method (Zone inhibition in mm)

Compound	Microbial Species					
	A	B	C	D	E	F
Control	12	15	18	20	20	15
Glu-ala Ligand	5	6	8	10	7	8
$[\text{Cd-gln-ala}.2\text{H}_2\text{O}]$	10	12	14	15	13	12

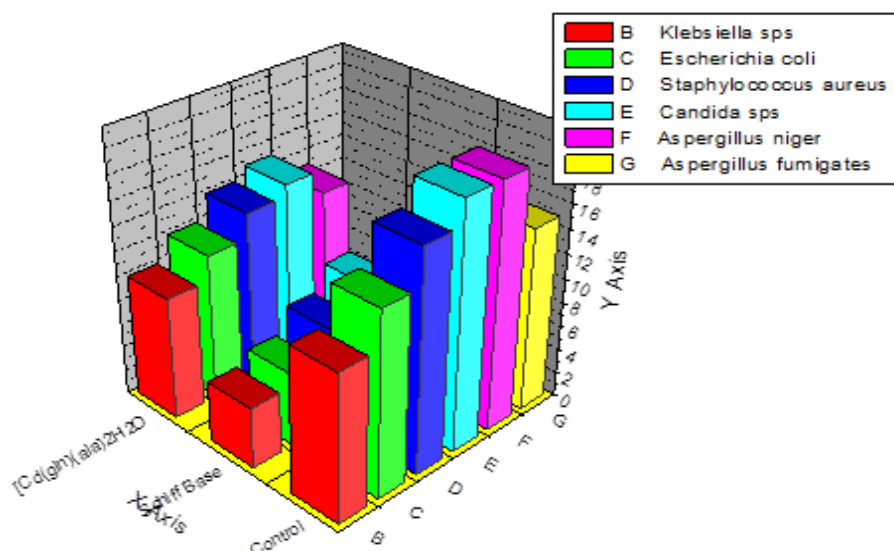


Fig. 8: Antimicrobial activities of the Schiff base and its complex

Conclusion

The elemental analysis, UV/ Visible, IR and ^1H NMR spectral observations and powder XRD study suggest the octahedral geometry for the Cd(II) complex of coordination number six. The very low conductance value for the complex indicates that the complex is non-electrolytic in nature. TGA study shows the presence of water molecules in the complex. Antimicrobial study indicates the predominant activity of the complex than its corresponding ligand.

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Synthesis and Characterization of New Aromatic Poly(amide-imide)

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ABSTRACT

New aromatic poly(amide-imide) with enhanced thermal stability was synthesized from a bis(4-amino-3,5-dimethylphenyl)4'-fluorophenyl methane. The tetrimer-dicarboxylic acid was readily obtained by the condensation reaction of p-phenylenediamine, pyromellitic dianhydride and p-aminobenzoic acid. Polymer was prepared by direct polycondensation reaction of tetrimer-dicarboxylic acid and bis(4-amino-3,5-dimethylphenyl)4'-fluorophenyl methane using triphenylphosphite in N-methyl-2-pyrrolidone solution containing dissolved CaCl₂. The newly synthesized monomer and poly(amide-imide) were characterized by elemental analysis, FTIR spectroscopy and the properties of the polymer including solubility, crystallinity and thermal behavior were also studied. The obtained poly(amide-imide) showed high thermostability. The polymer was easily soluble in organic solvents such as DMSO, DMAc, NMP, CHCl₃, THF, toluene and m-cresol

Keywords: poly(amide-imide), thermal behavior, solubility.

1. Introduction

Aromatic polyimides are high performance materials based on their excellent thermal stability, chemical resistance and mechanical properties [1]. Because of above mentioned properties, polyimides can be used in a wide variety of applications such as polymer matrices for high temperature advanced composites, membranes for the low temperature energy separation of industrial gases, interlayer dielectrics, high temperature adhesive and coatings[2]. Despite their widespread use, most of the polymers have high melting or softening temperatures and limited solubility in most of the organic solvents because of their rigid backbones and strong intermolecular interactions which may restrict their use in some fields. In the present paper, we report the synthesis and characterization of poly(amide-imide) from imide containing diacid and new aromatic diamine. Due to the presence of bulky pendant and amide group in the polymer backbone, decrease in the rigidity of the polymer chain would be improve the solubility of the polymer.

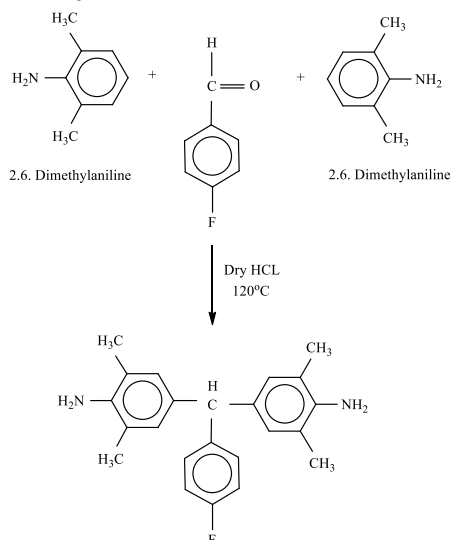
2. Materials and Methods

2,6-dimethyl aniline, p-phenylenediamine, pyromellitic dianhydride, (PMDA), 4-fluoro benzaldehyde, p-aminobenzoic acid, N,N-dimethylacetamide (DMAc), N,N-dimethylformamide (DMF), concentrated hydrochloric acid, toluene, acetone, chloroform, m-cresol, dimethyl sulphoxide (DMSO), N-methyl pyrrolidone (NMP), xylene, CaCl₂, triphenyl phosphate and tetrahydrofuran (THF) were purchased from Sigma Aldrich. The solvents used for polymerization were purified according to standard methods.

2.1 Synthesis of Monomer

2, 6-dimethylaniline (12.1g, 0.1 mol) was charged into a 250 ml three necked round bottomed flask equipped with nitrogen inlet, an additional funnel and a reflux condenser. Concentrated hydrochloric acid (8 ml) was added drop-wise to the reaction vessel for 30 minutes. The solid substance obtained was melted by heating to 100°C. To this 4-fluorobenzaldehyde (8.3 g, 0.05 mol) was added and the temperature was raised to 120°C and

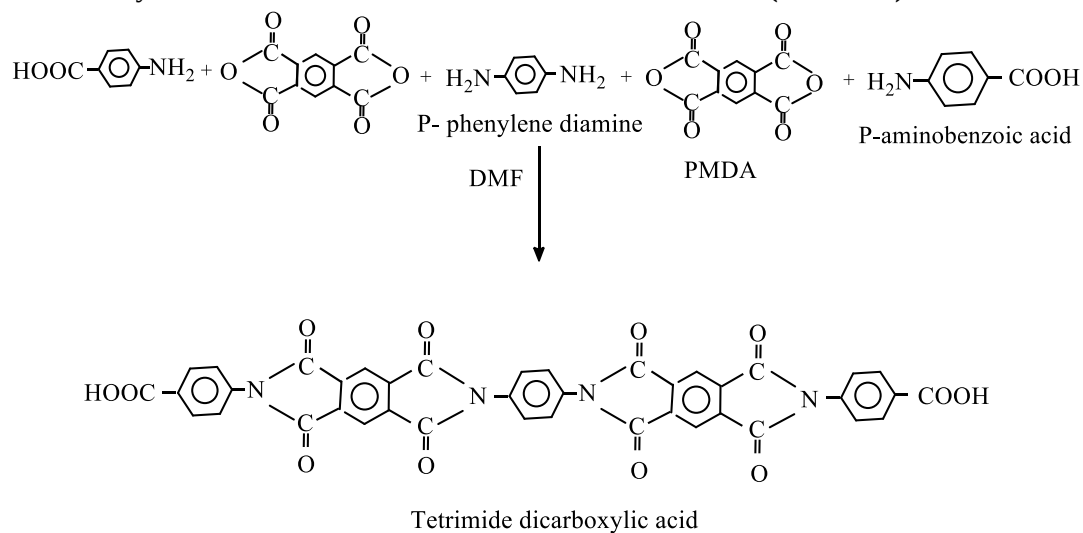
the reaction mixture was stirred at this temperature for 12 hrs, cooled and neutralized with sodium hydroxide solution. The solid product obtained was filtered, washed with methanol, recrystallized in ethanol and finally dried in vacuum at 70°C for 12 hrs (**Scheme1**).



Scheme 1 Synthesis of bis(4-amino-3, 5-dimethylphenyl) 4'-fluorophenyl methane (BAFM)

2.2. Synthesis of tetrimidedicarboxylic acid

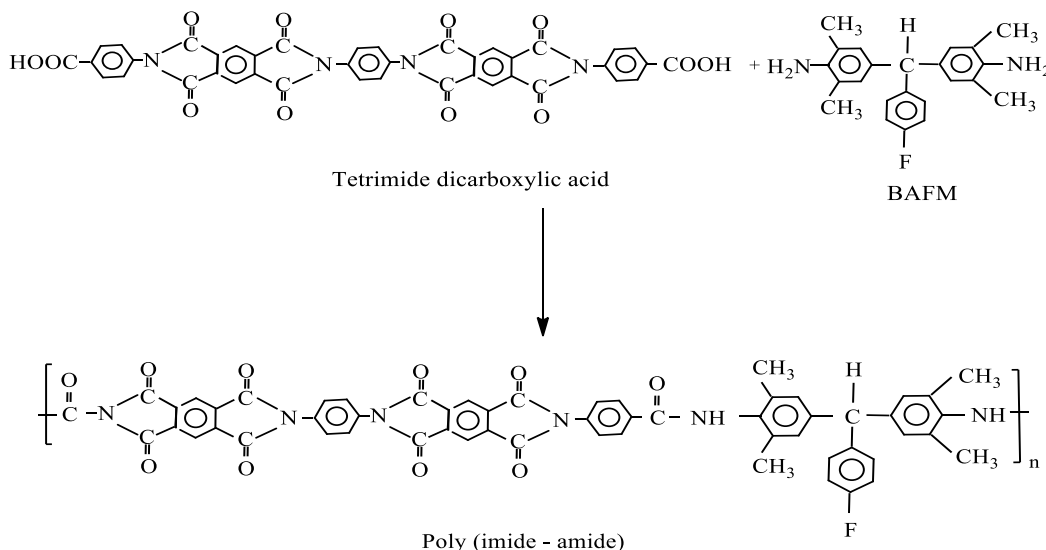
A three necked 150 ml RB flask equipped with nitrogen inlet, an additional funnel and a reflux condenser was charged with *p*-phenylenediamine (0.01 mole), *p*-aminobenzoic acid (0.02 mole) and pyromellitic dianhydride (0.02 mole) in 20 ml DMF. The mixture was stirred at room temperature for 2 hours. About 25 ml of toluene was then added and refluxed for 3 hours. The water formed in the reaction was distilled off azeotropically using Dean-Stark trap. At the end of the reaction, the residual toluene was distilled off under reduced pressure. After cooling, the solution obtained was trickled into water and the precipitated product was collected by filtration and dried in vacuum at 100°C for 12 hours (**Scheme 2**).



Scheme 2 Synthesis of tetrimidedicarboxylic acid

2.3. Polymerization

A mixture of tetrimer-dicarboxylic acid (1.25 mmol), bis(4-amino-3,5-dimethylphenyl) 4'-fluorophenyl methane (BAFM) (1.25 mmol), 0.3 g of CaCl_2 , 0.8 ml of TPP, 1.6 ml of pyridine and 7 ml of NMP were heated with stirring at 100°C for 8-12 hrs under nitrogen. The obtained polymer solution was trickled on 500 ml of methanol, collected by filtration and dried (**Scheme 3**).



Scheme 3 Synthesis of poly(amide-imide)

3. Characterization Studies

3.1 Elemental Analysis

The elemental analysis data of the monomer and polymer are in good agreement with the calculated values. The values are given in **Table 1**.

Table 1: Physico-chemical characteristics of PAI

S. No.	Code	Molecular Formula	% Yield	Elemental analysis (wt %)					
				Carbon		Hydrogen		Nitrogen	
				Calcd.	Found	Calcd.	Found	Calcd.	Found
1.	BAFM	$\text{C}_{23}\text{H}_{25}\text{N}_2\text{F}$	85	79.31	78.73	7.18	6.93	8.04	8.14
2.	PAI	$(\text{C}_{57}\text{H}_{37}\text{O}_{16}\text{N}_6)_n$	81	70.88	70.89	3.83	3.85	8.70	8.73

3.2 IR Spectral Studies

Infrared spectroscopy continues to be the prominent tool in determining the chemical structure of the product. The IR spectra of diamine monomer and polymer are shown in Figures 1 and 2. The diamine monomer (BAFM) shows absorption peaks around $3463\text{--}3337\text{cm}^{-1}$ due to N-H symmetric and asymmetric stretching of NH_2 groups and the absorption band around $1620\text{--}1606$ due to N-H bending vibration [3]. BAFM shows absorption band

around $2970\text{--}2867\text{cm}^{-1}$ due to the C-H stretching vibrations of CH_3 . The peak corresponding to C- F bond in monomer appeared in the region around 1072cm^{-1} . A peak around $3074\text{--}3050\text{cm}^{-1}$ region could be ascribed to the aromatic C-H stretching vibrations, in addition to these characteristics vibrations, all the monomers show absorption band around $1620\text{--}1447\text{cm}^{-1}$ corresponding to the aromatic ring vibrations. The polymer (PAI) shows absorption peaks at 1726 and 1778cm^{-1} correspond to symmetric and asymmetric stretching of the imide carbonyl group[4]. The peak at 1364cm^{-1} is due to the C-N-C stretching vibration of the imide ring. The peaks around 1115 and 731cm^{-1} correspond to the imide ring deformation.

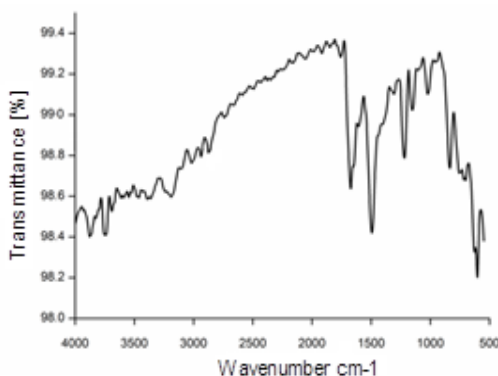


Figure 1: FTIR spectrum of BABM

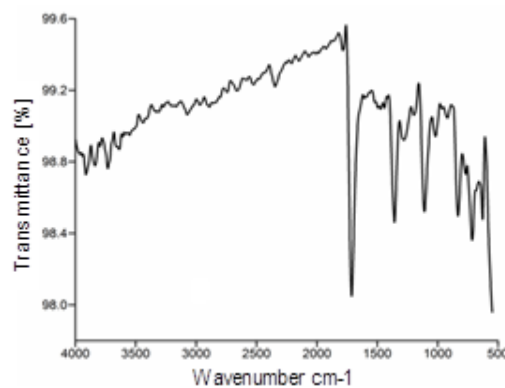


Figure 2: FTIR spectrum of PAI

3.3 Solubility

The solubility of the PAI was tested qualitatively in various organic solvents such as N-Methyl pyrrolidone (NMP), Dimethyl sulfoxide (DMSO), Dimethyl acetamide (DMAc), Chloroform (CHCl_3), Tetrahydrofuran (THF), Toluene, m-cresol and Xylene. The results are reported in Table 2.

Table 2: Solubility of the PAI

Polymer	NMP	DMSO	DMAc	CHCl_3	THF	Toluene	m-cresol	Xylene
PAI	++	++	++	++	++	++	++	-

Solubility keys: (++) soluble; (-) insoluble.

The excellent solubility may also be due to the presence of methyl group in the polymer backbone, which would decrease the packing density and intermolecular interactions of the macromolecular chain [5].

3.4 X-ray diffraction studies

The X-ray diffraction pattern shows PAI is almost amorphous in nature. This could be attributed to the introduction of the packing disruptive bulky pendant group (phenyl) which resulted in increased chain distance and decreased chain to chain interactions, thereby leading to decrease in crystallinity [6]. XRD patterns of PAI given in figure 3.

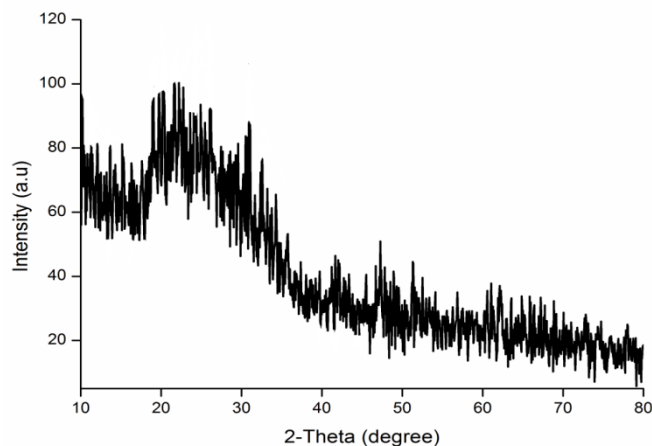


Figure 3: XRD patterns of PAI

3.5 Thermal Analysis

In the present study PAI is stable up to 420⁰C indicating high thermal stability. The high thermal stability of the polymer could be attributed to the presence of fluoro substituent, methyl group and amide unit in the polymer chain [5]. The dipolar effect from the C-F bond present in the polymer backbone also may increase the thermal stability.

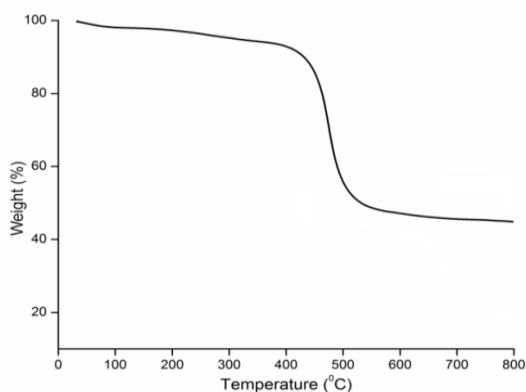


Figure 4: TGA Thermogram of PAI

Conclusion

The new poly(amide-imide) (PAI) was synthesized from a novel diamine and newly synthesized tetrimidedicarboxylic acid in the presence of pyridine and NMP. The elemental analysis and the spectral studies confirm the structure of the monomer and polymer. The incorporation of the pendant group in the polymer backbone has increased the solubility of the PAI. Hence the processability may also be increased. Therefore this PAI can be used as high performance polymer.

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Green Synthesis and Evaluation of antimicrobial activity of Silver Nanoparticles using *Piper nigrum* extract

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ABSTRACT

There is worldwide interest in silver nanoparticles (AgNPs) synthesized by various chemical reactions for use in applications exploiting their antibacterial activity, even though these processes exhibit a broad range of toxicity in vertebrates and invertebrates alike. In the recent years, with the increasing environmental problems, attempts for the synthesis of nanomaterials through the environmental clean methods have been increased. Green synthesis of nanoparticles is widely accepted due to the less toxicity in comparison with chemical methods. Here we report a novel cost-effective and eco-friendly method for the rapid green synthesis of silver nanoparticles using the extract of *Piper nigrum*. The fabricated nanoparticles possessed excellent antibacterial property against both Gram-positive and Gram-negative bacteria.

Keywords: Silver nanoparticles, nanomaterials, biological synthesis, *Piper nigrum*

1. Introduction

Nanoparticles (NPs) are defined as having one dimension 100 nm or less in size and due to their large surface area they tend to react differently than larger particles of the same composition, allowing them to be utilized in novel applications [1]. Among all nanomaterials, silver nanoparticles (AgNPs) are unique as they are used in vast arrays of applications including medicine, food and consumer products [2]. Synthesis of such variety of AgNPs is possible by thermal decomposition, laser ablation, ultrasound and aqueous chemical reduction method [3]. In order to minimise the risk of environmental hazards and to ensure economic sustainability by reducing production costs, there is a growing need to develop eco-friendly protocols for the nanoparticle synthesis employing green chemistry approaches using cheaply available, renewable natural resources. One of them is synthesis of nanoparticles by a biological process which is implemented to develop safe, cost-effective and environmentally friendly technologies. Earlier reports proved that the green silver nanoparticles have been synthesized using various natural products like green tea (*Camellia sinensis*), neem (*Azadirachta indica*) leaf broth, natural rubber, starch, aloe vera plant extract, lemongrass leaves extract, leguminous shrub (*Sesbania drummondii*) etc. [4] The plant parts like fruit, leaf, bark, seed and stem extracts have been effectively used for synthesis of nanoparticles [5]. In the group of medicinal plants, the *Piper nigrum* possess excellent medicinal properties due to the presence of enormous phytochemicals and biomolecules like alkaloids, proteins, polysaccharides, amino acids and vitamins. The piperine is an alkaloid, majorly found in *Piper nigrum* [6]. Owing to the presence of large amount of phytochemicals, *Piper nigrum* was taken into account for the synthesis of silver nanoparticles. Further, the synthesized silver nanoparticles were characterized by UV-Vis spectrophotometer, XRD, SEM and FTIR analysis. The antibacterial effect of silver nanoparticle was examined against different microbial species. The biomolecules present in *Piper nigrum* could be used as bioreductants to react with metal ions and they could also be used as scaffolds/template to direct the formation of nanoparticles in solution.

2. Materials and Methods

2.1. Preparation of *Piper nigrum* seed Extract

The *Piper nigrum* seeds were collected from the medicinal plant garden located in Castle rock estate, Keeriparai, India. The seeds were crushed into small pieces and washed with double-distilled water for 2-3 times. It was slightly dried at room temperature. About 10 g of seed was weighed and boiled with 100 mL of double-distilled water at 60-80°C for 10 min. After boiling, the solution was filtered through nylon mesh cloth and stored at 4°C for the nanoparticle synthesis.

2.2. Synthesis of Silver Nanoparticles by Using *Pipernigrum* seed Extract

For silver nanoparticle synthesis, about 10 mL of *Piper nigrum* seed extract was added separately to 90 mL aqueous solution of AgNO₃ (1 mM) and kept at room temperature. The color change from pale yellow to brown indicated that the silver nanoparticles were formed as a result of the reaction of the extract of *Piper nigrum* with silver metal ions. A control was maintained without addition of extract in the silver nitrate solution that showed no color change.

2.3. Characterization Studies

The formation of silver nanoparticles was monitored by measuring the UV-Vis spectra on Shimadzu UV-Visible spectrophotometer (UV-1800) operated with a resolution of 2 nm. Further, the reaction mixture was centrifuged at 10,000 rpm for 10 min and washed with double-distilled water. Repeated the centrifugation process for 4-5 times and allowed the pellet to dry in hot air oven. The dried powder was used for further characterization studies. For XRD analysis, the powdered nanoparticles were coated on the amorphous silica substrate. The spectra were recorded by using XDL 3000 powder X-ray diffractometer with 40 kV and a current of 30 mA with Cu K α (1.5405 Å) radiation. The shape of the silver nanoparticles was examined by SEM experiments using Philips Scanning Electron Microscope. The FTIR measurements were carried out using the Perkin-Elmer instrument at wavelength ranges from 4000 to 400 cm⁻¹ at a resolution of 4 cm⁻¹.

2.4. Assessment of Antibacterial Activity of Green-Synthesized Silver Nanoparticles

Agar well diffusion method was used to examine the microbial activity of green-synthesized silver nanoparticles using the Muller-Hinton agar plates against the strains of *Klebsiella* sps, *Pseudomonas aeruginosa*, *Candida albicans*, *Aspergillus flavus* and *Aspergillus oryzae*. The plates were incubated at 37 °C for 24 h. Sterile paper discs of 5 mm diameter saturated with plant extract, silver nanoparticle and double distilled water (as control) were placed in each plate and incubated. After incubation, the zones of inhibition were measured.

3. Results and Discussion

Biosynthesis of nanoparticles by using heterocyclic compounds gains more attention due to their simplicity and ecofriendly nature [7]. The color identification is a preliminary analysis to confirm the formation of silver nanoparticles. In the present study, the formation of brown color when 1mmol AgNO₃ mixed with 10 ml of *Piper nigrum* seed extract indicates the synthesis of silver nanoparticles. The color changes are acquired due to the excitation of

Surface Plasma Resonance in the synthesized metal nanoparticles [8]. The *Piper nigrum* extract shows the formation of brown color in 10 min. This indicates that the silver nanoparticle synthesis process has started. The intensity of brown color increases with increase in the duration of time.

3.1 UV-Vis Spectroscopic Analysis

UV-Vis spectroscopy could be used to examine the size and shape-controlled nanoparticles in aqueous suspensions. The addition of plant extract of *Piper nigrum* into the beaker containing aqueous solution of silver nitrate led to the change in the colour of the solution from yellowish to brown within reaction duration. The colour change is due to the formation of silver nanoparticles which are detected by Surface Plasmon Resonance (SPR) phenomenon. The metal nanoparticles have free electrons, which give the SPR absorption band due to the combined vibration of electrons of metal nanoparticles in resonance with light wave. From the literature, it was reported that the silver nanoparticles show SPR peak at around 420 nm[9]. The sharp bands of silver nanoparticles were observed around 410 nm (**Fig. 1 and 2**). So it was confirmed that *Piper nigrum* extract has more potential to reduce Ag ions into Ag nanoparticles. The reduction of the metal ions occurs fairly rapid. More than 90% of reduction of Ag⁺ ions is complete within 4 hrs, after addition of the metal ions to the plant extract.

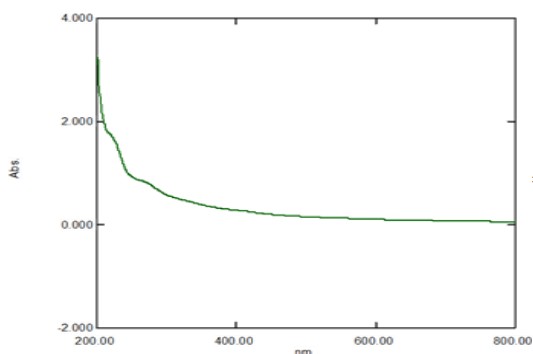


Fig 1. UV/Visible spectrum of
Piper nigrumExtract

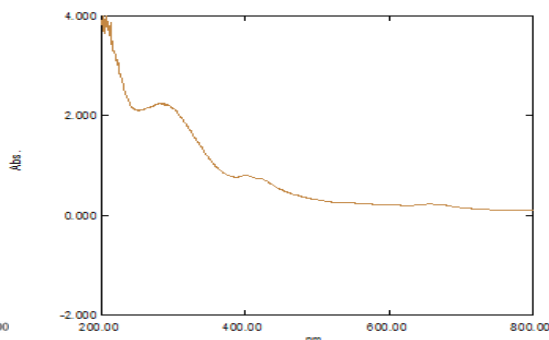


Fig 2. UV/Visible spectrum of
Silver nanoparticle

3.2. FTIR Analysis

The possible functional groups of phytochemicals in plant extract involved in nanoparticles synthesis are identified by FTIR analysis. The silver nanoparticles synthesized by seed extract of *Piper nigrum* (**Fig. 3**) exhibit intense absorption peaks in the range of 3314 cm⁻¹ – 3197 cm⁻¹ corresponding to N–H stretching of primary amine. Two weak bands observed at 2897 cm⁻¹ and 2362 cm⁻¹ indicates the H–C–H asymmetric and symmetric stretching of alkanes respectively. The band observed at 2362 cm⁻¹ denotes the presence of hydrogen-bonded OH stretching of carboxylic acids in the leaf extract, which may be a reducing agent responsible for the synthesis of silver nanoparticles. The absorption band at 1763cm⁻¹, 1668 cm⁻¹ and 1628 cm⁻¹ represents the C=O stretching of ketones. The peaks observed at 1532 cm⁻¹ and 1480 cm⁻¹correspond to the N–H bending of secondary amine and the band at 1399 cm⁻¹, 1383 cm⁻¹ and 1335cm⁻¹ exemplifies the N=O stretching of nitro groups of seed extract[10]. FTIR studies confirmed that the carbonyl groups from the

amino acid residues and proteins had the stronger ability to bind metal and hence preventing the agglomeration. This suggests that the biological molecules could possibly perform dual functions of formation and stabilization of silver nanoparticles in the aqueous medium. The presence of reducing sugars in the solution could be responsible for the reduction of metal ions and formation of the corresponding metal nanoparticles[11]. It is also possible that the terpenoids play a role in reduction of metal ions by oxidation of aldehydic groups in the molecules to carboxylic acids.

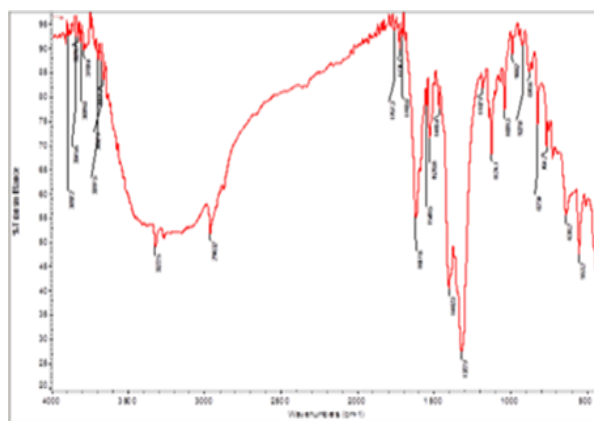


Fig 3: IR spectrum of Silver nanoparticles

3.3. SEM Study

Scanning electron microscope is one of the powerful tools to identify the morphology, size and shape of the nanoparticles. The silver nanoparticles synthesized by the *Piper nigrum* are predominantly spherical in shape (**Fig. 4**). The formation of silver nanoparticles as well as their morphological dimensions in the SEM study demonstrated that the average size was from 35-55 nm with inter-particle distance and spherical in shape. It was due to the interactions of hydrogen bond and electrostatic interactions between the bioorganic capping molecules bound to the AgNP's. The nanoparticles were not in direct contact even within the aggregates, indicating stabilization of the nanoparticles by a capping agent[12].

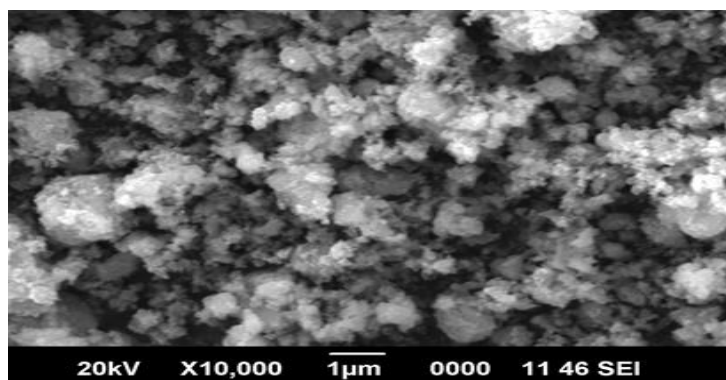


Fig 4. SEM image of Silver nanoparticles

3.4. XRD Analysis

The XRD spectra are used to confirm the crystalline nature of the silver nanoparticles synthesized by using *Piper nigrum* seed and the pattern is exhibited in **Fig. 5**. The spectra of

XRD clearly indicate that the silver nanoparticles are crystalline in nature. The Bragg reflections of silver nanoparticles are observed at values of 38.07° , 44.2° , 64.4° , and 77.5° for *Piper nigrum* seed. These reflections correspond to the lattice planes (1 1 1), (2 0 0), (2 2 0), and (3 1 1) which were indexed for fcc silver. The Bragg peaks observed are compared with pure crystalline silver published by Joint Committee on Powder Diffraction Standards [13]. The average size of the silver nanoparticle was estimated using the Debye Scherrer equation,

$$D = 0.94\lambda / \beta \cos\theta$$

Where D is the average particle size, λ is the X-ray wavelength ($1.5406 \text{ \AA}$), β is the full width at half maximum of the peak (FWHM), θ is the diffraction angle. The average size of the silver nanoparticle synthesized from the seed extract of *Piper nigrum* is around 27 nm.

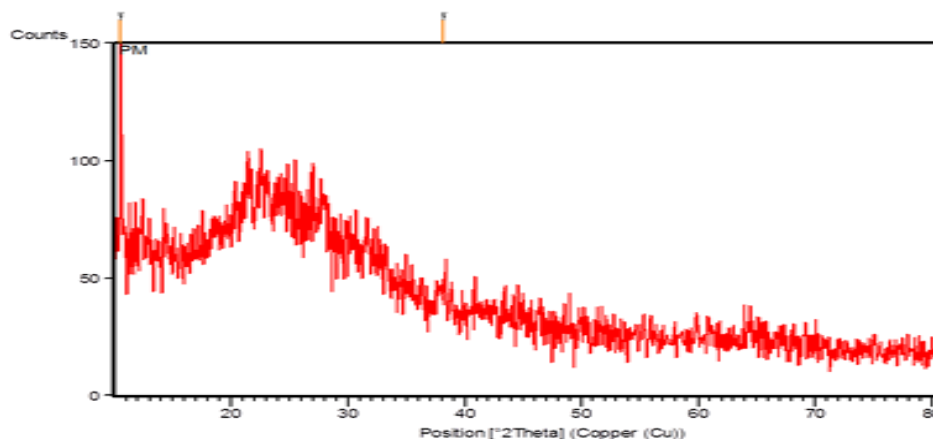


Fig 5. XRD pattern of Silver nanoparticles

3.5. Antimicrobial activity

Silver nanoparticles synthesized using plant extracts have been used for analysing their antimicrobial activities against different microbes. The inhibitory action of silver on bacterial cells is related to the strong interaction of silver with thiol groups present in key respiratory enzymes in bacteria, whereas nano crystalline silver shows the most effective inhibitory action with a rapid inhibition rate[14]. In the present study, the antimicrobial effects of the bio-synthesized silver nanoparticles from *Piper nigrum* extract was successfully investigated. In order for silver to have any antimicrobial properties, silver must be in its ionized form. Based on the zone of inhibition produced, synthesized silver nanoparticles prove to exhibit good antimicrobial activity against the bacterial and fungal strains such as *Klebsiella* sps, *Pseudomonas aeruginosa*, *Candida albicans*, *Aspergillus flavus* and *Aspergillus oryzae*. On the other hand, control and plant extract did not exhibit much antimicrobial activity.

4. Conclusion

A simple green synthesis of stable silver nanoparticles using *Piper nigrum* seed extract at room temperature is reported in this study. Synthesis was found to be efficient in terms of reaction time as well as stability of the synthesized nanoparticles which exclude external stabilizers/reducing agents. It proves to be an eco-friendly, rapid green approach for the synthesis providing a cost effective and an efficient way for the synthesis of silver nanoparticles. The synthesised silver nanoparticles showed efficient antimicrobial activities against various microbes and thus has a potential to use in biomedical applications.

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Comparison of Preliminary Phytochemical Screening of Male and Female Plant Parts of *Carica Papaya* L.

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ABSTRACT

Every part of *Carica papaya* is of economic value and its use ranges from nutritional to medicinal. phytochemical screening of leaf, flower and petiole of male and female *Carica papaya* L. has been carried out in the study. All the tested parts show the presence of phytochemicals, but it's exceptionally high in petiole of male and female plant. From the study it is concluded that it's not just leaves but all the parts show the presence of phytochemical substances.

Key words: *Carica papaya*, terpenoids, flavonoids, tannins, flavonoids, petiole, benzene

Introduction

Carica papaya L., is a herbaceous plant with prominent leaves (20-60 cm long), and is a member of the Caricaceae family, indigenous to the tropical region of Mexico, Central America and Northern South America. *C. papaya* is distributed throughout the tropics and subtropics where it is extensively cultivated. Papaya was introduced to India in the 16th century and was naturalized quickly. It is a fast growing and heavy yielding crop and is grown both commercially and in home gardens. Papaya has a rather complicated means of reproduction. The plants may be male, hermaphrodite or female. The male trees are not very common. Hermaphrodite trees (flowers with male and female parts) are the commercial standard plants that produce pear shaped fruit. These plants are self pollinated [1]. Papaya is mainly cultivated for its edible fresh fruit; it is also used in the preparation of drinks, jams, candies and dried fruit. Biochemically, its leaves and fruits produce several proteins and alkaloids with important medical and industrial application. The latex of green fruits contains a proteolytic enzyme, papain, used in food, beverage and pharmaceutical industries.

Materials and Methods

For the present study, leaves, petiole and flowers of male and female plants were collected from Elluvilai, Marungoor, Colachel, Pallam of Kanyakumari district and Holy Cross College Campus, Nagercoil. Collected plants were identified with the help of Flora of Presidency of Madras [2]. The materials collected were air dried at room temperature for nearly 2-3 weeks. The dried plant materials were ground into coarse powder.

Preparation of Plant Extract

Each powdered plant materials were extracted using solvents of increasing polarity such as Benzene, Chloroform and Methanol (10gm/25ml). This sequence of solvents allowed leaching of all compounds based on the polarity [3]. After a few days of regular stirring, the macerate was filtered through Whatman No.1 filter paper and the extract was concentrated. The concentrated extracts were stored in dark bottles in cool dry place.

Preliminary Phytochemical Test

The crude extracts were subjected to various phytochemical analyses[4] such as alkaloids, tannins, flavanoids, steroids, saponins and terpenoids.

Result and Discussion

Preliminary phytochemical screening

For phytochemical analyses, concentrated extracts of leaf, flower and petiole of male and female *Carica papaya* L. were taken using Methanol, Benzene and Chloroform solvents. The extracts were tested for the presence of alkaloids, terpenoids, saponins, flavonoids, phenols, steroids and tannins. The results were tabulated in Table-1, 2 and 3.

Table.1: Preliminary Phytochemical Analysis Using Chloroform Extract

Plant	Conditions	Phenolic Compounds	Alkaloids	Tannins	Flavanoids	Steroids	Saponins	Terpenoids
Male	flower	++	—	—	—	+	++	+
	petiole	++	—	—	++	++	++	—
	leaf	++	—	—	++	++	—	+
Female	flower	++	—	—	-	—	—	-
	petiole	+	—	—	+	++	+	++
	leaf	++	—	—	—	—	—	-

Table.2: Preliminary Phytochemical Analysis Using Methanol extract

Plant	Conditions	Phenolic Compounds	Alkaloids	Tannins	Flavanoids	Steroids	Saponins	Terpenoids
Male	flower	+	++	++	++	++	—	+
	petiole	++	+	—	—	++	++	++
	leaf	++	++	—	—	+	+	++
Female	flower	++	++	++	++	—	—	—
	petiole	+	+	—	—	—	—	—
	leaf	++	++	—	—	—	++	+

Table.3: Preliminary Phytochemical Analysis Using Benzene Extract

Plant	Condition	Phenolic Compounds	Alkaloids	Tannins	Flavonoids	Steroids	Saponins	Terpenoids
Male	flower	—	—	++	+	+	++	—
	petiole	—	—	+	+	++	++	++
	leaf	++	+	++	—	++	—	+
Female	flower	++	+	+	++	—	—	—
	petiole	+	+	++	++	++	+	++
	leaf	++	++	+	—	—	—	-

The presence of saponins supports the fact that male papaya parts have cytotoxic effects such as permealization of the intestine [5]. Saponins have a close relationship with sex hormones like oxytocin. Another important action of saponins is their expectorant action through the stimulation of a reflux of the upper digestive tract.

Alkaloids are the most efficient therapeutically significant plant substance. Pure isolated alkaloids and the synthetic derivatives are used as basic medicinal agents because of their analgesic, antispasmodic and bacterial properties [6]. They show marked physiological effects when administered to animals. The presence of alkaloids in the leaves shows that these plants can be used as effective anti-malarial drugs [7].

Comparison of Phytochemicals present in Male and Female Plant Parts of Papaya

Based on the limited effect of activity of the other extracts compared with the benzene extracts, it suggests that the active component is more soluble in benzene than in other solvents. The better efficacy of the benzene extract as against the aqueous extract may be because different solvents have different polarities, hence different degrees of solubility for the various phytoconstituents [8,9].

In the chloroform extract, the male flower shows the maximum number of phytochemicals (Table.1). In the methanol extract, alkaloids and tannins are all together absent. The male plant part especially petiole shows the presence of phenolic compounds, flavonoids, steroids and saponins. In the female parts, except in the petiole all the other parts have only phenolic compounds (Table. 2).

In the benzene extract, the female petiole shows the presence of all 8 phytochemicals tested, followed by the male petiole and the leaves with 6 phytochemicals and the least with 3 phytochemicals in the female leaf (Table. 3).

Except in the chloroform extract of the female petiole of papaya, all the other petiole extracts show the presence of maximum number of phytochemicals. This finding can be

attested to the work of [10] who also reported similar finding and also stated the effect of these phytochemical as a good antimicrobial agent on different test organisms.

Conclusion

This study has shown the phytochemical screening of leaf, flower, petiole of male and female *Carica papaya* L. This plant is used in herbal medicine, as a rich source of phytochemicals, coupled with the presence of the essential vitamins and minerals. *Carica papaya* leaves can be seen as a potential source of useful food and drug items. But importance should be given to the other parts like petiole and flowers of the plant as they contain more phytochemicals than the leaves. The presence of alkaloids in them explains the reason why it is being effectively used as an anti-malaria and anti-dengue agent.

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Biofilm formation by *Pseudomonas aeruginosa* B01 isolated from the waste water

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ABSTRACT

A few groups of bacteria produce extracellular polysaccharides, resulting in the formation of biofilm. In this study, the extracellular polysaccharide producing bacteria *Pseudomonas aeruginosa* B01 was isolated from municipal waste water. *Pseudomonas aeruginosa* B01 was able to form biofilm in microtiter plate and the biofilm formation was detected after crystal violet staining.

Key words: *Pseudomonas aeruginosa*, polysaccharides, biofilm

Introduction

Biofilm formation is an endless cycle in which organized communities of bacteria are encased in a matrix of extracellular polymeric substances (EPSs) that hold microbial cells together to a surface [1]. These are thought to be determinant in 65–80% of all microbial infections [2]. In this microscopic world, biofilms are metaphorically called a “city of microbes” [3] with EPS, which represents 85% of total biofilm biomass, as “house of the biofilm cells”. EPS is composed mainly of biomolecules, exopolysaccharides, extracellular DNA (eDNA), and polypeptides that form a highly hydrated polar mixture that contributes to the overall structural scaffold and architecture of the biofilm [4].

Pseudomonas aeruginosa produces at least three polysaccharides (alginate, Pel, and Psl) that are determinant for the stability of the biofilm structure [5]. Mucoid and nonmucoid *P. aeruginosa* strains differ by the qualitative composition of their polysaccharides in the biofilm matrix, predominantly alginate or Psl/Pel [6]. Alginate, a linear unbranched polymer composed of D-mannuronic acid and L-guluronic acid, contributes to the structural stability and protection of biofilms as well as to the retention of water and nutrients [7]. The Pel polysaccharide is mainly a glucose-rich matrix material with still unclarified composition while Psl comprises a repeating pentasaccharide consisting of D-mannose, L-rhamnose, and D-glucose. Pel and Psl can serve as a primary structure scaffold for biofilm development and are involved at early stages of biofilm formation [8,9,10].

2 Materials and methods

2.1 Isolation of EPS producing *Pseudomonas aeruginosa*

Isolation of EPS producing bacteria was carried out from the municipal waste water. One ml of sewage water was added in physiological saline (0.9% NaCl) and serial dilutions were made up to 10^{-7} and incubated in nutrient agar medium. Bacteria that produce EPS characterized by colonies of bacteria that form a very thick slime subsequently were selected and purified by streaking the four quadrants to obtain single colonies [11].

2.2 Morphological and biochemical characterization of EPS producing bacteria

Based on the morphological and biochemical tests, the bacterial isolates were identified. Gram staining, motility test, indole production, starch-, gelatin-, casein- hydrolysis, hydrogen sulphide production, urease, citrate utilization, nitrate reduction, catalase test, oxidase and oxidase fermentation tests were carried out [12].

2.3 Biofilm assay

This experiment was performed by crystal-violet adhesion assays. In this assay, 18 h culture of *P. aeruginosa* B01 was inoculated with newly prepared nutrient broth medium (1:100) and was allowed to grow for 40 h in a microtitre plate. The bacterial growth was monitored by analyzing the culture at 600 nm. The medium was discarded and rinsed with double distilled water and the bound cells are stained with crystal violet stain. The dye was dissolved in absolute ethanol and absorbance was determined using a microtitre plate reader at 540 nm against blank [13].

Result and Discussion

Biofilm producing bacteria are responsible for many recalcitrant infections and are notoriously difficult to eradicate. They exhibit resistance to antibiotics by various methods like restricted penetration of antibiotic into biofilms, decreased growth rate and expression of resistant genes. There are various methods for biofilm detection. The tested *P. aeruginosa* B01 was able to form biofilm in microtiter plate and the biofilm formation was detected after crystal violet staining (Fig. 2)

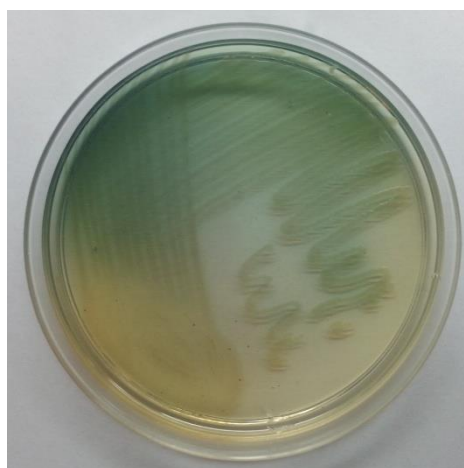


Fig 1. Growth of *P. aeruginosa* B01 on nutrient agar plates. Creamy appearance of colonies indicates EPS secretion.

The most common mode of bacterial growth in nature is the formation on surfaces of organized biofilm communities held together by a matrix composed of exopolysaccharides (EPS) [14]. The EPS matrix has been implicated in maintaining the individual cells and communities of a biofilm in close proximity and in providing a unique micro environmental niche [15]. Much of our understanding of biofilms comes from studies of the opportunistic pathogen *Pseudomonas aeruginosa*, which causes chronic lung infection and is the major cause of morbidity and mortality in patients with cystic fibrosis (CF) [16]. *P. aeruginosa* strains, isolated from the lungs of patients, especially with advanced stages of disease, are

distinctive because about 85% have a mucoid colony morphology [17]. In contrast, only 1% of strains isolated from other sites of infection are mucoid [18]. These observations suggest that mucoid *P. aeruginosa* cells have a distinct survival advantage in the CF lung environment. This mucoid phenotype is indicative of the overproduction of the EPS alginate, an O-acetylated linear polymer of D-mannuronate and L-guluronate residues [19]. Crystal violet staining is a well known method to find the biofilm formation of any bacterial isolate; however, it also stains negatively charged cellular components other than biofilm [20] such as exopolysaccharide present on the surface of sessile bacteria in the culture.

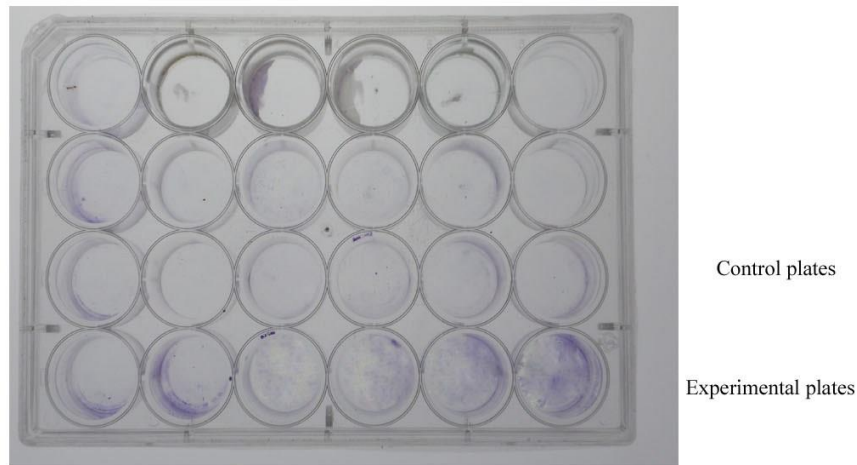


Fig. 2 Biofilm formation by *P. aeruginosa* strain B01 (wells stained with crystal violet indicates biofilm formation).

The structure of biofilms is increasingly recognized as a crucial factor in the persistence of several infections. Chronic infections have been remarkably demonstrated to involve biofilm production especially those infections associated with indwelling devices such as catheters and prostheses [21]. The ability of the biofilm to contribute to bacterial protection is widely different among microbes. Biofilms not only contribute to the resistance mechanisms against broad spectrum antibiotics but also against host immune systems. The antibiotic susceptibility of biofilm-producing bacteria is reduced because of a restricted antibiotic penetration, an adaptive response and the presence of persisting cells [22]. The formation of a biofilm is a multistage process that is initiated by the surface attachment of planktonic bacteria to form a monolayer followed by aggregation leading to the formation of microcolonies, maturation to form mushroom-shaped structures and dispersal [21]. The biofilm formation is accompanied by drastic changes in gene regulation. The formation of microcolonies in *P. aeruginosa* has been attributed to many factors. These include type IV pili, flagella, free DNA, alginate, Pel and Psl polysaccharides. Even if one of the factors is not functioning, the biofilm is still able to perform well [23].

Pseudomonas aeruginosa is well known for its genetic diversity. It has a relatively large genome (6.3 Mb) for a bacterium and contains a large number of genes involved in different metabolic activities, which might contribute to the environmental adaptability of this bacterium. Its ability to grow in the absence of oxygen using nitrates or other forms of oxidized nitrogen as electron acceptors is an important example of *P. aeruginosa*'s anaerobic

growth capacity [24], which opens up a wide range of environments in which *P. aeruginosa* can grow. Such anaerobic environments are present in a mature biofilm in which different nutrient gradients and differential physical properties appear. Previous reports have highlighted the oxygen concentration heterogeneity in biofilms using microelectrodes, and have described the oxygen diffusion profiles in continuous biofilms [25]. The oxygen concentration throughout the biofilm is thus a crucial parameter for bacterial growth in a mature biofilm and strongly defines its morphogenesis and final structure [26]. Metabolites and oxygen easily diffuse in the outer layers of the biofilm; however, the free oxygen concentration becomes reduced in lower layers, resulting in strict anaerobic conditions in the depths of the mature biofilm. The three ribonucleotide reductase classes encoded by *P. aeruginosa* (class Ia, encoded in *nrdA* and *nrdB*; class II, encoded in *nrdJa* and *nrdJb*; and class III, encoded in *nrdD* and *nrdG*) are likely to increase the capacity of this bacterium to grow in the different environments generated throughout biofilms [27].

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Antibiotic Susceptibility Profiles of *Escherichia Coli* and *Klebsiella Sps* in Urinary Tract Infected Patients

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ABSTRACT

Urinary tract infection (UTI) is the most common condition causing individuals to seek medical consultation. It is considered as one of the major health problems next to respiratory infections. *Escherichia coli* and *Klebsiella* spp are the most important pathogens causing UTI. These infections are treated with antimicrobial drugs. But, nowadays, the ready availability of broad spectrum antibiotics has changed the prescribing habit of physicians treating UTI, which leads to enhanced resistance. So, the present investigation was focused to analyse the profile of antibiotic resistance towards *E.coli* and *Klebsiella*, as it is in emergency to ensure the provision of safe and effective empiric therapy.

Key words: Urinary tract infections, Antibiotic sensitivity test, *Escherichia coli*, *Klebsiella*, Multidrug resistance.

Introduction

Enterobacteriaceae are the most common cause of UTIs in both community and healthcare settings [1]. UTI is a very common infection both in the community and hospital patients and ranks high amongst the most common reasons that compel a patient to seek medical attention. UTI is the most common of all infections and can occur at any time in the life of an individual. More than 25% of the women experience some form of UTI at least once during their life time.

Escherichia coli remained the most common causative agent of uncomplicated UTI for many years with 75 – 90% causes of UTI infections. *Klebsiella pneumonia* accounts for second highest organism [2]. The other gram negative pathogens causing UTI are *Proteus mirabilis*, *Pseudomonas aeruginosa*, however, *Enterococci* and coagulase negative *Staphylococcus* are the most frequently encountered gram positive organisms in UTI [3].

Antibiotic resistance is a specific type of drug resistance when a microorganism has the ability of withstanding the effects of antibiotics [2]. Multiple antimicrobial resistances in gram – negative organisms are a recognized problem with urinary tract infections [4]. It is well known that the mechanism of antimicrobial resistance could happen by enzymatic inactivation, altered receptors or by altered antibiotic transport [5]. They also rise by mutations in genes for common plasmid mediated beta lactamases after the configuration of enzyme. Although the mutational acquisition has an impact on the multi drug resistance development, the greatest concern is the mobile genetic resistance determinants as plasmids, transposons and integrons [6]. Selection of empiric antibiotics for urinary tract infections has become more challenging because of the increasing rates of multidrug resistant Enterobacteriaceae (MDRE) infections [7].

So, the present study was aimed to determine the type of pathogens responsible for UTIs and their susceptibility patterns for MDR urinary tract infections among the patients.

Methodology

Sample collection and identification of isolates

A total of 52 urine samples were collected and analysed in this study. A loopful of well mixed uncentrifuged urine was streaked onto the surface of Nutrient agar, Blood agar and Macconkey agar [8]. The plates were incubated aerobically at 37°C for 24 hours and counts were expressed in colony forming units (CFU) per milliliter (mL). A count of $\geq 10^5$ CFU /mL was considered as significant bacteriuria. The organisms grown on different agar plates were identified based on conventional bacteriological techniques, which include staining, biochemical tests and special tests [9].

Antibiotic sensitivity

Antibiotic susceptibility testing was performed by Kirby – Bauer disc diffusion method [10]. Each clinical isolates were swabbed over the entire surface of Muller Hinton agar medium. Then, different antibiotic discs like Ampicillin (20mcg), Cotrimoxazole (25mcg), Piperacillin (100 mcg), Gentamycin (10 mcg), Amikacin (30 mcg), Cefotaxime (30 mcg), Carbenicillin (100 mcg), Ceftizoxime (30 mcg), Tetracycline (30 mcg) and Ofloxacin (5 mcg) were placed on the agar surface and incubated at 37°C for 24 – 48 hrs. The zone of inhibition was measured and compared to that of Kirby – Bauer Chart. The highest concentration of an antibiotic showing growth was taken as the resistance level of the strain for that particular antibiotic.

Results and Discussion

A total of 52 urine samples were included in the present study. Urine samples of patients of all age groups and both sexes were processed. Among that, 19 patients (37%) were sterile, 21 patients (40%) showed significant growth of $\geq 10^5$ CFU /mL, 7 patients (13%) showed insignificant growth and 5 patients (10%) were contaminated with microbes. The clinical isolates grown in different media were also observed. With staining reaction and biochemical characterization, the organisms were identified and tabulated in Table 1. The identification of causative organism and its susceptibility to antimicrobials is important, so that proper drug is chosen to treat UTI [11]. Of these 21 positive urine samples ($\geq 10^5$ CFU /mL), 7 samples (33%) were identified as *E.coli*, 5 samples (24%) as *Klebsiella* spp, 3 samples (14%) as *Proteus*, 3 samples (14%) as *Pseudomonas*, 2 samples (10%) as *Enterobacter* and 1 sample (5%) as *Staphylococcus aureus*. The organisms responsible for UTI include *Escherichia coli*, *Proteus mirabilis*, *Klebsiella pneumoniae*, *Staphylococcus* and *Pseudomonas* [12]. Previous studies have also described that *Klebsiella* is one of the most frequent etiological agents causing community and hospital acquired UTIs [13].

Table 1: Profile of uropathogens showing significant growth in cultures (N = 21)

S.No	Isolated Organism	Total Number	Percentage (%)
1	<i>Escherichia coli</i>	7	33
2	<i>Klebsiella</i> spp	5	24
3	<i>Proteus</i>	3	14
4	<i>Pseudomonas</i>	3	14
5	<i>Enterobacter</i>	2	10
6	<i>Staphylococcus aureus</i>	1	5

Treatment of UTI is becoming a challenge due to the development of resistance in bacteria against many of the drugs that are available in market [14]. As *E.coli* and *Klebsiella* spp were predominantly found in urine samples, the antibiotic sensitivity tests were carried out in these two strains. Antibiotic sensitivity testing of confirmed *E.coli* and *Klebsiella* spp clinical isolates was done on Mueller – Hinton agar plates. On the basis of resistance to antibiotic, strains were categorized into three groups i.e. susceptible (S), resistant (R) and intermediate (I). The resistance pattern at various concentrations against different antibiotics was analysed and the antibiotic drug resistance profile was depicted in Table 2. In this study, all the clinical isolates showed a high degree of resistant profile against the antibiotics used (Ampicillin, Cotrimoxazole, Tetracycline, Piperacillin, Gentamycin, Amikacin, Cefotaxime, Carbenicillin, Ceftizoxime, Ofloxacin) for analysis. This result was in accordance with the observation about the prevalence of antimicrobial drug resistance of *Klebsiella pneumoniae* in India [15]. They suggested that 60% strains were resistant to chloramphenicol and tetracycline, 28 to 76% strains were resistant to cephalosporins (ceftizoxime and cefotaxime) and 80% showed resistance for beta- lactam, fluoroquinolones and quinolones. Twenty one antibiotics were tested and 53% were resistant to atleast 10 of them [16]. Resistance of aminoglycosides and chloramphenicol are mediated by β -lactamases, which are unaffected by exposure of the bacterium to the potential drugs [17]. The resistance to antimicrobial agents can readily be transferred among bacteria by transmissible elements[18,19].

Table 2 : Antibiotic susceptibility pattern of *E.coli* and *Klebsiella* spp

Antibiotics	<i>Escherichia coli</i> (n=7)			<i>Klebsiella</i> spp (n=5)		
	Resistant (R)[n(%)]	Susceptible (S)][n(%)]	Intermediate (I)][n(%)]	Resistant (R) [n(%)]	Susceptible (S)[n(%)]	Intermediate (I)][n(%)]
Ampicillin	7 (100)	-	-	4 (80)	1 (20)	-
Cotrimoxazole	6 (85.7)	1 (14.28)	-	5 (100)	-	-
Piperacillin	5 (71.42)	2 (28.5)	-	4 (80)	1(20)	-
Gentamycin	5 (71.42)	1 (14.28)	1 (14.28)	4 (80)	1 (20)	-
Amikacin	6 (85.7)	-	1 (14.28)	4 (80)	1 (20)	-
Cefotaxime	7(100)	-	-	5 (100)	-	-
Carbenicillin	4 (57.14)	2 (28.5)	-	5 (100)	-	-
Ceftizoxime	4 (57.14)	2 (28.5)	-	3 (60)	1 (20)	1 (20)
Tetracycline	6 (85.7)	1 (14.28)	-	3 (60)	1 (20)	1 (20)
Ofloxacin	5 (71.42)	1 (14.28)	-	4 (80)	1 (20)	-

As the clinical isolates showed high resistant towards the antibiotics, there is a need for development of new antimicrobial drugs. The regular monitoring of antibiotic susceptibility pattern and selection of a definite antimicrobial agent may be helpful for reducing the incidence of UTI infections.

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Prevalence of Bacterial Diversity in Manakudi Mangrove Soil

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ABSTRACT

Mangroves are complex and dynamic ecosystems varying in salinity, water level and nutrient availability. Mangroves provide a unique ecological niche to different microbes which play various roles in nutrient recycling as well as various environmental activities. Unreveiling the diversity and microbial communities in mangrove environments, it represents a better understanding of their role in ecosystem functioning. In this study, mangrove soil was collected and fifteen bacterial genera were identified based on their morphological, biochemical and cultural characteristics.

Keywords: Mangrove ecosystem, Microorganisms, Bacterial isolates, Identification of bacteria.

Introduction

Mangrove forests are among the worlds most productive ecosystems. They are adapted to survive in harsh conditions such as high salinity, high temperature, low oxygen, extreme tides, muddy and anaerobic soil and forceful winds [1]. The worlds mangroves span over 30 countries with a total area of 99,300 sq.km. The largest mangrove area occurs in Indonesia (30%), Brazil (10%), Australia (8%), India and Nigeria (75 each) [2].

Marine environments are largely untapped source for the isolation of new microorganisms with potentiality to produce active secondary metabolites [3]. Microorganisms form the integral part of the mangrove ecosystem [4]. They help in recycling and transformation of various nutrients and thus make the mangrove ecosystem more productive. The microorganisms of mangrove are essential in the productivity, conservation and rehabilitation of mangrove ecosystem [5].

The importance of microbially generated detritus in mangrove areas that act as the major substrate for bacterial growth in mangrove ecosystem was outlined in a conceptual model [6]. Mangrove ecosystem shows diversity of microbes such as bacteria, fungi, actinomycetes etc [7]. Bacteria includes various type of Nitrogen fixing bacteria, phosphate solubilising bacteria, sulphate reducing bacteria, photosynthetic anoxygenic bacteria, methanogenic bacteria, enzyme producing bacteria etc [8]. So, the main objective of this study was to understand the prevalence of bacterial genera found in mangrove soil.

Methodology

Sample collection

Soil samples were collected from Manakudi mangrove soil in sterile petriplates from three different mangrove locations of Manakudi, Kanyakumari District. Soil was collected from 4cm deep using a sterile spatula. The soil sample was collected in sterile polythene bags from 1-2 cm, and stored at 4°C till further processing.

Enumeration of bacteria [9]

The soil samples were serially diluted to tenfold with sterilized 50% seawater and were plated with Nutrient Agar. For plating, 1 ml of serially diluted samples of soil was pipetted out into sterile petri dish. Sterile media was then poured into petridish aseptically and swirled for thorough mixing. After solidification, the plates were incubated at $28 \pm 2^\circ\text{C}$. All the determinations were carried out in duplicates. After incubation, the colonies were counted. The counts were expressed in colony forming units (cfu) per gram of the sample.

Identification of microbes [10]

Spread plate technique on Nutrient agar plates were used for isolation of microorganisms [9]. A total of fifteen isolates were grown on Nutrient agar plates. The organisms were identified by inoculating them in suitable medium for colony morphological identification. Later, biochemical tests were performed for detection.

Results and Discussion

In the present investigation, the bacterial isolates of 3 sites were enumerated and fifteen different morphological features of isolates were determined. All the fifteen isolates exhibit good growth characters and morphological features. These isolates were small, round, white, mucoid, irregular, translucent colonies. In the marine environment, 90% of bacteria are Gram negative with different characteristics [11] and the Gram negative cell wall is better adapted for survival in the marine environment but contradictory utmost of Gram positive bacteria in mangrove soil. The enumeration of the isolates in different sites were expressed in cfu/gm and tabulated in Table 1.

Table 1: Enumeration of different isolates in site 1, 2 and 3

Isolates	Site 1	Site 2	Site 3
	Colony forming units (cfu/gm)	Colony forming units (cfu/gm)	Colony forming units (cfu/gm)
1	179×10^3	-	154×10^3
2	40×10^3	79×10^3	102×10^3
3	129×10^3	106×10^3	95×10^3
4	-	111×10^3	121×10^3
5	116×10^3	-	108×10^3
6	-	102×10^3	94×10^3
7	120×10^3	89×10^3	98×10^3
8	-	122×10^3	131×10^3
9	123×10^3	-	-
10	89×10^3	85×10^3	-
11	107×10^3	-	-
12	87×10^3	123×10^3	102×10^3
13	138×10^3	76×10^3	-
14	-	-	78×10^3
15	23×10^3	98×10^3	-

A similar trend has been recorded with *Rhizophora* zone, *Azotobacter* count ranges from $130 - 134 \times 10^3$ cfu/gm and in the *Avicennia* zone, *Azotobacter* counts varies from $55 - 150 \times 10^3$ cfu/gm [2].

In this study, fifteen bacterial genera namely *Pseudomonas* sps, *Staphylococcus* sps, *Streptococcus* sps, *Bacillus* sps, *Escherichia coli*, *Micrococcus* sps, *Enterobacter*, *Azotobacter*, *Klebsiella* sps, *Vibrio* sps, *Aeromonas* sps, *Shigella* sps, *Acetobacter* sps, *Aerococcus* sps and *Enterococcus* sps were identified from the mangrove soil and tabulated in Table 2. Similarly, twenty seven different bacterial colonies were isolated from Karankadu mangrove soil [2].

Table 2: List of Microorganisms in different sites

Isolates	Microorganisms	Site 1	Site 2	Site 3
1	<i>Bacillus</i> sps	P	A	P
2	<i>Pseudomonas</i> sps	P	P	A
3	<i>Streptococcus</i> sps	P	P	P
4	<i>Staphylococcus</i> sps	A	P	A
5	<i>Enterobacters</i> sps	P	A	P
6	<i>E.coli</i>	A	P	A
7	<i>Azotobacters</i> sps	P	P	P
8	<i>Micrococcus</i> sps	A	P	P
9	<i>Klebsiella</i> sps	P	A	P
10	<i>Enterococci</i> sps	P	P	A
11	<i>Vibrio</i> sps	P	A	A
12	<i>Aeromonas</i> sps	P	P	P
13	<i>Shigella</i> sps	P	P	A
14	<i>Acetobacter</i> sps	A	A	P
15	<i>Aerococcus</i> sps	P	P	A

P – Present; A - Absent

Table 3: Identification of bacterial isolates

Biochemical tests	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Gram's Staining	G + rod	G- rod	G+ cocci	G+ cocci	G - rod	G - rod	G + rod	G + cocci	G - rod	G + cocci	G - rod	G - rod	G - rod	G - rod	G + cocci
Motility	+	+			+	+						+			
Spore staining	+														
Indole Production test								+				+			+
Methyl red test	+						+						+		+
Voges Proskauer test	+				+	+		+	+	+	+	+			
Citrate utilization test	+	+	+	+	+		+		+			+			+
Catalase test	+	+		+	+		+	+	+		+	+	+	+	+
Oxidase	+	+					+				+	+			+
Urease				+	+		+	+	+						+
Nitrate reduction		+				+								+	
TSI Alkaline (Ak), Acid (A), Gas (G)]	Ak,G	-	Ak	Ak	G	A,G	Ak,A	Ak	A,G	G	A,G	-	-	Ak,G	Ak
Carb ohyd rate ferm entat ion	Glucose (G)	+	+	+	+	+	+		+	+	+	+	-	+	+
	Lactose (L)	+		+	+	+	+		+	+	+	-			+
	Sucrose (S)	+		+	+	-	+	+	+	+	+	+			+

Two genera *Staphylococcus* spp and *Streptococcus* spp grew on Nutrient agar and did not grow on Mangrove litter agar [12]. This shows that *Streptomyces*, *Micrococcus*, *Pseudomonas* and *Bacillus* spp were original residence microbes of mangrove swamp soils, while *Staphylococcus* and *Streptococcus* are invaders and transmitted from surrounding environment [13]. The maximum bacterial colonies present in summer seasons were compared with pre-monsoon, monsoon and post-monsoon seasons. The predominant bacterial genera were namely *Micrococcus* spp., *Bacillus* spp., *Acetobacter* spp., *Pseudomonas* spp., *Streptococcus* spp., *Staphylococcus* spp., *Enterococcus* spp., *Sulfidobacillus* spp., *Escherichia coli*., *Aeromonas* spp., *Brevibacterium* spp., *Listeria* spp., *Azotobacter* spp., *Cellulomonas* spp., *Corynebacterium* spp., *Aerococcus* spp., *Klebsiella* spp., *Marinococcus* spp., *Enterobacter* spp., *Thiobacillus* spp., *Planococcus* spp and *Shigella* spp [2].

The present investigation clearly emphasized that mangrove soil constitute a good biological entity and hence requires conservation strategies for maintenance and productivity. Further studies are needed to identify the different microbial population with novel applications.

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Moult and lunar periodicity in a male brachyuran crab, *Metopograpsus messor* (Forskal)

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ABSTRACT

The present paper reports the existence of striking correlation between moulting and lunar periodicity in a male brachyuran crab, *Metopograpsus messor*. The male population of *M. messor* exhibits two seasons of peak moulting activity i.e., March and November. The field observations on alternate days and those from the laboratory animals revealed that the stages in moult males of *M. messor* are closely entrained with lunar cyclicity; setagenic events in the maxillipedal epipodite were taken as cues for characterizing the moult stages. Early premoult (D_0) commences two or three days after or prior to the new moon/full moon days. D_1 begins on the 3rd to 6th day after new moon/full moon, while stages D_3 and D_4 occur on the 6th to 9th and 10th to 12th days respectively. Present study further reveals that the correlation between molting and lunar periodicity is applicable to both the moult seasons alike.

Key words: *Metopograpsus messor*, crustaceans, brachyurans, lunar periodicity, moulting

1. Introduction

Moulting and reproduction in decapod crustaceans are seasonal events. Previous investigations suggest that the up- and down regulation of these major metabolic events is accomplished by the interplay of extrinsic as well as intrinsic principles [1]. Intrinsically, the hormones produced by the Y-organ (ecdysone) and the mandibular organ (methyl farnesoate) are known to stimulate molting and gonadal growth respectively, while the neuro-secretory cells of the eyestalks are suggested to exert an inhibitory or partially inhibitory influence on both the functions [2,3,4,5]. Further, there have been suggestions that the hormonal machinery of the organism in question could respond to extrinsic cues (such as temperature, salinity and rainfall for example) which in turn could play a pivotal role in the precise seasonal programming of all the major metabolic events [6,7,8,9,10,11].

Browsing through the literature, it is quite apparent that the investigations made thus far on the question of extrinsic influences on the seasonal programming of metabolic events have been mainly devoted to study the female population, possibly due to its direct impact on fecundity; evidently, studies on the regulation of the male individuals have been practically ignored. This lacuna in information has encouraged us to pursue the present study that demonstrates for the first time the influence of lunar periodicity in molting in males of the grapsid crab, *Metopograpsus messor* that inhabits the Manakudy estuary of South Tamil Nadu (India).

2. Materials and methods

The adult males of *M. messor* of carapace width 1.8 to 2.2 cm were collected from inter tidal region of Manakudy estuary (S. Tamil Nadu, India) during 2012 and 2013. The animals were collected for every alternate day for six months. The maxillipede was carefully removed with the help of a fine forceps and then examined microscopically. The sub-sequential changes in an epipodite of the crab have been used as cue to identify the moult stages [12]. Epidermal retraction and appearance of rudimentary setal grooves are discernible in D_1 stage (Fig 1). The onset of premoult and the setal grooves are prominent during D_2

(Fig 1). Setal articulation, setal clefts and the new cuticle are visible during D₃ stage (Fig 3) and setal tips become distinct and they are seen extruded out of the setal grooves at D₄ stage (Fig 4).

After the characterization of the moult stages, the crabs were reared in plastic cisterns and fed *ad lib* on clam meat and maintained in near natural conditions for further observations. For the purpose of evaluating the relation, if any, between lunar periodicity and moulting, collections and field observations were made on alternate days to assess the moult stages; samples of at least one maxilliped from one crab were collected for approximately six months (November to January).

3. Results

A total of 1864 male crabs of *M. messor* were sampled during the study period (2012 & 2013). The sampling revealed that moulting activity in *M. messor* is seasonal with two peak seasons i.e. March and November. Occurrence of moulting is minimal in June-August (Table 1 & Fig 5). The results of moulting activity of *M. messor* with reference to each day in the lunar cycle are represented in Table 2.

Interestingly, there exists striking synchrony with respect to the preparatory stages of moulting (and eventually, the exuviations proper) throughout the male population of *M. messor*. Signs of premoult initiation appear on the 3rd to 4th days prior or after the new moon/full moon day, evidenced by the apolysis appearing at the apical part of the maxilliped (Stage D₁ of premoult). Meanwhile, another set of crabs enters the late premoult stage (D₄) characterized as the new juvenile setae protruded from the setal groove. In ~ 29% of the instances, ecdysis proper (exuviations of the exoskeleton) occurs on the 3 or 4 days prior and after to the new moon/full moon. Field collections revealed that there is maximum incidence of moult in the first and second day after new moon/full moon days. We had also made follow-up observations on the moulted males of *M. messor*. This in turn had revealed that the post moult crabs attain intermoult stage within six days after exuviations.

It has further been observed that approximately 25-30% of the male population undergoes ecdysis on the first and second day of a new moon/full moon day (Table 2 and Fig 6a). Another set of 25-30% of the males shows signs of premoult initiation in the subsequent lunar cycle to eventuate into ecdysis within the next 15-16 days (i.e., within 1-3 days after or prior to the succeeding new moon/full moon days (Fig 6b).

Table 1: Percentage of moult in the males of *Metopograpsus messor*

Months	Premoult & post-moult	Intermoult
January	10.7	83.3
February	38.1	61.9
March	46.1	53.9
April	40.7	59.3
May	30.9	69.1
June	14.1	85.9
July	04.5	95.5
August	05.8	94.2
September	21.8	78.2
October	45.1	54.9
November	49.1	50.9
December	20.9	79.1

Table 2: Lunar rhythm in moultin the malesof *M. messor*

Date	Pre-moult (%)			Post-moult (%)		
	Early (D ₀ -D ₂)	Late (D ₃ -D ₄)	Total	Early	Middle	Total
○ 1	17.3	7.2	24.5	10.2	nil	10.2
2	19.1	10.2	29.3	15.8	nil	15.8
3	20.3	7.6	27.9	28.7	nil	28.7
4	nil	14.7	14.7	13.7	7.1	20.8
5	nil	nil	-	3.6	12.7	16.3
6	nil	nil	-	nil	24.8	24.8
7	nil	nil	-	nil	28.4	28.4
8	nil	nil	-	nil	17.8	17.8
9	nil	nil	-	nil	9.1	9.1
10	nil	nil	-	nil	nil	
11	nil	nil		nil	nil	
12	nil	nil	-	nil	nil	
13	3.5	nil	3.5	7.4	nil	7.4
14	16.5	7.2	23.7	10.6	nil	10.6
15	19.3	11.1	30.4	18.7	nil	18.7
● 16	21.4	9.6	31.0	21.1	nil	21.1
17	21.7	7.8	29.5	16.4	2.7	19.1.
18	19.4	nil	19.4	4.5	3.0	7.5
19	7.15	nil	7.15	3.	7.6	10.6
20	nil	nil	-	nil	9.1	9.1
21	nil	nil	-	nil	15.6	15.6
22	nil	nil	-	nil	18.1	18.1
23	nil	nil	-	nil	22.3	22.3
24	nil	nil	-	nil	8.6	8.6
25	nil	nil	-	nil	nil	-
26	nil	nil	-	nil	nil	-
27	nil	nil	-	nil	nil	-
28	nil	nil	-	11.2	nil	11.2
29	12.3	3.2	15.2	10.2	nil	10.2
30	11.0	13.2	24.2	25.8	nil	25.8
31	16.3	15.8	32.1	28.7	nil	28.7

○ Full Moon day

● New Moon day

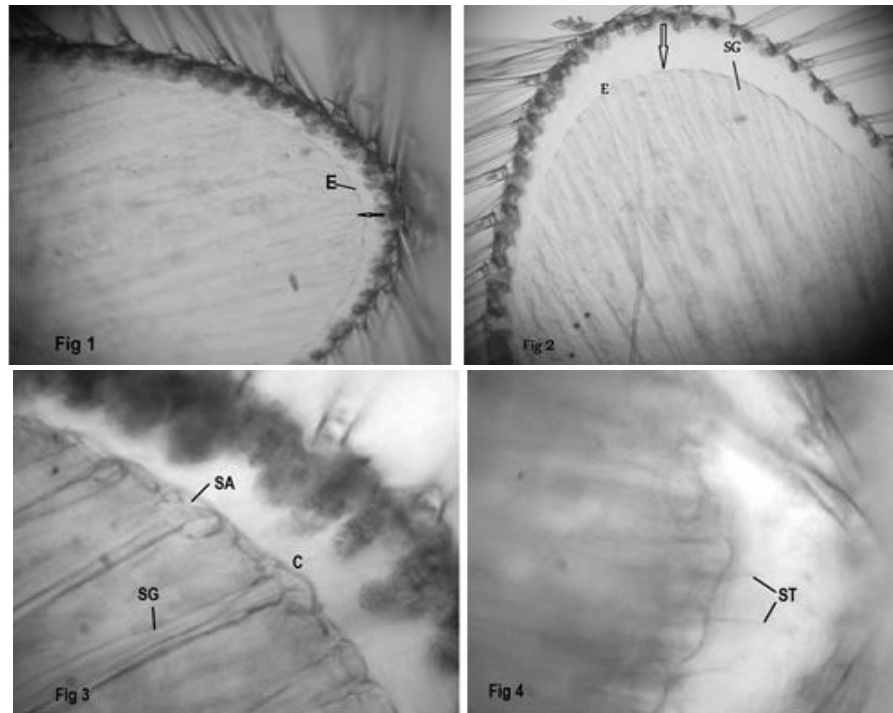
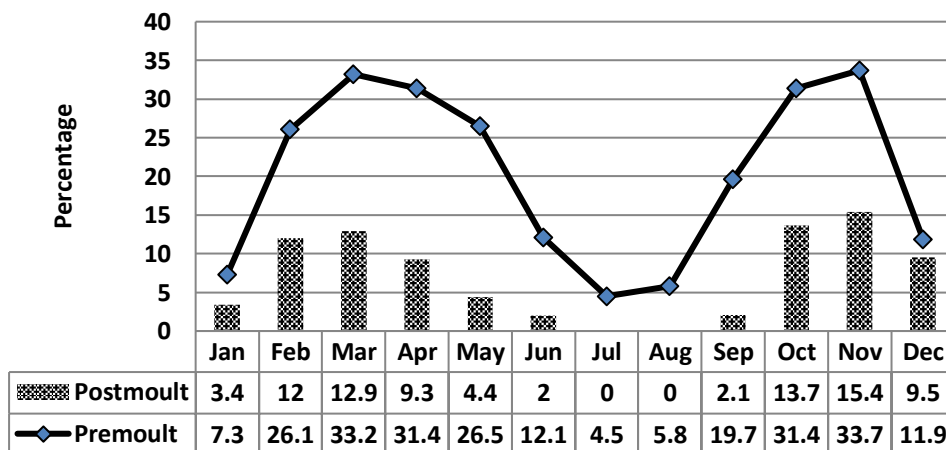


Fig 1 – 4. The epipodite of the maxilliped of *M. messor* depicting moult stages. 1- D1 stage with retracted epidermis (E) (arrow); 2 – appearance of setal grooves (SG); 3 – Visibility of setal articulation (SA) and the new cuticle (C); 4 – protrusion of new setal tips (ST)

Fig 5: Percentage of premoult and postmoult crabs of *M. messor* during 2012



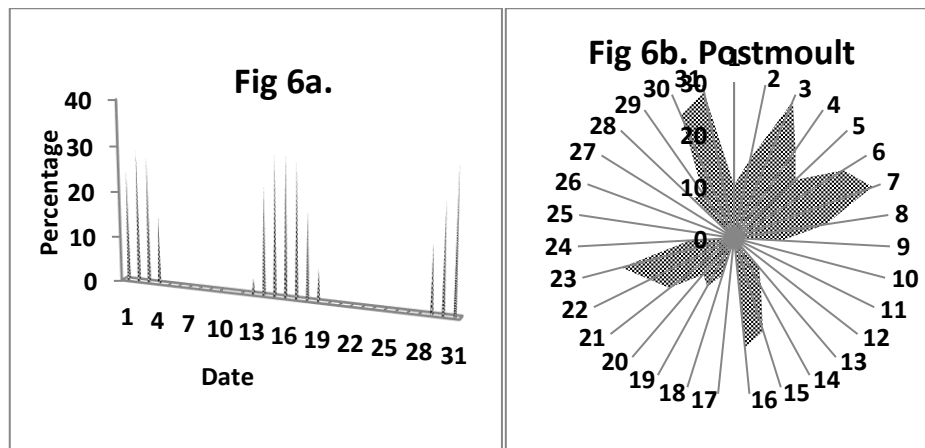


Fig 6a & 6b: Percentage of moult stage in relation to lunar periodicity

4. Discussion

The results of the present study demonstrate the existence of a striking correlation between lunar periodicity and moulting activity in *M. messor*, a report of the first of its kind in a male brachyuran crab. The impact of lunar periodicity in programming the physiological events (such as growth and reproduction) is not exactly known. Paucity of literature on this aspect restrains to draw any generalization in this connection. However, the type of correlation that exists in our present study seems to have adaptive significance. It is tempting to suggest that the water inundation correlated to the lunar periodicity could facilitate successful premoult/post moult changes in this crab, in as much as reports on water uptake as an essential phenomenon in immediately post moult individuals [13,3]. The field observations also reveal that *M. messor* inhabits the space between large pebbles, seen slightly above the intertidal zone. The high tide associated with new moon/full moon days leaves its habitat inundated which in turn permits the water uptake characteristic of post moult crabs and thus facilitates successful moult.

Laboratory observations reveal that the molting crabs under captivity would die due to insufficient water availability. In this context, it would also be worth recollecting the previous reports revealing the adaptive significance of the water inundation entrained with the occurrence of new moon/full moon in reproduction in brachyuran crabs. In *Sesarma quadratum*, the female individuals are reported to move in cohorts to the inter-tidal region during new moon/full moon to facilitate the larval release to the water [7,14] to ensure maximum survival of the offspring. At this juncture, it would be worth discussing some of the earliest findings that suggest a correlation between breeding and lunar periodicity. Many intertidal brachyuran crabs such as *S. reticulatum* [15], *M. messor* [7] exhibit synchronization with respect to lunar periodicity and reproduction. Larval release corresponding to spring tides (correlated with new moon/full moon periods) has been reported in *Uca* species [16]. For *M. messor*, there are two peak seasons of moulting; April and November, but declines from June to August (monsoon period). Interestingly, previous reports suggest that this is a moulting season in the females of *M. messor* as reported by Sudha [3]. This is in contrary to several other species wherein the males and the females moult at different periods of the year. The adaptive significance is that in this latter group, mating occurs between only a hard male and a soft female [17,18]. In this set of crabs, it appears that the soft gonoduct of the post moult female would facilitate smooth and safe sperm transfer during coitus. However, this

does not seem to occur in *M. messor*, wherein mating between a hard male and a hard female are found to be the rule judged by our field and the laboratory observations [7]. In female individuals, this moulting season for a second time in the year (September – November) does not seem to occur. Significantly, the female population as a whole would be involved in breeding which is totally antagonistic to premoult growth of the species [7]. The strategic importance for the existence of a second moulting season in males is unclear.

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Physico-chemical characterization of a natural agglutinin from the digestive gland of the starfish, *Pentaceraster mammillatus* (Audoin, 1826)

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ABSTRACT

*A natural agglutinin with specific affinity for the glycocalyx of the rabbit erythrocyte was identified in the extract of the digestive gland of the starfish, *Pentaceraster mammillatus*. The digestive gland agglutinin also agglutinated pig, rat and human erythrocytes. Maximum HA activity was observed at pH 9 and temperature 30°C. The HA activity was inhibited by glycoproteins: lactoferrin > BSM > thyroglobulin and weakly inhibited by sugars. The agglutinin activity was enhanced by calcium and reduced by the inclusion of increasing concentration of EDTA and trisodium citrate. Reduction in HA titer following the use of sialidase treated rabbit erythrocytes revealed the presence of sialic acid specific agglutinin in the digestive gland of the starfish, *P. mammillatus*.*

Key words: Agglutinin, Hemagglutination, Hemagglutination inhibition, Lectin, Digestive gland, *Pentaceraster mammillatus*.

1. Introduction

Lectins are carbohydrate binding proteins other than immunoglobulins that display no enzymatic activity towards the recognized sugars and are possessing at least one non catalytic domain that recognizes and binds reversibly to specific carbohydrates inside and outside the cell, they are present in plants, microorganisms, vertebrates and invertebrates [1]. Various lectins have been found in the hemolymph and tissue extracts of marine invertebrates [2]. Endogenous animal lectins are widely distributed in extra cellular matrix, cell membranes, cytoplasm and nuclei [3]. Recently several lectins have also been isolated from various tissues, such as gonad [4], spermatozoa [5], pedicellariae venom [6] and body wall [7]. Hence an effort is taken in this investigation to search for the presence of agglutinins in the extract of the digestive gland of the starfish, *P. mammillatus* and to do the physico-chemical characterization of the agglutinin if any.

2. Materials and Methods

2.1 Collection and maintenance of animals: The starfish, *P. mammillatus* were collected from the Arabian Sea at Pallam, Kanyakumari District, Tamilnadu, India. They were transported to the laboratory in plastic bucket containing the aerated sea water and fed with snail and small fishes. They were maintained at room temperature ($30 \pm 2^\circ\text{C}$).

2.2 Preparation of sample: Digestive glands were dissected from the starfish *P. mammillatus* and thoroughly washed in cold saline (0.7%) to remove adhering coelomic fluid. After gentle blotting, 100 mg of digestive glands were homogenized in 1 ml of cold TBS (Tris Buffered Saline pH 7.5: Tris-HCl 50 mM, NaCl 100 mM, CaCl_2 10 mM). The mixtures were filtered and centrifuged at 4000 rpm for 10 minutes and the supernatant was used for HA assay.

2.3 Preparation of erythrocytes: Mammalian erythrocytes were obtained by vein puncture of ear (rabbit), heart puncture (rat, mice and guinea pig), from the slaughter houses (cow, buffalo, camel, goat and pig) and from Kanya blood Bank, Nagercoil (human A, B and O) and collected in sterile modified Alseivier's medium and used for HA assay.

2.4 Hemagglutination (HA) Assay: Hemagglutination assays were performed in 'U' bottomed microtiter plates with 96 wells as described by Ravindranath and Paulson [8].

2.5 Effect of pH and thermal stability: To assess the effect of pH, 25 μ l of the digestive gland extract was serially diluted with equal volume of TBS at different pH (5-10) in a microtiter plate and was incubated at room temperature ($30\pm 2^\circ\text{C}$) for 1 hour, before adding the erythrocyte suspension. To study the effect of temperature on HA activity, 300 μ l of digestive gland extract in several aliquots were placed in a water bath at a temperature range from 5-100 $^\circ\text{C}$ and incubated for 1 hr. After incubation the HA activity was determined against rabbit erythrocytes.

2.6 Effect of cations, EDTA and trisodium citrate: Digestive gland extract (25 μ l) was serially diluted with equal volume of TBS (pH 9) with different concentration (0 -100 mM) of cations and chelators (EDTA and trisodium citrate) and incubated for 1 hour, before adding erythrocytes suspension. After incubation, the HA activity was determined against rabbit erythrocytes.

2.7 Effect of enzyme treatment: Following the procedure of Pereira *et al.* [9], equal volume of trypsin (1 mg/ ml of TBS pH 9) and neutral protease (0.25 mg/ml of TBS pH 9) were added, mixed and incubated at 37 $^\circ\text{C}$ for 1 hr. The enzyme treated erythrocytes were washed five times in TBS and used for HA assay.

2.8 Neuraminidase treatment: Following the method of Mercy and Ravindranath [10], a reaction mixture (total 5 ml) containing 10% washed, rabbit erythrocytes in PBS - BSA (pH 7.5) and 140 mU (milliunits) of neuraminidase of *Clostridium perfringens* (type X: Sigma) was incubated at 37 $^\circ\text{C}$ for 4 hrs. The tested cells were washed with PBS - BSA three times and were washed in TBS-BSA (pH 7.5) and tested for HA activity.

2.9 Hemagglutination inhibition assay: Known concentration of (glycoprotein: 5 mg/ ml; sugar 100 mM) of inhibitor (25 μ l) was serially diluted with 25 μ l of TBS (pH 9) in microtiter plate. Then 25 μ l of digestive gland extract diluted to sub agglutination concentration in TBS pH 9 (to give a HA titer of 2) was added and incubated for 1 hour. After incubation added 25 μ l of 1.5% rabbit erythrocyte suspension, mixed and incubated at room temperature ($30\pm 2^\circ\text{C}$). After 1 hr. the hemagglutination inhibition titer was recorded as the reciprocal of the highest dilution of inhibitors giving complete inhibition of digestive gland extract agglutination.

3. Results

3.1 HA assay: Agglutinins are found in the digestive gland of starfish, *P. mammillatus*. The maximum HA titer was observed with rabbit erythrocytes. However the agglutinin also agglutinated a wide variety of mammalian erythrocytes as follow: rabbit > pig = rat > human O > human B = human A > guinea pig = dog = cow = goat = horse = donkey = mice > camel = buffalo (Table 1).

3.2 Effect of pH and temperature: The HA activity gradually increased with increase in pH and maximum HA titer was observed at pH 9. Hence, further works were done with pH 9. HA activity of digestive gland extract of *P. mammillatus* was high at 30°C and decreased at increase in temperature and completely destroyed at 100°C (Table 2).

3.3 Effect of cations EDTA and trisodium citrate: Maximum HA activity was observed in the presence of 10 mM Ca^{2+} . Magnesium and manganese ions had no effect on the HA activity. The hemagglutination titer was reduced with increasing concentration of EDTA and trisodium citrate (Table 3).

3.4 Hemagglutination inhibition assay

Glycoprotein: Among the glycoproteins tested, the agglutinin of digestive gland extract of starfish, *P. mammillatus* with rabbit erythrocytes was inhibited by lactoferrin > BSM > thyroglobulin (Table 4).

3.4 Sugars: Among the sugars tested, the agglutinability of the digestive gland extract of the starfish, *P. mammillatus* with rabbit erythrocytes was inhibited by D-glucose-6-phosphate > lactose > melibiose > D-fucose > raffinose (Table 4).

3.6 Effect of Enzyme treatment: The HA titer of the extract of the digestive gland of the starfish, *P. mammillatus* showed a tremendous fall when tested with trypsin, protease and neuraminidase treated rabbit erythrocytes (Table 5).

Table 1: HA titer of the digestive gland extract of *P. mammillatus*

Erythrocytes tested (n=5)	HA titer (pH=7.5)
Rabbit	256
Pig, rat	128
Human O	64
Human A & B	32
Guinea pig, dog, cow, goat, horse, donkey & mice	8
Camel & buffalo	4

Table 2: Effect of pH and temperature on digestive gland extract of *P. mammillatus*

pH (n=5)	HA titer	Temperature (°C)	HA titer at pH = 9
5.5	8	5	512
6	8	10	512
6.5	16	20	512
7	32	30	1024
7.5	256	40	512
8	512	50	512
8.5	512	60	512
9	1024	70	512
9.5	256	80	256
10	32	90	2
10.5	8	100	0

n = number of animals tested.

Table 3: Effect of cations EDTA and trisodium citrate on the HA titer of digestive gland extract of *P. mammillatus*

Concentration (mM) (n = 5)	HA titer at pH 9					
	Ca ²⁺	Mg ²⁺	Mn ²⁺	Disodium EDTA	Trisodium Citrate	Tetra Sodium EDTA
0	512	512	512	512	512	512
0.01	512	512	512	256	512	512
0.1	512	512	512	64	128	512
1	512	512	512	64	128	256
10	1024	512	512	64	128	256
20	32	512	512	32	128	128
30	32	512	512	32	64	64
40	32	512	512	16	32	64
50	32	512	512	8	8	16
100	32	512	512	4	8	16

n = number of animals tested.

Table 4: HAI titer of digestive gland extract of *P. mammillatus*

Glycoprotein (n = 5)	HAI titer at pH 9	Mini. Con. for Inhibition (µg/ml)	Relative Inhibitory potency	Sugars (n = 5)	HAI titer at pH 9	Mini. Con. for inhibition (mM)	Relative Inhibitory Potency (%)
Lactoferrin	64	78.12	100	D-glucose-6- Phosphate	4	25	100
BSM	16	312.5	25	Lactose	4	50	50
Thyroglobulin	8	625	12.5	Melibiose	2	50	50
				D-fucose	2	50	50
				Raffinose	2	50	50

Glycoproteins: PSM, BSM, thyroglobulin, fetuin, transferrin and sugars: glucose, sucrose, fructose, mannose, trehalose, D-galactosamine, GlcNAc, ManNAc and GalNAc did not inhibit the HA.

n = number of animals tested

Table 5: Effect of enzyme activity on HA activity of digestive gland extract of *P. mammillatus*

Enzyme (n=5)	HA titer at pH = 9
None	1024
Trypsin	512
Neutral protease	16
Neuraminidase	256

n = number of animals tested.

4. Discussion

This investigation reveals the presence of natural agglutinin with diverse affinity to various mammalian erythrocytes in the extract of the digestive gland of the starfish, *P. mammillatus*. However, high HA titer was observed with rabbit erythrocytes. Rabbit erythrocyte specific lectin was also reported in echinoderm such as the seminal plasma of sea urchin, *Paracentrotus lividus* [11]. Next to rabbit erythrocytes, the digestive gland agglutinin of the starfish *P. mammillatus*, agglutinated pig and rat erythrocytes with high potency. The receptor component on the glycocalyx of rabbit erythrocytes is NeuAc [12], pig erythrocytes is both NeuAc and NeuGc [13]. So it can be suggested that the agglutinin may bind to the sialic acid component of the glycocalyx of these erythrocytes. A marked rise in agglutinability of the digestive gland agglutinin of the starfish, *Pentaceraster mammillatus* was observed from pH 8 with a peak at pH 9. Lectin isolated by Mojica and Merca [14] had a marked stability over a wide range of pH. Lectin was active at very high temperature range from 0-80°C. However, the activity suddenly dropped at 90°C and completely disappeared at 100°C. A highly thermo stable lectin was reported in the sea cucumber, *Holothuria grisea* [15].

The agglutinin activity of the extract of the digestive gland of the starfish, *P. mammillatus* was enhanced by calcium and reduced by EDTA and trisodium citrate. Magnesium and manganese ions were entirely ineffective. C-type lectins are also reported in the body wall of *Holothuria atra* [7]. Marchalonis and Edelman [16], reported that a agglutinating activity was potentiated by calcium but not by magnesium. They suggested that bound calcium may stabilize the native structure of the protein. The agglutinin activity was decreased when mixed with trypsin, protease and neuraminidase treated rabbit erythrocytes. This reveals the sialic acid specificity of the agglutinin which may be bound to the protein structure of the glycocalyx of the rabbit erythrocytes. Protease and neuraminidase treated rabbit erythrocytes would have removed the sialic acids and proteins which react with the agglutinin. The agglutinability of the digestive gland of the starfish *P. mammillatus* was inhibited by lactoferrin and BSM. Lactoferrin is a potent inhibitor rich in sialyl residues. High HA titer with rabbit erythrocyte, inhibition by sialoglycoproteins lactoferrin, BSM and thyroglobulin, reduction in HA titer with neuraminidase treated rabbit erythrocytes accounts for the sialic acid specificity. However, the exact specificity can be stated only after and subsequent characterization.

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Identification and Physico-Chemical Characterization of Agglutinin from the Flower Extract of *Sansevieria roxburghiana*

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ABSTRACT

Naturally occurring flower agglutinin with high specificity towards rabbit erythrocytes was observed in the flower extract of bowstring hemp plant *Sansevieria roxburghiana* by hemagglutination (HA) assay. The flower agglutinin also agglutinated rat and human erythrocytes with high HA titer. Physico-chemical analysis of the agglutinin revealed optimum activity at pH 7.5 and temperature from 0 to 45°C. The agglutinin was calcium dependent and reversibly sensitive to EDTA. Hemagglutination inhibition (HAI) assay revealed PSM as the potent inhibitor.

Keywords: Agglutinins, Hemagglutination, Hemagglutination inhibition, Erythrocytes, Lectin, *Sansevieria roxburghiana*.

1. Introduction

Sansevieria roxburghiana belongs to the family Dracaceae, commonly referred to as bowstring hemp, piles root [1] and Jaang Mattai in Tamil (vernacular). *Sansevierians* are popular garden indoor plants with long rhizomes and fibrous roots having ability to flourish under low light conditions and requiring minimal attention [2]. The medicinal use of *Sansevieria* species includes treatment for abdominal pain, earache, diarrhoea and hemorrhoids [3]. The medicinal property of *Sansevieria* species is well documented such as anti-inflammatory [4], analgesic [5], antioxidant and antimicrobial [6]. Many of the medicinal herbs are proved to possess agglutinin [7].

Agglutinins/lectins are a group of sugar binding proteins that recognize a specific carbohydrate structure and agglutinate various cells by binding to cell surface glycoconjugates [8]. They display a host of biological functions such as antitumor, antifungal, antiviral, insecticidal, antibacterial and opsonic activities [9]. Lectins are useful as molecular tools for isolating glycoconjugates, for typing blood, mitogenic stimulation of lymphocytes and for cell fractionation, bone marrow transplantation and preferential agglutination of tumor cells [10]. Some plant lectins play a role in defense mechanisms of the plant and to mediate plant symbiosis with nitrogen fixing bacteria [10].

Plant lectins play a role in the general defence against a multitude of plant attackers (phytopathogenic microorganisms, nematodes or pest insects, climatic conditions) and are also used as storage proteins for the growth and development of the plant [7]. Since lectins function in diverse ways, an effort was taken to analyse the presence of lectin in the extract of the flower of the herb, *Sansevieria roxburghiana* that has tremendous medicinal properties.

2. Materials and Methods

2.1 Collection of flower samples

Healthy, disease free *Sansevieria roxburghiana* flowers were collected from the plant in the garden. The name of the plant was authenticated at the Department of Botany, Holy Cross College (Autonomous), Nagercoil. Flowers were washed, ground and homogenized

using a mortar and pestle. Then, the homogenate was filtered using filter paper and centrifuged at 3000 rpm for 10 minutes. The crude extract was analyzed for the presence of hemagglutinins either immediately or stored at -20°C for further study.

2.2 Preparation of erythrocyte suspension

Blood samples of human A, B, AB, O, pig, rabbit, rat, buffalo, cow and goat were collected directly in modified Alsevier's medium (pH 6.1) containing sodium citrate (30 mM), sodium chloride (77 mM), glucose (114 mM), neomycin sulfate (100 µg/ml) and chloramphenicol (330 µg/ml). They were suspended and washed three times with ten volumes of Tris-buffered saline (TBS) pH 7.5 (Tris-HCl 50 mM, NaCl 100 mM, CaCl₂ 10 mM) and suspended in the same as 1.5% suspension.

2.3 Hemagglutination assay

The crude extract of the flower *Sansevieria roxburghiana* was assayed for the presence of agglutinins using TARSON 96 well U-bottom microtiter plates. The sample was diluted by two-fold dilution in TBS (25 µl) and incubated with 1.5% suspension of RBCs (25 µl) at room temperature (30±2°C) for an hour or until the negative control showed a red button formation. Agglutination activity was detected based on the RBCs appearance on the well: a positive result appears as a red-carpet layer, while negative results appear as a red button in the bottom of the well.

2.4 Effect of pH on hemagglutinating activity

To study the effect of pH on agglutinability of the crude extract, HA assay was carried out in TBS of different pH levels (5.0 to 9.5).

2.5 Effect of temperature on agglutinating activity

To study the effect of temperature on agglutinability of the crude extract of the flower *Sansevieria roxburghiana*, the extract was aliquoted as 500 µl and incubated at specific temperature (0-95°C) for an hour and used for HA assay.

2.6 Effect of divalent cations and chelators on hemagglutination activity

To assess the effect of cations on HA activity of the crude extract, the extract was serially diluted with 25 µl of TBS with different concentration of cations (Ca²⁺, Mg²⁺, Mn²⁺) and chelators (EDTA and trisodium citrate) and was incubated at room temperature (30 ± 2°C) for an hour prior to the addition of rabbit erythrocytes and the hemagglutination titer was determined.

2.7 Hemagglutination Inhibition assay

To a known concentration of serially diluted inhibitor (sugars/glycoproteins) solution (25 µl), 25 µl of the extract of the flower diluted to sub agglutination concentration was added, mixed and the plate was incubated for 1 hour at room temperature. Finally 25 µl of 1.5% rabbit erythrocytes suspension was added and incubated for 1 hour at room temperature (30±2°C). The minimum concentration of the inhibitors required to completely block the agglutination after 1 hour of incubation at room temperature (30 ± 2°C) was reported as the HAI titer.

3. Results

3.1 Hemagglutininability of the extract

Crude agglutinin of *Sansevieria roxburghiana* flower contains agglutinins that agglutinated all the tested erythrocytes except buffalo erythrocytes but with varying HA titers. Among the various erythrocytes tested, maximum agglutinability was observed with rabbit erythrocytes (Table 1).

3.2 Effect of pH on HA

The optimum pH of *Sansevieria roxburghiana* flower agglutinin to agglutinate rabbit erythrocytes was observed at pH 7.5. The agglutinability was low at acidic and alkaline pH (Table 2).

3.3 Effect of temperature on HA

The hemagglutination activity of the extract of the flower *Sansevieria roxburghiana* was stable from 0 to 45°C, while got gradually reduced above 55°C (Table 2).

3.4 Effect of cations and chelators

Maximum hemagglutination was observed in the presence of 10 mM Ca^{2+} but not Mg^{2+} and Mn^{2+} . However, addition of higher concentration of all the three cations (Ca^{2+} , Mg^{2+} , Mn^{2+}) decreased the HA titer (Table 3). A decrease in HA titer was observed with the addition of increasing concentration of EDTA and trisodium citrate.

3.5 HAI assay

Among the inhibitors tested, the agglutinability of the agglutinin was extremely inhibited by PSM followed by BSM, Melibiose, GlcNAc, α -lactose and glucuronic acid (Table 4).

Table 1: HA titer of flower agglutinin of *Sansevieria roxburghiana* with different mammalian erythrocytes

Erythrocytes (n=25)	HA titer
Rabbit	1024
Rat	512
Human A	256
Human O	128-256
Human B	64
Pig	16
Cow	16
Goat	4
Human AB	4
Buffalo	0

Table 2: HA titer of the flower agglutinin of *Sansevieria roxburghiana* in relation to pH and temperature

pH (n=5)	HA titer	Temperature (°C) (n=5)	HA titer
5.0	256	0	1024
5.5	256	5	1024
6.0	512	15	1024
6.5	512	25	1024
7.0	512-1024	35	1024
7.5	1024	45	1024
8.0	256	55	512
8.5	256	65	512
9.0	256	75	512
9.5	128	85	256

Table 3: Effect of cations and chelators on HA activity of the *Sansevieria roxburghiana* flower agglutinin

Concentration (mM) (n=5)	HA titer					
	Ca ²⁺	Mg ²⁺	Mn ²⁺	EDTA		Trisodium citrate
				Disodium	Tetra sodium	
0	256	256	256	256	256	256
0.01	256	256	256	256	64	128
0.1	512	256	256	256	64	32
1	512	64	64	32	64	32
5	512-1024	32	32	32	64	32
10	1024	32	32	32	32	32
20	512	32	32	32	32	32
30	32	32	32	32	16	32
40	32	32	32	16	16	32
50	4	32	32	4	16	16
100	0	32	32	4	16	8

Table 4: HAI titer of flower agglutinin of *Sansevieria roxburghiana* by various sugars and glycoproteins

Inhibitors (Sugars/Glycoproteins) (n=5)		HAI titer	Minimum Conc. Required (mM) / (μ g/ml)	Relative inhibitory potency (%)
Sugars	Melibiose	16	6.25	100
	GlcNAc	16	6.25	100
	α -Lactose	16	6.25	100
	Glucuronic acid	16	6.25	100
	D-Galactose	4	25	25
	D-fructose	4	25	25
	D-Raffinose	2	50	12.5
Glycoproteins	PSM	1024	4.882	100
	BSM	32	156.25	3.125
	Thyroglobulin	4	1250	0.390

n = number of animals tested

5. Discussion

Numerous lectins have been isolated from different plants. The data presented from this study showed that the *Sansevieria roxburghiana* flower contained assessable amount of hemagglutinin. The *Sansevieria roxburghiana* flower agglutinin agglutinated both human and other mammalian erythrocytes tested. Sugar moieties/sialyl residues are abundant on the surface of the mammalian erythrocytes [11]. So it can be concluded that the agglutinin may bind to the same sugar/sialic acid of the glycocalyx of these erythrocytes [12]. Agglutinability observed in *Sansevieria roxburghiana* flower agglutinin with different blood groups may be due to differences in carbohydrate-agglutinin binding interactions which can be attributed to differences in carbohydrates presented on the cell surfaces of the different blood groups [13]. A wide range of blood group specificity was also reported in *Artocarpus incisa* seed lectin [14].

The thermo-stability and pH sensitivity characteristics of agglutinins are known to differ from agglutinin to agglutinin. The hemagglutinating activity of the *Sansevieria roxburghiana* flower agglutinin was pH sensitive and stable upto 45°C. A fourfold decrease in agglutinability was observed at 85°C. This may be due to the denaturation of the agglutinin on exposure to high temperature which removes its agglutinating capacity. The pH 7.5 was reported as the optimum pH for agglutinability in leaf lectin of *Morus rubra* [15] and *Ipomoea asarifolia* [16]. Lectins have different optimum pH to maintain their stabilities [17]. Different pH conditions were found to have profound effects on the tertiary and quaternary structure of proteins and can perturb protein conformational stability [18], which would have resulted in different HA titer in different pH.

Maximum hemagglutination activity was found following the addition of 10 mM Ca^{2+} , but not Mg^{2+} and Mn^{2+} . The reduction in the HA activity observed after treatment of agglutinin with EDTA and trisodium citrate suggesting that, Ca^{2+} ions are essential for the hemagglutinating activity. Probably, the agglutinin found in the flower of *Sansevieria*

roxburghiana is a calcium dependent one. Specificity is influenced by the limited number of contacts with carbohydrates and depth of the sugar binding sites [19]. Sugar specificity of the *Sansevieria roxburghiana* flower lectin was examined by competitive inhibition of various sugars and glycoproteins against rabbit erythrocytes. The hemagglutinability was strongly inhibited by the glycoprotein, PSM (HAI titer=1024). Weak inhibition was observed when HAI was tested with sugars and other glycoproteins. It has been reported that larger and more complex polysaccharides interact with secondary sites on the lectin surfaces as well as with the primary binding sites [20]. Ability of the agglutinin to agglutinate rabbit erythrocytes with high HA titer and ability of PSM to inhibit agglutination of the agglutinin with rabbit erythrocytes suggest that the agglutinin binds to one of the sugar moiety (NeuGc/NeuAc), specifically found in PSM.

Conclusion

The present study described the agglutinability and characterization of the flower agglutinin of the *Sansevieria roxburghiana*. The agglutinin recognized rabbit erythrocytes, exhibiting high HA titer in the presence of Ca^{2+} ions at pH 7.5 and temperature upto 45°C. The agglutinability was specifically inhibited by the glycoprotein PSM. This study provides the physico-chemical characteristics necessary to purify the agglutinin.

5. References

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