

A One Day National Level Conference
On
**“Multi-disciplinary Research Methodology
In Humanities, Languages & Literature,
Commerce & Management Science,
Science & Technology**

17th April, 2023

Editors

Dr.P.P. Sharma,

Dr.R.P. Pawar,

Dr.S.U. Tekale

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HUMANITIES

A CROSS-CULTURAL ANALYSIS OF FEMALE PROTAGONISTS ON SELECT NOVELS OF CHITRA DIVAKARUNI AND BHARATI MUKHERJEE

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Abstract: *In the 21st century, women's writing in English has been considered as a powerful medium of modernism and feminist proclamation in the contemporary society of patriarchy life. The last two decades have witnessed extraordinary success in feminist writings of Indian English literature even Today is the generation of those women writers who are rich and have been educated in the West. Hence, this paper examines to analysis the cross- cultural values and divulgements of female protagonist's of the great diasporic writers Chitra Banarjee Divakaruni and Bharati Mukherjee select novels. It also discussed the problems of women and in their suppressions in our post- modern society how they lost their identity and how do they feel their separation of culture from native land to an alien land.*

Introduction:

Chitra Banarjee Divakaruni and Bharati Mukherjee is a well-known novelist both are also very famous writers in Indian Writing in English. Many of their writings have been dealt with by some of Indians and the USA, feature Indian-born women torn between new and old-world values. Their stories give a laser-like insight into the feminine nature. their skilled use of story, plot and lyrical description gives the readers a many-layered looks at their characters and their respective worlds which are filled with fear, hope, and discovery. Most of their works are autobiographical and are based on the lives of Indian immigrants. They have dealt with their lives and its many nuances in detail. They said to writes the unite people by breaking down old stereotypes (Nayar, 2008; Nelson, 2017; Sankar & Soundararajan, 2018).

Materials and Methods:

In 1997, Divakaruni first novel *The Mistress of Spices*. It is a dazzling tale of misbegotten dreams and desires, hopes and expectations, woven with poetry and storyteller magic. Divakaruni says about her first novel the following: “I wrote in a spirit of play, Collapsing the division between the realistic world of twentieth-century America and the timeless one of the myth and magic in my attempt to create a modern fable” (1990; 02). The main character of the book Tilo owns a spice shop in an Indian community in Oakland, California. She becomes involved in the lives of the customers and helps them by guarding them against abusive husbands, racism, generational conflicts, and drug abuse (Mishra, 2007; Mohan & Kumar, 2018 Naik & Narayan, 2001). The book was short-listed for the Orange Prize from England and was named one of the best books of 1997 by the Los Angeles Times. But, Mukherjee's female protagonists like Hannah Easton in *The Holder of the World*, Devi in *Leave It to Me*, Three daughters of Bhattacharya family, Padma, Parvati, and Tara in *Desirable Daughters* and Tara Lata in *The Tree Bride*. They are stated facts about Mukherjee's ideology on betrayal of women and searching for the identity. Mukherjee has confirmed frankly that she is nostalgic about India but she has no remorse and state publicly that she is an American citizen. These novels mainly focus on the diasporic situations and dislocations of Mukherjee own lives too, however, she has been describing the element of

immigrant consciousness and nostalgia in the wider sense and dimensions of nostalgia are far extended beyond the sentimental longing, to encompass all the meaning – exile, displacement, dislocation, relocation, expatriation and assimilation (Emmanuel Catherine, 2009, Junaidi, 2018; Mishra, 2016).

Furthermore, Mukherjee has paid special attention to the condition of the Indian woman immigrant in North America. Pradeep Tripathi has mentioned that in her 1990 *Iowa Review Interview*: “Bharati Mukherjee emphasizes that many of her stories are about psychological transformation; especially among women emigrate from Asia” (178). Her heroines endeavor for self-realization as Hannah Easton in *The Holder of the World*, Devi in *Leave it to me* and the three daughters of Bhattacharyya family namely Padma, Parvati and Tara in *Desirable Daughters* and *Tara in Tree Bride*. Mukherjee does not impose readymade solutions to the problems facing immigrant. She prefers showing them gradual acquiring power in order to control their fate. They offer role models for several immigrant women. As Fakrul Alam observes:

Once literature begins to serve as a forum illuminating female experience, it can assist in humanizing and equilibrating the cultural value system, which has served predominantly male interests. A literary work is capable of providing role models, instill a positive sense of feminine identity by portraying women who are self-actualizing, whose identities are not dependent on men. (128)

Mukherjee’s *The Holder of the World* is a feminist novel. It is a tale of dislocation and transformation of two cultures between India and America. The present novel is about the story of women protagonist Hannah Easton, She is an abandoned child came to India in the seventeenth century and imbedded herself in its culture. As Arshia Sattar states in the review of this novel:

(The novel) has a wide canvas that sweeps across continents and centuries, cultures and religions, immigration, exile, alienation, and foreign lands have always been the color of Mukherjee’s palate and with *The Holder of the World* she uses the familiar tones and shades to create a universe of infinite possibility and eternal time. (24)

However, Divakaruni once explained the reason for writing: “There is a certain spirituality, not necessarily religious – the essence of spirituality – that is at the heart of the Indian psyche, that finds the divine in everything. It was important for me to start writing about my own reality and that of my community” (Double Day, 156). Anju is the daughter of an upper-caste Calcutta family of distinction. Sudha is the daughter of the black sheep of that same family (Barry, 2017; Beauvoir, 1972; Divakaruni, 2010). Sudha is startlingly beautiful; Anju is not. Despite these differences, since the day the two girls were born the same day their fathers died. Mysteriously and violently Sudha and Anju have been sisters of the Heart. Bonded in ways even their mothers cannot comprehend, the two girls grow into womanhood as if their fates, as well as their hearts, are merged. Due to a change in family fortune, the girls are Urged into arranged marriages, their lives take opposite turns. One travels to America and on remains in India. When tragedy strikes both of them, however, they discover that, despite distance and marriage, they must turn to each other once again.

“Like the old tales of India that are filled with emotional filigree and flowery prose, Divakaruni’s (The Mistress of Spices) latest work is masterful allegory of unfulfilled desire and sacrificial love. It is also an intricate modern drama in which generations and castes struggle over old and new mores. Anju and Sudha are cousins, born in the same household in Calcutta on the Same Day? Which is also the day on which their mothers learn that both their husbands have been killed in a reckless quest for a cave full of rubies?”

Sudha grows up believing her father was a no-good schemer who brought ruin on his cousin, Anju’s upper-class father. AS they mature, Anju dreams of college, Sudha of children, but arranged marriages divide and thwart them. Anju adjusts to life in California with a man who lusts after Sudha; Sudha grapples with a mother-in –low ho turns to the goddess shasti to fill Sudha’s barren womb rather than to a doctor for her sterile son. Ultimately, the tie between Anju and Sudha supersedes all other love, as each sustains painful loss to save the other, When Sudha learns the truth about her father and no longer needs to right his wrongs, she sees that all along her affection for Anju has not been dictated by necessity. An inspired and imaginative raconteur, Divakaruni’s is sure to engender comparisons with Arundhati Roy (The God of small things),but Divakaruni’s novel stands in its own right as a compelling read mesmerizing narrative.” “like Rebecca Wells’s Secrets of the Ya-Ya Sisterhood, Divakaruni,s debut novel, The Mistress of Spices was a word –of –mouth hit ; its blend of magical realism and culinary sensuality also appealed to fans of Laura Esquivel’s Like Water for Chocolate(Aini, 2017; Alam, 1996; Ashcroft et al., 1998).

Divakaruni was inspired by many writers. Dabydeen and Asoka Weerasinghe are two of them. In the evolving history of South Asian Canadian literature, Dabydeen occupies a special place. He is not only a prolific writer-he has published over a dozen volumes of fiction and poetry-but also a writer who has conscientiously worked to gain recognition for minority writers in Canada. Dabydeen’s Stoning the Wind is a collection of fifty-eight poems. He is at most poetic when he uses images from his native landscape. Many of his poems are dedicated to individuals, and several of them directly pay tribute to a friend by remembering small, specific incidents.

Tears for My Roots are a slender volume of twenty-five poems by Ashoka Weerasinghe. He published several such volumes since 1968 when he immigrated to Canada from his native Sri Lanka via England. Its main interest lies in the use of newspaper clippings and photographs, ink-sketches of temple sculptures; and a refrain of silhouetted figures of elephant and dancers at border of each page add a dimension to the reading experience.

“Chitra Banarjee Divakaruni is a new name, which is likely to become more familiar. There is no doubt about the presence of poetic talent in Black Candle. The volume looks, feels and reads the way poetry should. The font used is aesthetic. The cover picture in purple, blue, and orange showing a cobra with raised hood is evocative of the power of fear of female sexuality. The book is dedicated to her mother and “for my sisters of the South Asian Diaspora,” the subtitle is “Poems about Women from India, Pakistan, and Bangladesh” (98).

But in Mukherjee’s *The Holder of the World* is a unique fusion of fiction and History. Mukherjee uses the technique of virtual reality as a trope for dislocating and transforming literary, cultural, and historical topographies of Mughal in India and colonial 17th and 18th century United States. Mukherjee exposes the snobbery, hypocrisy and corrupt world of East India Company’s rule in India. Hannah, a puritan American woman, visits India along with her husband and discovers true happiness in the company of a Hindu Raja-Jadav Singh and who returns home and changed and transformed a human being. When Hannah came to India from America she lost her identity and consciousness of western culture. Malikarjun Patil observes: “The novel is a candid depiction of 1970’s life of an American woman whose lifestyle of functioning is totally untraditional, and whose mind, is tom due to her cloudy headedness” (66). It depicts an American Woman’s exile to India and spoiling of her own self-conscience.

In Bharati Mukherjee’s earlier novels, the protagonists’ journey commences from the East and it ends in the Westbut in *The Holder of the World* the protagonist’s journey begins from the West and it ends in the East. The novel revolves sound on the lives of two white

women, Hannah Easton who was from the 17th century American Puritan world and Beigh Master who is the narrator of the novel respectively, whereas her first three novels are Indian protagonist who travels from the East to the West. Beigh Master is assets hunter and at present, she enthusiastically reconstructs the life of Hannah Easton. She does the work to find lost possessions of the people. Hannah holds the opinion:

People and their property often get separated or people want to keep their assets hidden. Nothing is ever lost, but continents and centuries sometimes get in the way. Uniting people and possessions; it's like matching orphaned socks, through times.(5)

The Holder of the World Mukherjee expresses the experiences of relocation and dislocation of Hannah Easton, is a Puritan American. Her quest is for self-realization and independence. She wants to free herself from orthodox Puritan world. She follows the footsteps of her mother. Hannah is daughter of Edward Easton and Rebecca Easton. Edward Easton has died of bee sting when Hannah is one year old. Her mother becomes widow at the age of twenty-two years. Rebecca suffers from loneliness and she falls in love with Nipmuc man. Rebecca runs away with Nipmuc man leaving behind Hannah.

Results and Discussions:

Thus, The Protagonists Hannah and Jasmine both are raised in traditional society they face many problems which transforming themselves to modern society and culture. Hannah wants to get freedom from the strict Puritan society but she cannot revolt against society and she is not clear about her aim in life. On the other hand Jasmine is also born in gender-biased society where daughter is curse but she revolts against conventional norms of the society from the beginning. She is very clear about her goal. Jasmine and Hannah both never think to return their motherland. Jasmine assimilates in American culture. Hannah, in the beginning, socializes only with the Englishwomen because the local people cannot enter into the White Town. The Chief Factor Cephus Prynne allotted the Legges Late Chief Factor Henry Hedges house(Abrams & Harpham, 2011; Agarwal, 2007).

Bhagmati worked for Henry Hedges and she stays in the house even after the death of Henry Hedges. Hannah hires Bhagmati as her maid. Hannah socializes with Martha Ruxton and Sarah Higginbotham. Martha Ruxton and Sarah Higginbotham always remain nostalgic about her life in England and they want to return England after completion of her husband's work. Hannah wants to explore varieties of the Coromandel Coast. Bhagmati tells her stories about the Mahabharata and the Ramayana epics. She is Hannah's only companion when Gabriel is on the voyage. Hannah and Bhagmati share common language. Hannah asks her about the Lord Hanuman. Bhagmati tells her about the story of the legendary Sita and how she sacrifices her life for the love of her husband Rama. Hannah compares her mother Rebecca's life with the legendary Sita. She thinks that her mother prefers to live with Ravana instead of Rama.

However, In the novel *The Mistress of My Heart*, Divakaruni represents all the major problems of women who belong to the Diaspora. She describes realistically how women are ill-treated by their abusive husbands, how they are bullied by their fathers-in-law and mother-in-law, and how they lose their female identity and individuality. The novel also offers solutions to the problems of women who are enslaved by mythological beliefs and abusive restrictions and conventions of the Indian family system. Moreover, the novel *The Mistress of My Heart* tries to evolve a female identity in the novel, which can emancipate women from their traditional bonding and abusive relationships.

Conclusion:

Both the writer’s novels represent women’s lives and their various problems. They do this by contrasting western culture and Indian culture. They tend to praise excessively the American traditions and ways of life and the freedom they are thought to afford to women and to underestimate the Indian traditional values and ways of life. The reason for the partial treatment of the Indian traditional values might be the fact that these novels were written mainly for western readers.

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हिंदी का वैश्विक परिदृश्य

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स. प्राध्यापक प्रकाश आनंदा लहाने, कोहिनुर कला, वाणिज्य व विज्ञान

महाविद्यालय, खुलताबाद

हिंदी विश्व के देशों की भारतीय संस्कृति को जिंदा रखने के लिए मातृभाषा या मुलभाषा ही नहीं, प्राणभाषा भी है | हिंदी विश्वभर में बस रहे भारतवासियों की सांस्कृतिक भाषा है, जिसकी लम्बी ऐतिहासिक परंपरा है | और वही हिंदी भाषा की शक्ति है | जो विश्व के धरातल पर अपना स्थान दिन-प्रतिदिन उच्च शिखर पर ले जा रही है ---

भाषा व्यक्ति के हृदय पर अभिव्यक्ती के लिए उगी हुई फसल है, जिससे प्रतिभा की भूख मिट सके | संस्कारों को पोषण मिले | हिंदी भाषा के विश्व में हिंदुस्थानी संस्कृति की रक्षा की| विदेशों में भारतीय संस्कृति का वैभव प्रवासी भारतवासियों के पसीने की कमाई का पुरस्कार है, उनके मन- मानस और देह खदानों का लाल सोना है |

वैश्वीकरण एक ऐसी विचारधारा है जिससे सामाजिक संबंधों का विकास होता है | वैश्वीकरण की नयी अर्थव्यवस्था विकसित देशों की ही देन है | वैश्वीकरण को आज सांस्कृतिक साम्राज्यवाद के रूप में देखा जा रहा है | इंटरनेट, साईबर स्पेस, सभ्यता का इतिहास, सुचना, प्रौद्योगिकी और सुचना क्रांती का इस पर गहरा असर पडा है | ज्ञान की अर्थव्यवस्था भूगोल, विदेशी प्रत्यक्ष निवेश व पूँजी प्रवाह की यह देन है |

वैश्वीकरण वह शब्दावली है जिसका प्रयोग कुछ ऐसे आर्थिक, सामाजिक, सांस्कृतिक, तकनिकी तथा राजनीतिक परिवर्तनों के जटील समुह के लिए किया जा रहा है | जिसके परिणाम स्वरुप विश्वस्तर पर दूर- दराज एवं विभिन्न स्थानों पर बैठे व्यक्तियों, समुहों कंपनियों अथवा सरकारों के बीच अंतसबघ काफी तीव्रता से बढ़ता जा रहा है | वैश्वीकरण की धारणा समय तथा स्थान की सिकडून तरफ भी संकेत करती है |

आधुनिक समाज तथा पहले के समाज में भाषा शिक्षण के लक्ष्य अलग-अलग रहे हैं | आधुनिक समाज में शिक्षा और साक्षरता भाषा और संस्कृति के मानकीकरण के प्रमुख साधन हैं | आज के युग में राजनितिक सामाजिक नियंत्रण पर भी अर्थ और वाणिज्य का गहरा असर है | शिक्षा और साक्षरता का महत्व इसलिए और भी अधिक है |

भाषा विचारों के आदान प्रदान का माध्यम होती है। भाषा जितनी सुबोध, सरल और सहज होगी, भाव सम्प्रेषण उतना ही सफल और सशक्त होगा। भारतीय भाषाओं की परम्परा, इतिहास और विकास क्रम में हिन्दी का वही स्थान एवं महत्व है जो पुरा काल में संस्कृत का था। वर्तमान में हिन्दी भाषा न केवल भारत में अपितु विदेशों में भी करोड़ों लोगों की संपर्क भाषा बनी हुई है। भारत की आबादी का तकरीबन आधा हिस्सा मूलतः हिन्दी भाषी है और वह आपसी विचार-विनिमय के लिये हिन्दी का ही प्रयोग करता है। दरअसल भाषा किसी देश के इतिहास का वह आईना होती है, जिसमें भविष्य भी देखा जा सकता है। हिन्दी भारतवर्ष का स्वाभिमान है और हिन्दी के विकास तथा प्रचार-प्रसार में वास्तविक रूप

से भारत के भविष्य की झाँकी देखी जा सकती है। आज हिन्दी का स्वरूप वैश्विक या ग्लोबल हो चला है, वह अंतर्राष्ट्रीय स्तर पर अपनी पकड़ मजबूत कर रही है साथ ही वह अपने स्वरूप को निरंतर माँज भी रही है।

प्रस्तावना :

भारतीय संविधान के अनुसार देवनागरी लिपि में लिखी गई हिन्दी को संघ की राजभाषा घोषित किया गया। सरकारी प्रयोजनों के लिए भारतीय अंको के अंतर्राष्ट्रीय स्वरूप को मान्यता प्रदान की गयी। साथ ही 1965 ई. तक अंग्रेजी भाषा का प्रावधान रखा गया। लेकिन बाद में संशोधन कर इसे आगे के लिए बढ़ा दिया गया। आज हिन्दी भारत के अलावा कई देशों में व्यवहृत हो रही है। दुनिया के कई छोटे बड़े देशों में प्रवासी भारतीयों की संख्या लगातार बढ़ती जा रही है। दुनिया में अनेक देशों के सामाजिक, आर्थिक एवं सांस्कृतिक परिदृश्य में भारतीय मूल के नागरिकों और हिन्दी भाषा की उपस्थिति अब प्रभावी मानी जा रही है। इस बड़े फलक पर चहुँमुखी चुनौतियों और प्रतियोगिताओं के बीच से उभर उभरकर अब भारतीय मूल के अनगिनत प्रवासी अपनी उपस्थिति को सार्थक सिद्ध करते हुए हिन्दी भाषा को सृजन और अभिव्यक्ति का माध्यम बना रहे हैं। विवेचना :

आज वैश्वीकरण, ग्लोबलाइजेशन या भूमण्डलीकरण का अर्थ है, विश्व में चारों ओर अर्थव्यवस्थाओं का बढ़ता हुआ एकीकरण । वास्तव में यह एक आर्थिक अवधारणा जो आज एक सांस्कृतिक और बहुत कुछ अर्थों में भाषायी संस्कार से भी जुड़ चुकी है। वैश्वीकरण आधुनिक विश्व का वह स्तम्भ है जिस पर खड़े होकर दुनिया के हर समाज को देखा, समझा और महसूस किया जा सकता है। वैश्वीकरण आधुनिकता का वह मापदण्ड है जो किसी भी व्यक्ति समाज राष्ट्र को उसकी भौगोलिक सीमाओं से परे हटाकर एक समान धरातल उपलब्ध कराता है, जहाँ वह अपनी पहचान के साथ अपने स्थान को पुष्ट करता है। वैश्वीकरण के प्रवाह में आज कोई भी भाषा और साहित्य अछूता नहीं रह गया है, वह भी अपनी सरहदों को पारकर विश्व भर के पाठकों तक अपनी पहचान बना चुका है जिसमें दुनिया भर के प्रबुद्ध पाठक भी एक दूसरे से जुड़ सके हैं और साहित्य का वैश्विक परिप्रेक्ष्य में मूल्यांकन संभव हो सका है।

हिन्दी भारतवर्ष की प्रमुख भाषा है। आंकड़े बताते हैं कि देश में हिन्दी को मातृभाषा के रूप में प्रयोग करने वाले भारतीयों का प्रतिशत लगभग 43 है। यह मातृभाषा के रूप में बोलने वालों का आंकड़ा है, यदि हम संपर्क और द्वितीय भाषा के रूप में प्रयोग करने वाले भारतीयों की संख्या भी इसमें जोड़ दें तो इसका प्रतिशत बहुत अधिक बढ़ जाता है। भारत के लगभग सभी क्षेत्रों में बसने वाले लोगों की संपर्क भाषा हिन्दी है। उत्तर से दक्षिण में बसने वाले लोगों और दक्षिण से उत्तर पूर्व में बसने वाले लोगों की संपर्क भाषा भी हिन्दी ही है। हिन्दी के अतिरिक्त कोई और भाषा इस देश की संपर्क भाषा हो भी नहीं सकती है। इस संदर्भ में हम यह रेखांकित कर सकते हैं कि अंग्रेजी तो बिल्कुल भी देश की संपर्क भाषा नहीं बन सकती क्योंकि यह देश की जनसंख्या की एक प्रतिशत से भी कम लोगों की मातृभाषा है। स्वतंत्रता आंदोलन के दौरान गांधी जी ने इस स्थिति को पहचानते हुए ही कहा था कि "कांग्रेस अधिवेशन -की कार्यवाही केवल हिन्दी में होगी, क्योंकि संपूर्ण राष्ट्र तक यदि हमें कांग्रेस का संदेश पहुंचाना है तो यह केवल हिन्दी के माध्यम से ही संभव हो सकता है।"

यदि हम वैश्विक परिदृश्य में हिन्दी का प्रयोग करने वालों की स्थिति का अवलोकन करें तो पाते हैं कि वर्ष 1952 ई. में हिन्दी विश्व में पांचवें स्थान पर थी जबकि 1980 ई. के आस-पास वह चीनी और अंग्रेजी के बाद तीसरे स्थान पर आ गयी। वर्ष 1991 की जनगणना में हिन्दी को मातृभाषा घोषित करने वालों की संख्या के आधार पर पाया गया कि इसकी संख्या पूरे विश्व में अंग्रेजी भाषियों की संख्या से

कहीं अधिक है। इसी सम्बंध में भाषाविद जयंती प्रसाद नौटियाल, जिन्होंने लगातार 20 वर्ष तक भारत और विश्व में भाषाओं सम्बन्धी विभिन्न अध्ययन प्रस्तुत किये हैं, का कहना है - "विश्व में हिन्दी प्रयोग करने वालों की संख्या चीन से भी अधिक है और हिन्दी अब प्रथम स्थान पर है। उसने अंग्रेजी समेत विश्व की अन्य सभी भाषाओं को पीछे छोड़ दिया है।"2

हिन्दी के विकास और विस्तार की कहानी बड़ी रोचक और उतार-चढ़ाव से भरपूर है। मध्यकाल की शैरसेनी अपभ्रंश से विकसित पश्चिमी हिन्दी से निःसृत खड़ी बोली का विकास आधुनिक काल में हुआ। स्वतंत्रता आंदोलन के दौरान हिन्दी ने देश को एकता के सूत्र में बांधने का कार्य किया। भारत के स्वाधीनता आंदोलन में पूरे देश को जोड़ने में हिन्दी का महत्वपूर्ण योगदान रहा है। "स्वाधीनता संग्राम में हिन्दी और लोकभाषाओं की भी महत्वपूर्ण भूमिका रही है। स्वाधीनता की बलिवेदी पर न्योछावर होने की लौ जो देशवासियों के भीतर जगाई गई, वह हिन्दी भाषा के माध्यम से ही जगाई गई थी। क्योंकि इस संग्राम में हर तबके हर मजहब, हर भाषा और विभिन्न संस्कृतियों के जानने वाले लोग थे, जिनके मध्य संचार और व्यवहार का कार्य हिन्दी ही करती थी। स्वाधीनता संग्राम में सामान्य जन की भागीदारी महत्वपूर्ण रही है। विशिष्ट लोगों का कार्य दिशा-निर्देशन करना एवं उन्हें सही व गलत राह की पहचान कराना था। भारत में स्वाधीनता की जो लौ जलाई गयी, वह मात्र राजनैतिक स्वतंत्रता के लिए ही नहीं थी वरन् सांस्कृतिक अस्मिता की रक्षा के लिए भी प्रमुख थी। भारत में साहित्य, संस्कृति और हिन्दी एक दूसरे के पर्याय रहे हैं, ऐसा कहना कोई अतिशयोक्ति नहीं होगी।"

अंतिम दशकों एवं इक्कीसवीं सदी के पहले दशक में हिन्दी भाषा में जो परिवर्तन हुए हैं वे साधारण नहीं हैं। आज हिन्दी का स्वरूप ग्लोबल हो चला। भाषा और व्याकरण में नए प्रयोग किये जा रहे हैं। साथ ही आज हिन्दी का महत्व अन्तर्राष्ट्रीय स्तर पर भी बढ़ रहा है। आज दुनिया की कोई ऐसी जगह नहीं है जहाँ भारतीय न हों। अप्रवासी भारतीय पूरे विश्व में फैले हुए हैं, यदि हम आंकड़ों पर गौर करें तो पाते हैं कि विश्व में फैले इन अप्रवासी भारतीयों की संख्या लगभग 2 करोड़ है जिनके मध्य हिन्दी का पर्याप्त प्रचार प्रसार है। "आज हिन्दी भाषा का अध्ययन विश्व के अनेक देशों में प्राथमिक स्तर पर, माध्यमिक स्तर पर, तो कहीं विश्वविद्यालय स्तर पर हो रहा है। कहीं यह अपनी मातृभूमि भारत से जुड़े रहने का भावात्मक माध्यम लगता है तो कहीं इसका उद्देश्य आधुनिक भारत के अंतर्मन को समझना है। विश्व में हिन्दी शिक्षण को बढ़ावा देने के लिए निजी संस्थाएँ, धार्मिक संस्थाएँ और सामाजिक संस्थाएँ तो आगे आ ही रही हैं, सरकारी स्तर पर विद्यालय एवं विश्व विद्यालयों द्वारा भी हिन्दी शिक्षण का बखूबी संचालन किया जा रहा है। उच्च अध्ययन संस्थानों में भी अध्ययन-अध्यापन एवं अनुसंधान की अच्छी व्यवस्था है।" इस सम्बंध में अमेरिकी विद्वान डॉ. शोमर का कहना है "अमेरिका में ही 113 विश्वविद्यालयों और कॉलेजों में हिन्दी अध्ययन की सुविधाएँ उपलब्ध हैं, जिनमें से 13 तो शोध स्तर के केन्द्र बने हुए हैं। आँकड़े बताते हैं कि इस समय विश्व के 143 विश्व विद्यालयों में हिंदी शिक्षा की विविधि स्तरों पर व्यवस्था है। 5

आज दुनिया में लगभग 45 से अधिक देशों के विभिन्न विश्वविद्यालयों में हिन्दी का पठन-पाठन और शिक्षा जारी है। भारत के बाहर जिन देशों में हिन्दी का बोलने, लिखने-पढ़ने तथा अध्ययन और अध्यापन की दृष्टि से प्रयोग होता है, उनको अध्ययन की सुविधा की दृष्टि से निम्न वर्गों में बांटा जा सकता है -

1. जहाँ भारतीय मूल के लोग अधिक संख्या में रहते हैं, जैसे- पाकिस्तान, नेपाल, भूटान, बंगलादेश, म्यामांर, श्रीलंका व मालदीव आदि।

2. भारतीय संस्कृति से प्रभावित दक्षिण पूर्वी एशियाई देश जैसे इंडोनेशिया, मलेशिया, थाइलैंड, चीन, मंगोलिया, कोरिया तथा कनाडा ।
3. जहाँ हिन्दी को विश्व की आधुनिक भाषा के रूप में पढ़ाया जाता है, जैसे- अमेरिका, आस्ट्रेलिया, कनाडा और यूरोप के देश ।
4. अरब तथा अन्य इस्लामी देश जैसे संयुक्त अरब अमीरात (दुबई), अफगानिस्तान, कतर, मिश्र, उजबेकिस्तान, कजाकिस्तान, तुर्कमेनिस्तान आदि ।

निश्चित रूप से आज हिन्दी अन्तर्राष्ट्रीय स्तर पर किसी पहचान की मोहताज नहीं है वरन उसने विश्व परिदृश्य में एक नया मुकाम हासिल किया है। अमेरिका जो कि आज उन्नत टेक्नोलाजी, बेहतर शिक्षा, दूर संचार के क्षेत्र में दुनिया में अग्रणी है वहाँ भी हिन्दी भाषा का प्रयोग बढ़ा है और इसके प्रचार-प्रसार की पुरजोर वकालत की जा रही है। अमेरिका के पूर्व राष्ट्रपति जार्ज बुश ने तो राष्ट्रीय सुरक्षा भाषा कार्यक्रम के तहत अपने देशवासियों से हिंदी, फारसी, अरबी, चीनी व रूसी भाषाएँ सीखने को कहा था। अमेरिका जो कि अपनी भाषा और पहचान को लेकर दुनिया में श्रेष्ठता का दावा करता है, हिन्दी सीखने में उसकी रुचि का प्रदर्शन निश्चित ही भारत के लिए गौरव की बात है। अमेरिकी राष्ट्रपति ने स्पष्टतया घोषणा की कि "हिन्दी ऐसी विदेशी भाषा है, जिसे 21वीं सदी में राष्ट्रीय सुरक्षा और समृद्धि के लिए अमेरिका के नागरिकों को सीखना चाहिए। 7

उपसंहार :

निःसंदेह आज हिन्दी का फलक विस्तृत हुआ है। भारत के साथ-साथ आज हिन्दी विश्व भाषा बनने को तैयार है। आज हिन्दी में वह सामर्थ्य है जो पूरे देश को एक सूत्र में पिरोकर रख सकती है। आज हिंदी बाजार और व्यापार की प्रमुख भाषा बनकर उभरी है। हिन्दी आज अंतर्राष्ट्रीय स्तर पर अपने पैर जमाने में कामयाब हुई है। अब वह संयुक्त राष्ट्र संघ की भाषा बनने के लिए प्रयत्नशील है। हिन्दी के प्रचार-प्रसार और विकास में सभी भाषा-भाषियों का महत्वपूर्ण योगदान रहा है। वैश्विक फलक पर हिन्दी को स्थापित करने के लिए जहाँ एक ओर साहित्यकारों, विभिन्न पत्र-पत्रिकाओं ने इसकी पृष्ठभूमि तैयार की तो वहीं दूसरी तरफ हिन्दी फिल्मों, गीतों, विज्ञापनों, बाजार, कम्प्यूटर, इंटरनेट आदि ने इसे विस्तीर्ण किया है।

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दलित रंगभूमीचा उदय आणि विकास

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सुरुवातीच्या काळातील अधुरा असलेला मराठी दलित नाट्यलेखनाचा प्रवास अलीकडच्या काळात बहरत चालला आहे असे दिसून येते. कथा, कविता आणि कादंबरी या साहित्य प्रकारापेक्षा नाटक हे जनसमुहाशी प्रत्यक्ष संवाद साधणारे आणि समाजजागृतीचे अत्यंत प्रभावी साधन आहे. दलित समाज आणि दलित साहित्य चळवळीच्या दृष्टीने दलित नाटकाचे हे प्रभावित साधन फार मोठ्या प्रमाणात व्यक्त होताना दिसून येत आहे.

आज घडीला मराठी नाट्य रंगभूमीचा विचार केला तर असे दिसून येते की, प्राचीन पारंपरिक पद्धतीच्या नाटकाचे स्वरूप बदलत चालले असून नवनवीन नाट्य प्रयोग अवतीर्ण होताना दिसून येते. मराठी रंगभूमीच्या बाबतीत प्रा.भालचंद्र फडके असे म्हणतात की, 'एका बाजूला जीवनातील क्रौंचाचे, हिंसाचाराचे व सुरताचे चित्रण होत आहे तर दुसऱ्या बाजूला मांगल्याची, मूल्यांची पूजा चालू आहे. कोणत्याही देशाची रंगभूमी त्या त्या जनतेची सुखदुःखे, त्यांच्या समस्या, त्यांच्या आशा- आकांक्षा, स्वप्ने रंगवीत असतात'. मराठी रंगभूमीवर मराठी माणसाचे, त्याच्या जीवनातील प्रसंगाचे, त्याच्या मनाचे जे दर्शन घडते ते अधूरे आहे. कारण या मराठी रंगभूमीवर उभे राहणारे नाटक हे एका विशिष्ट समाजातील जीवनाला अपरिहार्यपणे स्पर्श करणारा वर्ग आणि या नाटकाचा आस्वाद घेणारा प्रेक्षक वर्ग हा त्याच समाजातील आहे हे निश्चित.

आजच्या आधुनिक तंत्रज्ञानाच्या युगात दलितांवर अमानुषपणाचे, जुलूमी अत्याचाराचे, विकृत मनोवृत्तीचे अन्याय होत असताना आणि माणुसकीला काळीमा फासणाऱ्या घटना घडत असतानाही आधुनिक मराठी नाट्य रंगभूमीने या निष्पाप जीवन जगणाऱ्या आणि हाल अपेष्टा सहन करणाऱ्यांकडे फारसे लक्ष वेधले असे दिसत नाही. परंतु मराठी नाट्य रंगभूमीची आणि तिच्या घडामोडींचे स्वरूप लक्षात घेता असे दिसून येते की, आज आपल्या मराठी रंगभूमीवर येऊ पाहणाऱ्या दलित नाट्याचे व दलित रंगभूमीचे निराळेपण पटकन लक्षात येते. म्हणून दलित साहित्य चळवळीच्या दृष्टीकोनातून नाही तर संपूर्ण सामाजिक परिवर्तनाच्या क्रांतीची हुबेहूब प्रेरणा आणि मानसिक ताकद प्राप्त करून देऊ शकणारे अत्यंत प्रभावी साधन आणि महत्त्वाचे माध्यम म्हणजे आजघडीला दलित नाट्यलेखन आहे हे समजून घेतले पाहिजे.

मराठी नाटकाची परंपरा : जशी मराठी रंगभूमीला प्राचीन परंपरा लाभलेली आहे तशी परंपरा दलित रंगभूमीच्या इतिहासात सापडत नाही. विसाव्या शतकात दलित कवितेप्रमाणे दलित नाटक काही प्रमाणात चित्रित होताना दिसते. सत्यशोधक चळवळी पासून सुरु होणारा तमाशा, वगनाट्य, फार्स, दंडारी, जलसे, प्रहसने अशा प्रकारातून दलित नाटकाचे स्वरूप व्यक्त होताना दिसते. दलित नाटकाचे पहिले प्रवर्तक म्हणून किसन फागुजी बनसोडे यांच्याकडे पाहिले जाते. तमाशा, वगनाट्य आणि प्रहसणाऱ्या माध्यमातून बनसोडेनी दलित नाटकाला सुरुवात केली. दलित नाट्याचा आढावा घेताना डॉ. प्रभाकर गणवीर लिहितात, 'सत्यशोधक जलशांनी घराघरातून नवक्रांतीचा विचार पसरविला. या जलशात बरीचशी प्रहसने किसन फागुजी बनसोडे यांनी रचलेली दिसतात. त्यात सामाजिक जाणीवा होत्या, त्याचप्रमाणे जुन्या प्रथेचे उच्चाटन, रूढी-परंपरा यावर प्रकाश टाकण्याचे कार्यदेखील या प्रहसणांनी केलेले आढळते.

त्या काळात प्रसिद्ध झालेले भट आणि भटजींचा संवाद हे किसन फागुजी बनसोडे रचित उपाहासात्मक प्रहसन सामाजिक व्यंगावर प्रकाश टाकण्यात अग्रेसर ठरले. त्या दृष्टीने केशव मेश्राम यांची कविता नाट्य उद्बोधन करताना दिसते ती अशी.

रंगमंचावर मी पाय टाकतात डफावर थाप पडली !

झाडा झाडावर लटकलेली वटवाघुळे दचकली !

झाडीतले जून जुनाट काजवे दचकून उडाले!

त्यांचे कुल्ले झगमगले, साऱ्यांना उजेडच वाटला !

माझ्या पहिल्याच एन्ट्रीला अंधार टरकन फाटला !

या ओळी वाचल्या म्हणजे नाटकाचा आविष्कार घडून येतो. अण्णाभाऊ साठे आणि शाहीर अमरशेख यांनी आपल्या सामाजिक, आर्थिक, राजकीय विषयावरील मुक्त लोकनाट्याच्या रूपाने महाराष्ट्रात प्रचंड मोठ्या प्रमाणात जनजागृती केली असे दिसते.

त्याचबरोबर सामाजिक जलसेही दलित नाट्याचे स्वरूप आहे हे दिसून येते. डॉ. बाबासाहेब आंबेडकरांच्या सुरुवातीच्या काळात त्यांच्या सामाजिक, राजकीय कार्याचे महत्त्व जलसेकारांनी खेडोपाडी आणि घोरोघरी पोहोचविले. त्यांच्या त्या सामूहिक जलशाला नाट्य संगीताचे व मुक्त नाट्याचेच स्वरूप प्राप्त होते. त्यात सामाजिक सुधारणा, राजकीय हक्काची जाणीव, ओतप्रोत भरलेली असे दिसते. महाडचा सत्याग्रह, नाशिकच्या काळाराम मंदिर सत्याग्रह, या ऐतिहासिक घटनांमुळे तर शाहीर जलसेकारांच्या प्रतिभेला नवीन अंकुर फुटला आणि बहरत गेला. महार वतन, गुलामीची प्रथा नष्ट करणारे, तसेच अन्याय अत्याचाराविरुद्ध विद्रोहाचे बंड पुकारणारे, आव्हान देणारे सारे समाजमन पेटविणारे नाट्यसामर्थ्य त्यांच्या तमाशात जलशात असे. खटकेबाज संवाद, अस्सल विनोद, सवाल आणि जवाब यातून अनेक विषयाचे आकलन केले जात होते, गोंधळ, जागरण, भासूड, एकतारी भजन याही प्रकारांचा त्यात उपयोग होत असे.

किसन फागुजी बनसोडे : पहिला दलित नाटककार, १९२४ सालात 'संत चोखामेळा' हे नाटक बनसोडे यांनी लिहिले. हा त्यांचा पहिला अनुभव होता. त्यानंतर 'एका साधूची फजिती', 'पारतंत्र्य विमोचन', 'अंत्यज सुधारण्याचा मार्ग', असे काही तमाशेही त्यांनी लिहिले आहे. त्यांनी लिहिलेले 'सनातन धर्माचा पंचरंगी तमाशा' हे चांगलेच गाजले. उपहासगर्भता, स्पष्टोक्ती यामुळे या तमाशाने त्या काळात जनमानसात बंडखोरीची भावना निर्माण केली.

प्रा.म.भि.चिटणीस : चिटणीस यांचे 'युगयात्रा' हे नाटक १९५५ सालात लिहिलेले आहे.

बाबासाहेब आंबेडकरांच्या वाढदिवशी, त्यांच्या समक्ष सादर केलेले हे नाटक आहे. हे नाटक बराच प्रभाव सोडून जाते. या नाटकाचा दुसरा प्रयोग १४ ऑक्टोबर १९५६ सालात नागपूरला दीक्षाभूमीवर करून दाखविण्यात आला. प्राचार्य चिटणीसांना दलित रंगभूमीची चांगलीच जाणीव होती हे त्यांच्या नाटकातून दिसून येते. या नाटकातील एक पात्र नाटकाच्या सुरुवातीलाच म्हणतो, 'गावकुसाबाहेरच्या लोकांचे जीवन आणि गावातील लोकांचे जीवन यात जमीन अस्मानचा अंतर होता, त्या भाग्यशाली लोकांच्या जीवनात रोज नवा दिवस उगत होता. रोज नव्या आशा मोहरत होत्या परंतु तो एक पंचमाश गावकुसाबाहेरचा अभागी भारत प्राचीन काळात कोण्या एका अशुभ क्षणी त्याची प्रगती जी खुंटली, त्याचा दिवस जो मावळला त्यात काहीच बदल घडला नाही'. आजपर्यंत ज्यांची माणुसकी हिरावली जाऊन पशुहूनही हीण जगणं त्यांच्या कपाळी आलं होतं त्या सर्वांचा अन्यायाविरुद्ध घुमसणारा मूक क्षोभ त्या पुरुषांच्या अंतःकरणात प्रकट झाला. या नाटकात अनेक वेगवेगळी ऐतिहासिक प्रसंगाची दृश्य परिणामकारकपणे चित्रित केलेली दिसतात. युगायुगाच्या यात्रेत यातना सोसत आलेल्या दलितांना अखेरीस अस्मितेचा प्रकाश मिळाला असे लेखकाने सुचविले आहे. या नाटकाच्या शेवटी एका युवकाने गायिलेले गीत म्हणजे बाबासाहेब आंबेडकर यांच्या कर्तृत्वाची साक्ष आहे असे दिसते.

'दिले जगा आव्हान भीमाने दिले जगा आव्हान'!

'महाडात चवदार तळ्यावर रोवून समर निशाण'!

'मनुचे भीषण शासन करुनी अग्निला बलिदान'!

'सहस्र वर्षे वेशीवरती झाली जी हैराण'!

'त्या जनतेच्या हक्कासाठी दिले जगा आव्हान'!

कमलाकर डहाक : कमलाकर डहाक हे आजच्या नाटककारात एक उत्साही नाटककार. दलित समाजातील ज्वलंत समस्या घेऊन वास्तविक स्वरूपाचे त्यांचे लेखन आहे. 'त्रिशुळाचे चौथे टोक' हे तीन अंकी नाटक त्यांनी लिहिले असून 'पडयामागील पडदा', 'असाही एक दिग्दर्शक', 'चोरांनो शतशः प्रणाम', 'येथे दात बसवितात', 'अंगुलीमालका परिवर्तन', 'मृत्युदिन वा मुक्तिदिन' यासारख्या अनेक एकांकिका त्यांनी सादर केल्या आहेत. मृत्युदिन वा मुक्तीदिन या एकांकिकाने प्रेक्षकांच्या मनावर चांगलाच प्रभाव पाडला होता. भारतीय स्वातंत्र्य हेच मुळात भांडवलशाही, वर्णवाद, आणि जातीयवाद यांचे गुलाम बनले आहेत. या तीन आघोऱ्या प्रवृत्तीच्या मगरमिठीतून स्वातंत्र्याला मुक्त करण्याचा प्रयत्न या नाटकातून केला आहे.

इ. मो. नारनवरे : नारनवरे यांनी 'विद्रोहाचे पाणी पेटले आहे' ही एकांकिका लिहिली आहे. नावाप्रमाणेच ही एकांकिका विषय आणि आशयाचे अन्वर्थक आविष्काराने जुळलेली आहे, आणि दलित जीवनाचे नाट्य लेखकाच्या अभिव्यक्तीने पुरेसे पकडले आहे याची प्रचिती ही एकांकिका वाचल्यावर येते. या नाटकातील सुदर्शना आणि वज्रा हे दोन भाऊ डोळे गमावल्यानंतर शेवटी वैतागून म्हणतात, 'आमच्या वाट्याला अंधार आलाय हे बरेच झाले. त्याचा नाश करण्याची इच्छा तर नाही मरणार कधीच. आमच्या अंधारलेल्या नेत्रज्योती पाजळणारच आहेत. क्रांतीसुर्याचे ताफे तेव्हा'. अशा पद्धतीने आपली भावना व्यक्त करताना दिसतात. दलितांची फसवणूक, विटंबना, छळणूक, बलात्कार असे अनेक प्रसंग एकात्मभाव नाट्यासह कलात्मक रीतीने या नाटकाद्वारे लेखकाने चित्रित केले आहेत.

प्रेमानंद गज्वी : प्रेमानंद गज्वी यांचे गाजलेले नाटक म्हणजे 'घोटभर पाणी'. अस्पृश्यतेचा अत्यंत मूलगामी विषय घेऊन अवतरलेले हे नाटक आहे. सशक्त अभिव्यक्तीची वेधक आणि तात्विक भाषा, त्यात दलितांच्या अंतकरणातील मूलभूत हक्क आणि अधिकार, त्यातून निर्माण झालेले प्रश्न याची योग्यप्रकारे मांडणी लेखकाने केली आहे असे दिसते. त्याचबरोबर मर्मभेदक व हृदयविदारक अनुभूतींचा उत्कट प्रत्यय आपून देणारी. कलात्मक पातळीवरही सफल झालेले दलित जीवनाचे हृदयस्पर्शी नाटक म्हणून या नाटकाचा उल्लेख करावा लागेल.

रत्नाकर मतकरी : मराठी नाट्यसृष्टीत गाजलेले नाव म्हणजे रत्नाकर मतकरी हे होय. त्यांनी अनेक प्रकारचे नाटक लिहिले आहेत. हे त्यांचे एक नाटक चर्चेचा विषय ठरला आहे. प्रेक्षकापुढे कधी प्रश्न निर्माण करणारे, गुंतागुंतीच्या भावनांच्या भोवऱ्यात फिरणारे तरी एका ठाम मतावर उभे असलेले एक विलक्षण नाटक समजले जाते. प्रेक्षकापैकी कोणाला ते न नाट्य, न कथा, न कहानी वाटते तर कोणाला ते दलित जीवनावर असलेली कलात्मकपूर्ण व समर्थ अशी पूर्ण नाट्यकृती वाटते. या नाटकाच्या प्रस्तावनेत वसंत बापट म्हणतात, 'अनेक हकीकतींच्या साधारण विभाज्यावर ही कैफियत उभी आहे. वार्ता कथनाला दृक्सहाय्य दिले आणि संकलनाची कैची चालवली तर एका स्फोटक आणि प्रभावशाली नाटकाचा खेळ उभा राहिल, हे जाणून त्यांनी लोककथा ७८ सादर केलेली आहे'. तिच्यातील नाट्य स्वयंभू आणि स्वतः सिद्ध आहे. परंतु एक नवा विषय घेऊन नव्या तंत्रासह सादर केल्यामुळे प्रेक्षक रसिकामध्ये हे नाटक न नाट्याचा भ्रम निर्माण करणारे आहे हे, खरे पण हेच या नाटकाचे वैशिष्ट्य मानले पाहिजे.

रत्नाकर मतकरी यांनी पारंपरिक नाट्यतंत्राची निरगाठ सुरगाठ वगैरे चाकोरी मोडून काढली आहे. त्यांनी नाट्य विषय केलेल्या वार्ताकैफियतीच्या अखेरीस पूर्णविरामाचे शील न ठेवता प्रश्नांकित शेवट केला आहे असे दिसते. खऱ्या अर्थाने न्यायाची भावना समाजात वावरताना दिसत नाही. आजच्या दलित विद्रोहाने दरारून अत्याचारी लोक आपले हितसंबंध धोक्यात येत असल्याच्या भावनेने अधिकच पिसाळत आहेत. त्यांचे जुलूम वाढतच आहेत. ही वस्तुस्थिती आहे. पण हे जुलूम, अत्याचार, छळणूक, पिळणूक, बलात्कार यांचे सत्र कुठपर्यंत चालू राहणार आहे ? ते आता संपवून माणुसकीचे झरे मोकळे होतील अशा विवेकाची व समता न्यायाची प्रतिष्ठापना करणारा प्रवाह या समाजमनातून कधी वाहणारच नाही काय ? की या स्फोटक, भीषण बीभत्स व करुण वार्ता हकीकतीना हा समाज सामाजिक भूषणाच्या विजय घंटा म्हणूनच मिरवणार आहे का ? हा या नाटकातील विचारलेला प्रश्न अत्यंत मुलगामी, महत्त्वाचा आणि निकडीचा आहे. आणि हाच खरा दलित प्रश्न आहे असा विचार त्यांनी आपल्या नाटकातून व्यक्त केला आहे.

एकंदरीत मराठी नाट्यसृष्टीत दलित रंगभूमीचा उदय आणि विकास योग्य पद्धतीने झाला आहे असे निदर्शनास येते.

संदर्भ ग्रंथ :

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पर्यावरण, रोजगार व आरोग्य

डॉ. बी.एन. कावळे

(संशोधन मार्गदर्शक)

(प्राध्यापक व समाजशास्त्र विभाग प्रमुख)

इंद्रराज कला वाणिज्य व विज्ञान महाविद्यालय सिल्लोड, ता सिल्लोड जि. औरंगाबाद.

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गोषवारा:-

प्रस्तुत संशोधनात पर्यावरण, रोजगार आरोग्य विषयक समस्यांचा अभ्यास करण्यात आला असून त्यामध्ये मानवी विकासात सुरुवातीला माणूस जेव्हा जंगली अवस्थेत होता तेव्हा त्याच्या गरजा पूर्णत निसर्गाकडून मिळणाऱ्या साधन संपत्तीचा वापर करून पूर्ण करित होता तेव्हा मानव स्वावलंबी होता, परंतु जसजसा मानवाच्या गरजा वाढत गेल्या तेव्हा साधन संपत्तीच्या अति वापरामुळे पर्यावरणाचा समतोल बिघडू लागला यातूनच मानवी आरोग्याच्या समस्या निर्माण होऊ लागल्याचे दिसून येते. तसेच हासंशोधन लेख लिहित असतांना वर्णनात्मक संशोधन पद्धतीचा वापर करून, तथ्य संकलनासाठी द्वितीयक साधनांचा वापर केला आहे.

प्रस्थावना:-

पर्यावरण, रोजगार आणि आरोग्यविषयक समस्यांचा अभ्यास करत असतांना असे लक्षात येते की ही समस्या भारतातच नव्हे तर जगभरातील विविध देशांमध्ये प्रामुख्याने आढळून येते. कारण संपूर्ण पृथ्वीतलावरील मानवी समूहाची प्राथमिक गरज अन्न, वस्त्र व निवारा हीच असल्याचे दिसून येते. आणि याच तीन गरजा पूर्ण करण्यासाठी जगभरातील सर्वचमानवी समूह, आदिम समाज व्यवस्थेपासून ते आजच्या प्रगत समजल्या जाणाऱ्या जागतिक सामाज व्यवस्थेपर्यंत मार्गक्रमण करत आलेला आहे. अश्या प्रकारचे मार्गक्रमण करित असतांना या मानवी समूहांनी आपले जीवन अधिक सुखकर कसे करता येईल, या करिता नवनवीन शोध लावले आहेत. त्यामध्ये स्वतःची भूक भागविण्याकरिता प्राण्यांची शिकार करता येईल अशी दगडी हत्यारे व अन्न शिजवण्याकरिता मातीच्या भांड्यांपासून सुरु झालेला प्रवास आजच्या आधुनिक युगातील स्वः संरक्षणासाठी आण्विक व जैविक शस्त्र व अन्न शिजवण्यासाठी वेगवेगळ्या धातूंपासून बनवलेले विविध प्रकारची भांडी ईतपर्यंत येऊन थांबतो. परंतु या मधल्या काळात म्हणजेच आदिम युग ते आजचे प्रगत समजले जाणारे आधुनिक युग या मधल्या कालखंडात मानवाने केलेल्या प्रगतीचा परिणाम म्हणून पर्यावरणाचा समतोल बिघडलेला दिसून येतो. या बिघडलेल्या पर्यावरणाचा मानवी समाजव्यवस्थेवर काय परिणाम होऊ शकतो याचा अभ्यास प्रस्तुत शोध निबंधामध्ये करण्यात येत आहे.

Keyword: पर्यावरण, रोजगार, आरोग्य

संशोधन पद्धती:- प्रस्तुत संशोधनात पर्यावरण, रोजगार व आरोग्यहा शोध निबंध लिहित असतांना वर्णनात्मक संशोधन पद्धतीचा वापर करण्यात आला आहे, तसेच तथ्यसंकलनासाठी द्वितीयक साधनांचा वापर करण्यात आला आहे.

संशोधनाची उद्दिष्टे:-

१. पर्यावरण, रोजगार आणि आरोग्य यांच्या परस्पर संबंधाचा अभ्यास करणे.

प्रस्तुत संशोधन:-

आजचा प्रगत आधुनिक मानव जस जसा यशाच्या शिखरावर प्रगती करित पुढे जात आहे तस तसा तो पर्यावरणाचा न्यास करित आहे. पृथ्वीवरील संपूर्ण सजीव सृष्टि ही निसर्गावर अवलंबून आहे. त्या सजीव सृष्टीत इतर सर्व प्राण्यात मानव प्राणी अतिशय बुद्धिमान असल्याने त्याने आदिम युगापासूनच आपल्या बुद्धीच्या जोरावर स्वतःच्या अन्न, वस्त्र व

निवारा संबंधित प्राथमिक गरजा भागवण्यासाठी पूर्णतः निसर्गावर अवलंबून असल्याचे दिसते. परंतु हा मानव जसजसा उत्क्रांत होऊ लागला तेव्हा त्याने अनेक नवनवीन शोध लावले. त्यामध्ये अग्नि, दगडी अवजारे, शेती, पाळीव प्राणी, मातीची भांडी तसेच चाकाचा शोध लावला. याच कालावधीत मानवाने आपली पाण्याची गरज भागवण्यासाठी नदीकाठी आपली मानवी वस्ती निर्माण केली. या कालखंडात मानवाने आपल्या दैनंदिन गरजा भागवितांना शेती बरोबरच जंगलात उपलब्ध असणारे फळे, फुले आणि कंदमुळे गोळा करून आपल्या गरजा भागविल्या आहेत, या कालखंडात मानवी समाजजीवन शेती आणि वन संपत्ती वर आधारीत असल्याने, मानवाच्या दैनंदिन गरजा भागवण्यासाठी रोजगार निर्मिती ची गरज आदिम समाजव्यवस्थेत भासत नव्हती. कारण त्यांना आवश्यक असणाऱ्या वस्तूंची उपलब्धता ते स्वतः करित. त्यांची गरज पूर्ण होऊन शिल्लक राहिलेल्या वस्तू ते इतरांना देत. वस्तू विनिमय पद्धत असल्याने गरज भागविणे हा उद्देश्य होता पैसा कमविणे हा उद्देश्य नव्हता. या कालखंडात पर्यावरणाशी निगडित कुठलीही समस्यांची जाणीवआदिम मानवी समूहास नव्हती.

परंतु आजच्या आधुनिक युगात जंगलातील मोठ्याप्रमाणात वनसृष्टी मानवाने नष्ट केल्याने त्याचा परिणाम आता पर्यावरणावर होऊ लागला आहे. आपल्या भारत देशात ७०% लोक शेती आणि शेतीशी निगडित व्यवसायावर अवलंबून आहे. आणि ही शेती पूर्णतः निसर्गावर अवलंबून असल्याने शेतीतून मिळणाऱ्या आर्थिक उत्पन्नाची शास्वती कमी झाली आहे. त्यामुळे रोजगारक्षम तरुण रोजगार मिळविण्याकरिता वर्षानुवर्षापासून धडपड करत असल्याचे दिसून येते. भारत देशाचा विचार केल्यास सन १९५२ मध्ये जवळपास ८५० रोजगार कार्यालयामध्ये नोंदणीकृत रोजगार न मिळालेल्या व्यक्तींची संख्या ४.३७ लाख होती. १९६७ मध्ये त्यामध्ये वाढ होऊन २७.४० लाख झाली, १९७१ मध्ये ५०.९९ लाख, १९७६ मध्ये ९३.२६ लाख, १९८१ मध्ये १७८.३ लाख, १९८३ मध्ये २१९.५ लाख, १९८५ मध्ये २६२.७ लाख, १९८७ मध्ये ३०२.४ लाख, १९९० मध्ये ३४६.३ लाख आणि १९९१ मध्ये ३६३.० लाख लोक

बेरोजगार असल्याचे दिसून येते. अशा प्रकारे भारतातील बेरोजगार असणाऱ्या लोकांची संख्या वाढण्याचे आणखी एक कारण म्हणजे मानवी लोकसंख्येच्या प्रमाणात जमीन. लोकसंख्या वाढत आहे पण जमीन वाढवता येत नाही. आपल्या भारत देशात जमिनीचे प्रमाण १९६५ मध्ये प्रति व्यक्ती ०.१५ हेक्टर वरून आणखी कमी होऊन, १९७५ मध्ये ०.१३ हेक्टर प्रति व्यक्ती आणि आवश्यक वाटू लागले. त्यासाठी अमेरिकेची रूपरेषा समोर ठेवली. अमेरिका या देशाच्या राष्ट्रीय उत्पन्नात शेतीचा वाटा सन १८३९ मध्ये ६९% वरून खाली येऊन सन १९२८ मध्ये १२% आणि सन १९९२ मध्ये ४ % झाले आणि सद्यस्थितीत ३% शेतीचा वाटा आहे बहुतेक विकसित समजल्या जाणाऱ्या देशात हीच स्थिती दिसून येते.

त्यामुळे भारत देशाचा विकास करायचा असेल तर विकसित देशांप्रमाणे नियोजन आखून बेरोजगारीचे प्रमाण कमी करण्यासाठी शेतीवर आधारीत लोकसंख्येला बहुसंख्य प्रमाणात उद्योग व्यवसाया

मध्ये गुंतवावे लागेल. जेणे करून प्रति मानसी उत्पन्न वाढेल.परंतु हे करीत असतांना वाढत्या कारखानदारीमुळे विषारी वायूचे प्रमाण दिवसेंदिवस पर्यावरणास हानी पोहचवत असल्याने पर्यावरणाचे प्रश्न निर्माण झाले आहे. त्यामुळेच पर्यावरणासाबंधी १९७१ साली ‘स्टोक होम’ येथे एक आंतरराष्ट्रीय परिषद भरल्याचे दिसून येते. तसेच त्यानंतर जून १९९२ मध्ये रिओ- डी-जानेरो (ब्राझील) मध्ये पृथ्वी शिखर परिषद भरल्याचे दिसून येते. तेव्हा पासून पर्यावरणाविषयी जाणीव जागृती वाढू लागली. एकीकडे ‘विकास’ ही संकल्पना वापरली तरी त्यात किंवा आधुनीकरण प्रक्रियेमध्ये वस्तू-उपभोगाची पातळी वाढणे अन्युस्युत आहेच आणि उपभोग पातळी वाढवायची म्हणजे पर्यावरणाचा विनाश अटळ होऊन बसतो.

म्हणूनच आजच्या आधुनिकीकरणाच्या प्रक्रियेत विकासाची प्रक्रिया घडवून आणतानी चिरंजीवी विकास कसा घडवता येईल याचा विचार करणे गरजेचे आहे. कारण आज मानवी जीवन सुखकर करण्याच्या नादात आपण पर्यावरणाची हानी करत आहोत त्याचा परिणाम म्हणूनच आता मानवी आरोग्य धोक्यात आले आहे. आधुनिकीकरणाची प्रक्रिया होण्याच्या अगोदर माणूस अत्यंत साधे जीवन जगत होता. जंगलातून किंवा शेतातून गायीसाठी चारा आणला जायचा किंवा घरची दुभती जनावरे जंगलात चरायला जायची, त्या जनावरांपासून दुध, शेन आणि गोमुत्र मिळायच दुधाचा वापर पूर्णान्न म्हणून केला जायचा शेनापासून गोवऱ्या थापल्या जायच्या, गोवऱ्या चुलीत इंधन म्हणून वापरल्या जात, चुलीत इंधन म्हणून वापरलेली गोवारीची राख सकाळी दात घासण्यासाठी वापरली जात, आणि गोमुत्र हे शेतातील पिकांवर शिंपडल तर ते पिकांच्या वाढीसाठी उपयुक्त होते. मानवाच्या या अवस्थेत पर्यावरणाची कुठलीही हानी होत नव्हती, मानवाला रोजगार शोधण्याची आवश्यकता नव्हती, पशुपालन आणि शेतीतून पिकवलेल्या थोड्याफार धान्यावर तो आपल्या कुटुंबाच्या गरजा भागवीत होता. आणि निसर्गाच्या सानिध्यात असल्याने मानवी आरोग्य चांगल्या प्रकारचे होते.

परंतु आजच्या आधुनिक विकासाच्या प्रक्रियेत वाढत्या शहरीकरणाचा परिणाम म्हणून पर्यावरणाचा न्हास तर होतोच आहे परंतु त्यासोबतच वाढत्या गरजा लक्षात घेता आता मानवी विकासाकरिता रोजगार उपलब्ध करणे महत्वाचे झाले आहे सदयस्थितीत आपल्या भारत देशात शिक्षणावर प्रचंड भर दिला जातो आहे परंतु शिक्षणाचा उद्देश्य नोकरी मिळविणे हाच दिसून येतो. आज कित्येक उच्च शिक्षित अर्धवेळ नोकरी करतांना दिसतात डॉ. प्रमोद येवले डॉ. बाबासाहेब आंबेडकर मराठवाडा विद्यापीठाचे कुलगुरू आपल्या भाषणात म्हणतात, ‘चार पदव्या आणि दोन पीएच डी. करून उमेदवार जेव्हा तासिका तत्वावर मुलाखती देण्यासाठी येतात, तेव्हा आम्हाला लाज वाटते.’ अश्या प्रकारे अवस्था आज रोजगाराच्या बाबतीत निर्माण झाली आहे.अशाच प्रकारे महाराष्ट्रातील विना अनुदानित उच्च माध्यमिक शिक्षकांच्या समस्या दिसून येतात रोजगार आहे परंतु योग्य मोबदला शासनाकडून अजूनही दिला जात नसल्याच्या बातम्या दररोज वाचायला मिळत आहेत.यावरून आधुनिक विकासाच्या प्रक्रियेत रोजगाराच्या समस्या आढळून येतात.त्यासोबतच वाढत्यालोकसंख्येला अन्नधान्य, भाजीपाला, दुध, मास आणि अंडी इत्यादी वस्तूच्या उत्पादनासाठी रसायनाचा वापर वाढला असून, त्याचा परिणाम म्हणून मानवी आरोग्य धोक्यात आले आहे तसेच मानवी विकासाच्या प्रक्रियेत वातावरणातील झालेल्या बदलांमुळे श्वसनाचे आजार निर्माण झाले आहेत एकूनच आजच्या विकासाच्या प्रक्रियेत मानवी आरोग्य धोक्यात आले आहे.

सारांश यावरून असे लक्षात येते की जेव्हा मानवाच्या गरजा मर्यादित होत्या तेव्हा मानव नैसर्गिक साधन संपत्ती चा वापर मर्यादित प्रमाणात करत असल्याचे दिसून येते तेव्हा त्याला रोजगाराची आवश्यकता वाटत नव्हती व आरोग्य ही उत्तम होते. परंतु आजच्या आधुनिक युगात मानवाच्या गरजा मर्यादेपेक्षा वाढल्याने आता नैसर्गिक साधन संपत्तीचा वापर भरमसाठ केला जात आहे. त्याचाच परिणाम निसर्गाचे संतुलन बिघडल्याने पर्यावरांच्या समस्या निर्माण झाल्या व मानवी आरोग्य धोक्यात आले आहे.

यावरून पर्यावरण, रोजगार व आरोग्य या संकल्पना एकमेकांशी निगडित आहेत म्हणूनच मानवी रोजगारासाठी विकासाची प्रक्रिया राबवतांना पर्यावरणाचा विचार करून निर्णय घेतला तर मानवी आरोग्याच्या समस्या निर्माण होणार नाहीत.

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समकालीन हिंदी नाट्य लेखिकाओं के नाटकों में स्त्री चेतना

डॉ. मनिषा गंगाराम मुगळीकर

इंद्रराज कला, वाणिज्य एवं विज्ञान महाविद्यालय सिल्लोड

सृष्टि अपने आप में सबसे खूबसूरत और समर्थ रंगमंच है। हिंदी नाट्यविधा यह साहित्य भी है और रंगमंच भी। नाटक और रंगमंच यह पुरातन भारतीय परंपरा है। समसामयिक नाटक की सबसे महत्वपूर्ण उपलब्धि है की पाठक को बेचैन करना। समकालीन नाटककार यह आदर्शपूर्ण समाधान के मोह में न पड़ते हुए जिंदगी के अनेक मुखौटों से पर्दा हटाता है। वह वर्तमान में फैली हर बुराई से सीधा साक्षात्कार करवाता है। समकालीन नाटककार यह अपने परिवेश के प्रति सचेत है। स्वातंत्र्योत्तर भारतीय समाज में बदली हुई परिस्थितियों को देखे तो नाटक साहित्य भी इससे अछुता नहीं रह सका। समाज में व्याप्त हर समस्याओं, पहलुओं को निचोड़कर एक साहित्यकार अपनी रचनाओं में साकार करता है साथ ही इस सामाजिक बदलाओं के दुष्परिणामों से हमें सचेत कराता है। नाटक विधा में हर विभिन्न समस्याओं को अपने-अपने युगीन परिवेश के साथ नाटककारों ने उभारा है। प्राचीन काल से अलग-अलग विषय को लेकर मनोरंजन करनेवाला नाटक अब सामाजिक, राजनैतिक, आर्थिक, पारिवारिक सांस्कृतिक समस्याओं से उपर उठकर एक नई समस्या में उभारा वह है स्त्री चेतना या स्त्री विमर्श।

समकालीन हिंदी नाट्य जगत को नई दिशाओं की ओर अगेसर करके उसे नवीन आयामों से जोड़ने की पहल कई प्रतिभासंपन्न नाटककारों ने की है। उसी तरह कई महिला नाट्य लेखिकाएँ भी नाट्य विधा की ओर मुड़कर सफल नाटककार के रूप में अपना योगदान दे रही हैं। समकालीन नाटक साहित्य में भी लेखिकाओं ने अपना पांडित्य प्रदर्शित किया है। समकालीन महिला नाटककारों में मन्नू भंडारी, कुंथा जैन, मृदुला गर्ग, त्रिपुरारी शर्मा, आशा वर्मा, सरोज बिसारिया, गिरीश रस्तोगी, मधु धवन, उषा गांगुली, मीराकांत विभा रानी, नादिरा जहीर बब्बर आदि प्रमुख हैं। जिस प्रकार स्वतंत्रता आंदोलन के परिणामस्वरूप साहित्य विधा में भी नए प्रयोग हुए उससे भी स्वतंत्रता के बाद भारत में उत्पन्न हुई विभिन्न समस्याओं का प्रभाव लोगों पर पड़ा जिसके परिणाम स्वरूप जैसे परिस्थितियां बदली वैसे सन 60 के बाद नाट्य साहित्य में भी नई सर्जनात्मकता के साथ नया इतिहास शुरू हुआ। समकालीन नाटककारों ने नारी की करुण दशा पर आंसू ही नहीं बहाए अपितु उसकी हालत सुधारने के लिए आवाज भी उठाई हैं। नारियों के साथ हो रहे शोषण, मौजूदा व्यवस्था की कामुकता और अनैतिकता के चंगुल में फंसकर अपनी मान मर्यादा खो बैठने वाली नारियों के संघर्ष को उजागर करने का सार्थ प्रयास भी नाटककारों ने किया है।

महिला रचनाकारों ने जब अपनी रचनाओं में अपनी बात प्रस्तुत की तो उसका तेवर ही बदल गया इसलिए डॉ. एम. षण्मुख जी ने लिखा है, “जब महिलाएँ कसकर लिखने लगी तो सारा सृजनात्मक परिवेश ही तब्दील हो गया।” इन महिला साहित्यकारों ने युग के साथ-साथ अतीत से भी आबद्ध रही हैं। समकालीन हिंदी नाटककारों ने समकालीन विसंगतियों को अपने नाटकों का विषय बनाया है। आठवें एवं नवें दशक में आम आदमी का विश्वास लोकतंत्र से उठा था। महिला नाट्य लेखन और उनके नाटकों में प्रयोग विषय के लिए सर्वप्रथम महिला नाटककारों के नाटकों की खोज जरूरी है। हिंदी साहित्य के इतिहास में महिला नाटककारों के नाम दुर्लभ दिखाई देते हैं। साहित्य के केंद्र में स्त्री रही है किंतु साहित्य सृजन के क्षेत्र में स्त्री साहित्यकारों के नाम कम हैं।

महिला नाटक लेखिकाओं में मन्नू भंडारी का नाम महत्वपूर्ण रहा है। उनका ‘बिना दीवारों का घर’ यह नाटक शिक्षित कामकाजी महिला के जीवन संघर्ष को प्रस्तुत करते हुए लेखिका ने अपनी अस्मिता की

तलाश करते नारी मन को छूने का प्रयास किया है। नाटक की शोभा शादी के बाद भी पढ़ाई जारी करके कॉलेज में लेक्चरर बनती है। स्त्री सेल्फमेड होना पुरुष वर्चस्ववादी समाज के लिए स्वीकार्य नहीं है। मृदुला गर्ग के नाटकों में बहुचर्चित है 'एक और अजनबी' यह स्त्री पुरुष संबंध के नए प्रतिमानों को तलाशनेवाला नाटक है। कुसुम कुमार के 'संस्कारों को नमस्कार' नाटक में उन्होंने नारी सुधार केंद्र महिला आश्रमों में नारी के शोषण को उजागर किया है। विमला रैना के नाटक 'काला सिंदूर' में स्त्री के साथ अन्याय की समस्या को प्रस्तुत किया गया है। 'साथी हाथ बढ़ाना' एकांकी संग्रह की लेखिका सोमवीरा जी के कुल 11 एकांकियों का संग्रह है। इन एकांकियों में सोमवीरा जी ने नारी के अंतर्मन को सर्वथा नूतन रूप देने में सक्षम है। 'धारा और किनारें', 'यमुना के तीर', 'हीरक हार' में भी सोमवीरा ने नारी के मन की परतों को उभारा है।

सुशीला टाकभौर का 'चष्मा' नाटक में बूढ़े पति- पत्नी का जीवन पुनः जीने के लिए फिर से युवा बन जाते हैं अंत में स्त्री- पुरुष असमानता और पुरुष की सर्वोच्चता को खंडित कर स्त्री-पुरुष समानता को प्रतिष्ठित किया गया है। 'व्हीलचेअर' नाटक में स्त्री कमजोर विकलांग मानसिकता की शिकार है। पति के प्रत्येक आज्ञा का पालन करने वाली पत्नी स्वयं को व्हीलचेअर पर देखती है। पति की प्रताड़ना से दुःखी स्त्री एक दिन आक्रोश के साथ व्हीलचेअर को लाथ मारकर पति के साथ बराबरी का अधिकार प्राप्त करती है। विमला रैना समकालीन नाटक साहित्य के सशक्त महिला नाटककार है। उन्होंने अपने नाटकों का विषय नारी समस्या बनाया। स्त्री चेतना की दृष्टि से उनकी 'न्याय' सशक्त नाट्य रचना है। ममता कालिया का 'यहाँ रोना मना है' भी एक नारी केंद्रित लघु नाट्य कृति है। इस नाटक में ममता जी ने ससुराल में पीड़ित नायिका कार्तिकी जो पिता के घर लाड प्यार में पली थी। उसे अपने माँ के गुजर जाने पर भी जाने नहीं दिया जाता है। घर की शादी के काम में लगा देते हैं, वह अपना दुःख बन्नो गीत गाते तथा नाचते-नाचते सारा गम प्रकट करती है। उसने मौन रूप से अपना विरोध दर्शाया। वह विरोध उन समस्त नारियों के विरोध का प्रतिनिधित्व करता है जो ससुराल रूपी काल कोठरी के कैदी हैं। कुसुम कुमार 'ओम क्रांति क्रांति', 'सुनो शेफाली', 'दिल्ली ऊँचा सुनती है', 'रावणलीला', 'संस्कार को नमस्कार' आदि स्त्री चेतना की दृष्टि से सशक्त नाटक है। प्रस्तुत नाटक में दलित युवती है जो सत्ताधारी भ्रष्टाचारियों के छल कपट और अवसरवादीता के खिलाफ जंग बोल देती है। पूरे नाटक में शेफाली का चित्रण व्यक्तित्व से भरपूर युवती के रूप में किया गया है।

त्रिपुरारी शर्मा हिंदी की प्रसिद्ध रंगकर्मी, नाटककार, निर्देशक और प्रबुद्ध प्रशिक्षक है। स्त्री चेतना की दृष्टि से 'बहु', 'अक्स/पहेली', 'रेशमी रुमाल' एवं 'सत्तावन का किस्सा: अर्जाजुन निसा' उल्लेखनीय रचनाएँ हैं। 'बहु' नाटक में सामंती संस्कारों से जर्जर ग्रामीण समाज की एक विधवा युवती की निजी और पारिवारिक स्थिति का मर्मस्पर्शी चित्रण किया गया है। 'बहु' नाटक में बहु के माध्यम से सामंती सोच, जर्मीदार और पुरुष से छली स्त्री की की वेदना को अभिव्यक्त किया गया है। यह केवल एक बहु की वेदना ना होकर समस्त संसार की सभी स्त्रियों की वेदना है और अपनी अस्मिता की खोज करनेवाली नारियों की सराहना भी करती है।

डॉ. गिरीश रस्तोगी का 'अपने हाथ बिकानी' स्त्री के अछूते अनुभव करनेवाला सशक्त नाटक है। समस्त संसार की सभी स्त्रियों की वेदना है और अपनी अस्मिता की खोज करनेवाली नारियों की सराहना भी करती है। स्त्री और पुरुष में हो रहे भेदभाव और पुरुष की स्वार्थी प्रवृत्ति असली रूप दिखाया है। उषा गांगुली का 'अन्तयात्रा' नाटक स्त्री चेतना की दृष्टि से महत्वपूर्ण है एवं इसमें उन्होंने संपूर्ण स्त्री जीवन के संघर्ष एकाभिनय द्वारा मंच पर जिवंत कर दिया है। मीराकान्त इस सदी की सशक्त नाटककार है जिन्होंने अपने नाटकों में ईहामृग में दसवीं शताब्दी की ऐतिहासिक पृष्ठभूमि पर स्त्री के अस्तित्व संकट, निजी

एकांत नारी, नेपथ्यराग में नाटक प्राचीन प्रसंगों के माध्यम से आधुनिक युगीन स्त्री समस्याओं पर प्रकाश डाला है। नाटक में यह दिखाया गया है कि पुरुष अहंकार के कारण विदुषी स्त्री को युग-युगों से नेपथ्य में रहना पड़ा है। ‘अंत हाजिर हो’ नाटक में लड़कियों के साथ होनेवाली पारिवारिक यौन हिंसा का पर्दाफाश करता है।

विभारानी के ‘तनिक प्रेम करें’ नाटक में पारिवारिक जीवन की भूमि में स्त्री जीवन के संघर्ष को उभारने का प्रयास हुआ है। ‘अगले जनम मोहे बिटिया न कीजो’ में यह दिखाया गया है कि स्त्री अपने घर में भी सुरक्षित नहीं। महिला नाटककारों के स्त्री चेतना के नाटकों में स्त्री अस्मिता, पुरुष का वर्चस्ववाद, शोषण का विरोध, संघर्षपूर्ण जीवन, पीड़ा-दर्द, पितृसत्तात्मकता आदि की सशक्त अभिव्यक्ति हुई है। महिला नाटककारों ने नाटकों के माध्यम से यह दर्शाने का सफल प्रयास किया है कि स्त्री दूसरे दर्जे की नहीं है तथा उनकी दूसरी नागरिकता नहीं है, स्त्रियों का भी अपना व्यक्तित्व है और वह अपने अस्तित्व को पहचानकर संघर्ष करना जानती है। स्त्री मुक्ति के संदर्भ में यह नाट्य कृतियाँ गहराई में सोचकर सामाजिक परिवर्तन चाहती हैं। जब दृष्टि बदलने की जरूरत है तो पहले मानसिकता बदलने की जरूरत होगी तभी स्त्री की अस्मिता उभर कर आएगी।

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CITATION ANALYSIS: AN IMPORTANT TOOL OF RESEARCH EVALUATION

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Abstract:

Citation analysis is an important tool of research evaluation. It helps to identify the quality of the information sources. It is a very essential technique to measure the quality of source of material and useful for understanding subject relationships, author effectiveness, publication trends, and so on. It is one of the most widely used methods of bibliometrics and employed in recent years for identification of core documents and complex relationship between citing and cited documents for a particular scientific community in a geographical proximity. In library and information science citation and citation analysis has received importance and value because the basic idea behind citation study measure is to access the impact, importance or quality of research work and to find out which resources have been used for conducting the research study, to analyse the scholarly work etc.

Keywords:

Bibliometrics, Scientometrics, Informetric, Citation.

Introduction:

Bibliometrics is one of the instruments of statistical analysis in Information and Library science. It is a quantitative study of various aspects literature. It is used in library management for mathematical and citation analysis. Citation analysis is one of the branches of bibliometrics in research methodology. Citation is a reference to a published or unpublished source. It is an abbreviated alphanumeric expression embedded in the body of an intellectual work that denotes an entry in the bibliographic references section of the work for the purpose of acknowledging the relevance of the works of others to the topic of discussion at the spot where the citation appears.

It becomes easy to know which material was used in research work because of citation analysis. It also helps to know and understand the priority list of periodicals, journals and the books. Citation analysis is the examination of the frequency, patterns, and graphs of citations in articles and books. Citations use in scholarly works to establish links to other works or other researchers.

The development of citation analysis has been marked by the invention of new techniques and measures, the exploitation of new tools and the study of different units of analysis. These trends have led to a rapid growth in both the number and types of studies using citation analysis. Diadoto (1994) defines citation analysis as “a wide ranging area of bibliometrics that studies the citations to and from documents. Such studies may focus on the documents themselves or on such matters as: their authors; the journals (if the documents are journal articles) in which the articles appear.”

Garfield is a father of citation analysis who studies enormous views based on analytical studies and out of his hundreds of studies which cover almost every branch of the natural and social sciences, indicated the better use of citation studies. he developed *Science Citation Index* and *Social Science Citation Index* which is based on citation analysis. The

journal impact measure became popular and widely spread among the scientific community as journal impact factor. Journal impact factor is calculated based on citation counts and nowadays, it is linked to prestige or quality of journals in scientific area. Impact factors are not only used to rank journals, but also to evaluate individual scholars and research groups or department performance according to the journals they select for publication. Garfield pointed out importance of citation, co-citation, self-citation and citation analysis studies in measuring performance. Since then, citation analysis studies become more valuable. Garfield noted that citation analysis is used to study the journals as well as the people and work of science. Citation analyses of different subjects are based on a literary model of scientific process. He has observed that scientific work is represented by the papers published to report it, and the relationships between works are represented by references Garfield Citation refers to the list of references to other works in a published work.

Citations acknowledge the existence of related literature Those help in communicating specialist knowledge. Typically, citation shows a relationship exists between the work of an author and the previous works done in that field. A citation is a bibliographical entry in a footnote, reference list or bibliography of a document that contains enough information to verify the original item and checking of research documents and comparison of those citations with the availability of materials in a local collection offers unobtrusive and cost-effective method of evaluating that collection's ability to support research. Citation analysis helps in determining the competitive position of authors and can help to identify useful journals. It may be viewed as a collaborative effort that can promote the quality of scholarly research and to identify core articles, authors, or journals in a field. Citation analysis as taken to mean the analysis of the citation or reference which form part of the articles in journals or any communication, it is not taken to include the study of reference appearing in secondary periodicals. Citation analysis helps to know reading habits of users in every field of knowledge. It is also helpful to librarian for studying the present position of literature and to identify the core journals.

Citation analysis is an effective tool to decide the use of literature in a specific field. This is indirect method like the analysis of the library record to determine the actual use of document sources. This type of information can be utilized for setting policies for different activities in library e.g., acquisition of materials, selection of periodicals etc. The primary purpose of citation is to enable a reader to go the referred document for information on a point of check the authenticity of a particular view finding or method. Each citation is a message from the author of a document to his readers. Citation analysis provides relevant measurement of utility and relationship of journal whose primary function is to communicate research result. This analytical method is very useful in libraries.

To conclude, it is very clear that citation study is very valuable for measuring utility and the evaluation of research work. Now days, bibliometrics and scientometrics make extensive use of citations to assess quality and trace patterns of scholarly communication. Many governments, funding agencies and tenure and promotion committees use citation data to evaluate the quality of a researcher's work, partly because they prefer not to rely on peer review and publication output alone. Citation analysis has received wide publicity and Web has also taken a note of it and they have also developed tools for citations for literature published over the web like Scopus, Web of Science, Google scholar which have used the citation patterns for academic papers.

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सम्राट अशोक कालीन शासन व्यवस्था

वंदना जालमसिंह देवरे (राजपूत)
संशोधक विद्यार्थिनी

प्रस्तावना

सम्राट अशोकाच्या काळात मगधमध्ये राजेशाही शासनव्यवस्था होती.त्यावेळी सर्व सत्ताधारी हा सम्राट अशोक होता.सम्राट अशोकाने केंद्रीय प्रशासन, प्रांतीय प्रशासन,नगर प्रशासन आणि ग्राम प्रशासन अशा चार भागात केले होते. केंद्रीय प्रशासन व्यवस्थित आणि सुरळीत चालण्याकरीता विविध खाते तयार केले होते. तसेच प्रांतीय प्रशासनामध्ये विविध प्रांतानुसार विभाजन करून शासन व्यवस्था केली होती.

सम्राट अशोकाच्या काळामध्ये शासन अत्यंत उच्च दर्जाचे चालविले जात होत. रामराज्याचा आदर्श डोळ्यासमोर ठेवून राज्यकारभार चालविला जात होता. सर्व प्रजेच्या कल्याणाचा आणि जनकल्याणाचा विचार सदैव केला जात असे. सम्राट अशोक हे जनकल्याणासाठी तत्पर राहत असत. ”अर्थशास्त्र” या ग्रंथानुसार सम्राट अशोक न्यायमंडळ,कार्यकारीमंडळ व कायदेमंडळ यांचे प्रमुख होता. त्यामुळे सर्व अधिकाऱ्यांच्या नेमणूका तो स्वतः करत असे. त्यामुळे त्याचे शासन हे व्यवस्थितरित्या चालत असे. सम्राट अशोकाची शासन व्यवस्था खालील प्रमाणे होती.

अ) केंद्रीय प्रशासन

केंद्रीय प्रशासन हे राजा आणि मंत्रिपरिषद या दोन भागात विभागली होती.

1. **राजा :-** राजा हा राज्याचा प्रमुख असे तो सर्वांवर अधिकार गाजवत असे. सर्व विभाग त्यांच्या अधिकारात काम करत असे. सम्राट अशोक राजा झाल्यानंतर त्याने राज्याची घडी नीट बसवली. राजा हा सर्व सत्ताधीश होता. तो सर्व अधिकाऱ्यांच्या नेमणूका स्वतः करत असे. परराष्ट्राशी कशा प्रकारचे धोरण ठरवायचे हे राजाच ठरवत असे. राज्यात शांतता व सुव्यवस्था, स्थिरता ठेवण्याचे काम राजा करत असे.
2. **मंत्रिपरिषद :-** सम्राट अशोकाला त्याच्या कार्यात सहकार्य करण्यासाठी एक मंत्रिपरिषद होती. या मंत्रिपरिषदेमध्ये राजाचे सर्व खास विश्वासू व्यक्तींची नेमणूक केली जात असे. मंत्रिपरिषद राजाला सल्ला देण्याचे काम करीत असे. सम्राट अशोकाच्या काळात मंत्रिपरिषद एक महत्वपूर्ण संस्था होती. सर्व महत्वाच्या कार्यांसाठी निर्णय मंत्रिपरिषदेतच घेतला जात असे. राजाने दिलेला आदेश पूर्णपणे कार्यान्वित होते की नाही हे पाहण्याचे काम मंत्रिपरिषद करत असे. सर्व शासकीय कर्मचाऱ्यांवर नजर ठेवण्याचे काम मंत्रिपरिषदेचे होते.

शासनाच्या सोयीकरीता विविध खाते तयार करण्यात आले होते. ते विविध खाते खालील प्रमाणे होत.

1. **अर्थखाते :-** अर्थखाते हे सर्वात महत्वाचे खाते होते. राज्याचा खर्च भागविण्या करीता जनतेवर कर लावावा लागत असे. हा कर लावण्याचे काम अर्थखात्यामार्फत केले जात असे. राज्यात होणारा खर्च, राज्याकडे येणारा पैसा, संपत्ती याचा हिशोब अर्थखात्याचा प्रमुख ठेवत असे. लष्कराचा खर्च या काळात महत्वाचा खर्च होता. त्या काळात लष्कराचा खर्च सर्वात जास्त असे. या काळात शेती हा प्रमुख व्यवसाय होता. या काळात शेतीवर सुध्दा कर लावला जात होता.
2. **न्याय खाते :-** धर्म, रूढी, परंपरा, व्यवहार व सदसद् विवेकबुद्धीवर कायदा व न्यायदान आधारलेले होते. कायदा व न्यायदान हे दोन प्रमुख विभाग या मध्ये होते.
3. **लष्कर खाते :-** सम्राट अशोकाच्या काळात लष्कर खाते महत्वाचे खाते होते. कोणत्याही राज्याच्या

शक्ती त्याच्या लष्करावर अवलंबून होती. त्याकाळात सम्राट अशोकाकडे सर्वोच्च लष्कर होते. लष्करामध्ये पायदळ, घोडदळ, रथदळ, गजदळ अशा प्रकारचे सैन्य होते. त्याचप्रमाणे आरमार देखील होते.

4. **परराष्ट्र खाते :-** सम्राट अशोकाने कलिंग युद्धानंतर शांततेचे धोरण स्वीकारले होते. त्यामुळे इतर राज्यांशी संबंध ठेवताना सहकार्य व मदतीचे मैत्रीपूर्ण संबंध ठेवले. सम्राट अशोकाने त्याकाळात बौद्ध धर्माचा प्रचार प्रसार करण्यासाठी धर्मप्रचारक नेमले.
5. **गुप्तहेर खाते :-** सम्राट अशोकाने गुप्तहेर खाते स्वतंत्र बनवले होते. हे अत्यंत महत्वाचे खाते होते. कोणत्या राज्यात काय हालचाली चालू आहेत, जनता कोणत्या स्थितीत आहे या सर्व बातम्या गुप्तहेर राजाला देत असे.

ब) **प्रांतीय प्रशासन :-**

अखंड अशा मगध राज्याचा कार्यभार चालवणे सोपे काम नव्हते. शासनाच्या सोयीसाठी अशोकाने मगध साम्राज्याचे विभाजन पाच प्रांतांमध्ये केले होते. 1) प्राच्य प्रांत 2) मध्य प्रांत 3) पश्चिम वायव्य प्रांत 4) दक्षिण प्रांत 5) कलिंग प्रांत.

वरील प्रमाणे राज्याचे विभाजन पाच प्रांतांमध्ये करून त्या प्रत्येक प्रांतावर एक प्रमुख नेमला होता.

क) **नगर प्रशासन :-**

सम्राट अशोकाने त्याकाळातील शहरांसाठी स्वतंत्र नगरप्रशासनाची व्यवस्था केली होती. तक्षशिला, पाटलीपुत्र, अवंती, सुवर्णगिरी या सारख्या शहरात हे प्रमुख प्रशासन होते. शहरात शांतता व सुव्यवस्था ठेवून शहराचा विकास करणे हे प्रमुख काम त्या नगर प्रशासनाचे होते. कर गोळा करणे, शहरात स्वच्छता राखणे, जन्म-मृत्यूची नोंद ही कामे नगर प्रशासन करत असे.

ड) **ग्राम प्रशासन :-**

अशोकाच्या काळात अनेक खेडी होती व दळणवळणाची साधने नव्हती. त्या काळात खेडी ही स्वयंपूर्ण होती. अशा स्वयंपूर्ण खेड्यासाठी ग्राम प्रशासन असे. गावातील सर्व व्यवहार ग्राम प्रशासनाच्या अखत्यारीत असे.

सारांश :-

सम्राट अशोक हा एक उत्तम राजनीतीज्ञ होता. आपल्या साम्राज्यासाठी त्याने मजबूत प्रशासन यंत्रणा उभारली होती. त्याच्या काळातील संरक्षण व्यवस्था कडेकोट होती. गुप्तहेरामार्फत राज्यातील कटकारस्थानांची माहिती मिळवत असे. राजा म्हणून तो जागरूक होता. राजाची सर्व कर्तव्ये योग्यपणे बजावत होता.

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नोटबंदीचे अर्थव्यवस्थेवर घडून आलेले दुष्परिणाम

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वास्तविक पाहता भारतीय अर्थव्यवस्थेत काळ्या पैशाने घातलेले थैमान, बोकाळलेला भ्रष्टाचार आणि नकली चलनाच्या आधारावर थैमान घालत असलेला आतंकवाद मोडून काढण्याकरिता सरकारला कुठला तरी ‘हाय डोज’ देणे गरजेचे होते, यात कुठलेही दूत असण्याचे कारण नाही. परंतु सरकारने कुठल्याही प्रकारची पुर्वतयारी न करता किंवा हा निर्णय घेतांना आवश्यक परिस्थिती आहे किंवा नाही याचा विचार न करता हा निर्णय लादला गेला त्याचे अत्यंत भयावह परिणाम घडून आले व भविष्यातही ही परिस्थिती सावरता – सावरता सरकारची पुरेवाट होणार यात मुळीच शंका नाही.

असे म्हटले जाते की, भूतकाळ किंवा वर्तमान काळातील अनुभव आपणाला भविष्यातील परिणामांची जाणिव करून देत असतो. याच आधारावर केंद्र सरकारने दि. ०८/११/२०१६ ला रू. ५०० व १००० च्या नोटा बंद करण्याचा अचानक घेतलेला निर्णय व त्याचे अर्थव्यवस्थेवर व पर्यायाने समाजावर झालेले दुष्परिणाम याचा तटस्थ भूमिकेतून विचार व्हावा म्हणून हा लेखन प्रपंच.

या निर्णयामुळे भारतीय अर्थव्यवस्थेपुढे निर्माण झालेले प्रश्न, त्यांचे स्वरूप व त्यांची तीव्रता किती भयावह असू शकते याचा अंदाज सहज बांधता येऊ शकतो. वास्तविक पाहता सरकारने घेतलेल्या ह्या निर्णयाचे किंवा त्यानंतर घडलेल्या घटनांचे जे दुष्परिणाम दृष्टिगोचर होत आहेत ते लक्षात घेता भविष्यात सध्याच्या परिस्थिती पेक्षाही अत्यंत वाईट असे दुष्परिणाम अर्थव्यवस्थेवर घडून येऊ शकतात. अर्थात त्यावर थातूर मातूर उपाय योजून, अंदाजपत्रकाच्या माध्यमातून ह्या चुकीच्या निर्णयावर फुंकर घालून किंवा समाजाला भूलथापा देवून परिस्थिती सुधारेल किंवा पुर्वपदावर येईल अशी शक्यता फारच कमी आहे.

ह्या दुष्परिणामांची चाहूल देशी—विदेशी अर्थ तज्ञांना व देशी—विदेशी वर्तमान पत्रांनाही लागताच त्यांनी सुचनेच्या स्वरूपात ती मांडण्याचा प्रयत्न केलेला आहे. यात पूर्व प्रधानमंत्री डॉ. मनमोहन सिंग, वित्तमंत्री चिदंबरम, अर्थतज्ञ अमर्त सेन, व इतरही अनेक अर्थतज्ञांनी याबाबतीत महत्वाच्या सुचना केलेल्या आहेत. परंतु अड्डाहासी सरकारला मात्र हे सर्व विरोधकांचे बोल वाटले व त्यामुळे त्यांनी त्यावर उलट प्रतिक्रिया दिल्यात व त्यांना दुर्लक्षित केले. तसेच देशी वर्तमान पत्रात व न्युयार्क टाइम्स या अमेरिकन वृत्तपत्रानेही यावर सडकून टिका केलेली आहे. परंतु सरकारच्या कृतीवर त्याचा कुठलाही परिणाम झालेला दिसत नाही.

तेव्हा असले महत्वाचे निर्णय घेतांना प्रचलित परिस्थितीकडे लक्ष न देता किंवा तज्ञांनी व अनुभवी लोकांनी दिलेल्या सुचनांकडे मुद्दाम दुर्लक्ष करून जेव्हा असे निर्णय समाजावर लादले जातात तेव्हा त्याचे दुष्परिणाम समाजाला भोगावे लागणार यात दूत होण्याचे कारण नाही. परंतु कुठलाही निर्णय लादतांना त्यावेळची परिस्थिती लक्षात घेवून किंवा भविष्यातील परिणामांची जाणिव न ठेवता असला दूरगामी परिणाम करणारा निर्णय घेणे व तो जनतेवर लादणे यात सरकारचा आकस्मिकपणा दिसून येतो, हे कुणालाही मान्य करावेच लागेल.

अर्थात या निर्णयाचे जे अत्यंत भयानक परिणाम अर्थव्यवस्थेवर दिसून आले त्यांचा ह्या बाबतीत विचार होणे आवश्यक आहे. तसेच त्याचा भविष्यकाळातही काय परिणाम होतील याचाही विचार झाला पाहिजे.

श्रमशक्तीचा नाश:— या निर्णयाचा पहिला व अत्यंत वाईट परिणाम म्हणजे गरीबांपासून तर सर्वसामान्य मध्यमवर्गीय माणसाला आपापली महत्वाची कामे सोडून कित्येक दिवस पैशांकरिता बँकांपुढील लांबच लांब रांगामध्ये उभे राहावे लागले. त्यात काहींचा मृत्यू झाला. अनेक लोक आजारी पडले, तर काही चक्कर येवून पडले त्यामुळे ह्या लोकांची अनेक आवश्यक कामेही त्यांना करता आली नाहीत. निर्माण होणाऱ्या वस्तू व सेवांच्या उत्पादनालाही खीळ बसली. पैशाअभावी औषधीय उपचाराशिवाय मृत्यू ओढावलेत. या काळातील श्रमशक्ती नष्ट झाली आणि मग सरकारचे फरमान निघाले, “लवकरच परिस्थिती सुधारेल, जरा वाट पहा, थोडी कळ सोसा” अशी नकली सांतवना देवून ह्या काळात त्यांचे झालेले नुकसान भरून निघेल काय? याचे उत्तर नाही असेच द्यावे लागेल.

रोजगाराच्या पातळीत मोठ्या प्रमाणावर घट:— देशात अगोदरच रोजगार गमावने सोपे असले तरी रोजगार मिळविणे अत्यंत कठिण आहे. अशा स्थितीत या निर्णयामुळे सर्वत्र पैशाची चणचण निर्माण झाली. किंमती पडू लागल्या व त्यांना पुढे-पुढे नुकसान सहन करावे लागले. ह्या दोन महिन्यांच्या काळात जवळपास ७५ लक्ष लोकांचा रोजगार गेला. आणि मंदीच्या परिस्थितीला चालना मिळाली. असंघटित कृषी क्षेत्रालाही त्याचा मोठ्या प्रमाणावर परिणाम भोगावा लागला.

रिझर्व्ह बँक व सरकारवरील लोकांच्या विश्वासाला तडा:— शरिरात रक्ताभिसरण संस्थेला जे शरीर स्वास्थात महत्व आहे तेवढेच अर्थव्यवस्थेत चलनभिसरणाला अत्यंत महत्वाचे स्थान आहे. अर्थव्यवस्थेच्या स्वास्थाकरिता हे अभिसरण करण्याची महत्वाची जबाबदारी केंद्रीय अधिकोष व सरकारची असते. ह्यामुळेच रिझर्व्ह बँक व सरकारवरही लोकांचा विश्वास असतो. परंतू ह्या निर्णयामुळे लोकांना त्यांचाच पैसा मिळविण्याकरीता कित्येक दिवस रांगामध्ये उभे रहावे लागले ह्यामुळे ह्या दोन्ही संस्थावरील लोकांच्या विश्वासाला तडा गेला आहे. आणि भविष्यात याचे अत्यंत बिकट परिणाम सरकारला आणि लोकांनाही भोगावे लागणार. रिझर्व्ह बँक ही म्हणूनच स्वायत्त संस्था ठेवण्यात आलेली आहे. परंतू ह्यावेळी तिच्या अधिकांच्यावरही हा निर्णय लादण्याचा दबाव आलेला असल्याचे वर्तमानपत्रातून जाहीर झालेले आहे. ही देशाच्या स्वातंत्र्याच्या इतिहासात पहिल्यांदाच घडलेली घटना आहे.

सर्वसामान्य जनतेला सर्वात जास्त त्रास :— स्वातंत्र्याच्या काळातील ही पहिलीच घटना आहे की, ह्या निर्णयाचा सर्वात जास्त त्रास गरीब व सर्वसामान्य जनतेला झालेला आहे. ह्या निर्णयामुळे सर्वत्र गुंतागुंतीची व गोंधळाची परिस्थिती निर्माण झाली त्यामुळे गरीब, मध्यमवर्गीय, लहान व्यापारी, व्यावसायिक आणि काळ्या पैशाशी ज्यांचा काहीही संबंध नाही अशाच लोकांना या निर्णयाचा सर्वात जास्त फटका बसलेला आहे. अनेकांची लग्ने तुटली, औषधऔपचाराशिवाय अनेकांना जीव गमवावा लागला, आजान्यांना तडफडावे लागले, शेतमालाच्या किंमती पडल्या, अनेक पाल्यांना शाळेला मुकावे लागले, एवढेच नाही तर भविष्याची स्वप्ने पहाणाऱ्या तरून पिढीलाही खूप त्रास सहन करावा लागला आहे व त्यांचे स्वप्न उद्वस्त होवू पाहत आहे.

पूर्व तयारीचा अभाव :— नोटबंदीचा निर्णय हा भारताला किंवा जगालाही नवीन नाही. डॉ. बाबासाहेब आंबेडकरांनीही दर दहा वर्षांनी असले निर्णय घेण्याची सुचना केलेली आहे. परंतू असले महत्वाचे निर्णय घेतांना सरकारने पुरेशी पूर्व तयारी करायला हवी. समाजातील किंवा अर्थव्यवस्थेतील चलन विषयक परिस्थिती विघडणार नाही याची पूर्व व पुर्ण दक्षता घ्यायला पाहिजे होती, परंतू यावेळी अशी कुठलीही पुर्वतयारी नसल्यामुळे सर्वत्र गोंधळाची परिस्थिती निर्माण झाली. त्यात सरकारने रोजच्या रोज घेतलेल्या निर्णयातील परिवर्तनामुळे या गोंधळात आणखीच भर पडली व त्यामुळे सरकार व रिझर्व्ह बँकेवरील लोकांचा विश्वास डळमळीत झालेला आहे.

जागतिक स्तरावरही विपरित परिणाम :— या निर्णयाचे भारतीय अर्थव्यवस्थेवरच वाईट परिणाम झालेले आहेत असे नाही तर जागतिक स्तरावरही त्याचे अनिष्ट परिणाम झालेले आहेत. एवढेच नाही तर राजकीय मुत्सद्देगिरीवरही त्याचा परिणाम झालेला आहे. ह्या निर्णयामुळे जगातील गुंतवणूक दारांनी भारतातील संस्थामध्ये गुंतविलेल्या ५० अरब रूपयांच्या रकमा परत नेलेल्या आहेत व नेत आहेत. एवढेच नाही तर ५७ अरब रूपयांची नव्याने होणारी गुंतवणूकही थांबविण्यात आलेली आहे. तसेच शेअर बाजारात १ लक्ष ५० हजार कोटीपेक्षा अधिक रूपयांचे भांडवलाचे नुकसान झालेले आहे.

विदेशात राहणाऱ्या भारतीय नागरिकांकडून येणारा पैसाही थांबला :— विदेशात राहणाऱ्या भारतीय नागरिकांकडून ७४ अरब डॉलरपेक्षा जास्त येणारी विदेशी मुद्राही नवीन वर्षात येण्याची शक्यता मावळली आहे. कारण ह्या नोटबंदीच्या काळात म्हणजे ५५ ते ६० दिवसात ह्या विदेशी मुद्रेच्या येणाऱ्या प्रवाहात ३०० टक्क्यांनी घट झालेली आहे. ह्या कारणामुळे यांचे २०१७ ह्या वर्षात अर्थव्यवस्थेवर फारच अनिष्ट परिणाम होण्याची शक्यता आहे.

सर्वसामान्य जनतेच्या खर्चात घट :— भारतातील उपभोक्ता बाजारात दरवर्षी जवळपास १८० लक्ष कोटी निरनिराळ्या वस्तू व सेवांवर खर्च होत असतात म्हणजे दरमहा ५० लक्ष कोटी व दररोज ५० हजार कोटी रूपये खर्च होत असतात. परंतू चलनाच्या अभावामुळे तो खर्च ८० टक्के च्याही खाली येण्याची शक्यता आहे. त्यामुळे किंमती पडून मंदीची परिस्थिती निर्माण होईल व विकासालाही खीळ बसेल यात शंका नाही. तसेच एकदा का हे चक्र फिरू लागलं तर अमेरिकेसारख्या

मजबूत व समृद्ध अर्थव्यवस्थेलाही ते सावरता आलं नाही तर भारतात काय परिस्थिती निर्माण होईल याची कल्पनाच केलेली बरी.

निर्यातीत वाढ होण्याची श्रेय घेणे बरोबर नाही :- देशात वस्तू व सेवांच्या किंमती कमी झाल्या तर भारतासारख्या विकसनशील देशात अविश्वासाचे वातावरण निर्माण होणे स्वाभाविक आहे. सध्या अशीच परिस्थिती असल्यामुळेच लोकांनी आपला खर्च कमी केला असावा असे वाटते. त्यामुळेच सरकारला आणि रिझर्व्ह बँकेला याचा विचार करणे भाग पडत आहे. ही देशाच्या दृष्टिने भविष्यात अत्यंत हाणीकारक बाब ठरणार आहे. किंमती कमी झाल्यामुळे देशी वस्तू विदेशियांना स्वस्त वाटल्यामुळे भारतीय मालाला मागणी वाढली असली म्हणून निर्यात वाढणे स्वाभाविक आहे यात सरकारी धोरणाचे श्रेय नाही.

विकास दरात घट :- भारतात आजच विकासाच्या दरात सतत घट होत आहे. ७ ते ७.४ टक्के विकासाचा दर वाढणार आहे असे सांगत असलेले सरकारच तो भविष्यात ६ ते ६.५ टक्के च्या दरम्यान राहणार असे सांगत आहे आणि असे झाले तर त्याचे आणखीणच अनिष्ट परिणाम होणार यात शंका नाही.

लहान व मध्यम उद्योग बंद पडण्याची शक्यता:- ह्या परिस्थितीवर ताबडतोब उपाययोजना केली नाही तर या किंमत घटीच्या प्रक्रियेत लहान व मध्यम उद्योगधंदे बंद पडून रोजगारीत, उत्पादनात, किंमतीत घट होवून अर्थव्यवस्थेला वाईट परिस्थितीला तोंड द्यावे लागेल. तशी परिस्थिती आजच निर्माण होत आहे. ह्या परिस्थिती वर नियंत्रण मिळविता येणे शक्य दिसत नाही.

भयानक मंदीची चाहूल:- भारत सरकारच्या ह्या निर्णयामुळे मंदीची लाट येण्याची शक्यता लक्षात घेवून अनेक अर्थतज्ञ, राजकीय नेते, अर्थशास्त्राच्या अभ्यासकांनीच नव्हे तर जागतिक स्तरावरील अमेरिका, चीन, रशिया आदी देशांनीही या बाबतीत चिंता व्यक्त केली आहे.

शेतीवर विपरित परिणाम :- या निर्णयाचे शेतीवर तर फारच अनिष्ट परिणाम होत आहेत. शेतमालाच्या किंमती मोठ्या प्रमाणावर पडलेल्या आहेत. अनेक उत्पादक शेतकरी देशोधडीस लागलेले आहेत. कर्जाचा बोजा वाढलेला आहे. अंदाजपत्रकात कितीही कर्ज देण्याची तरतूद केली तरी कर्ज घेवून कर्जाच्या ओझ्याखाली दबलेल्या शेतकऱ्याला पुन्हा कर्ज देणार काय? किंवा तो घेणार काय ? यापेक्षा कर्जव्याज माफ करणे हा उपाय चांगला होता. आणि अधिक कर्ज घेतले तर मग आता होत असलेल्या आत्महत्यामध्ये भर पडणार नाही काय? याचा विचार करण्याची वेळ आलेली आहे.

सामाजिक परिस्थितीमध्ये बिघाड :- लोक बेकार झालेत किंवा त्यांच्या उत्पन्नाचे साधन राहिले नाही तर समाजातील शांतता नष्ट होवून चोरी, मारामारी, खुन, लुटमार इत्यादी परिस्थिती निर्माण होवून सामाजिक शांततेलाच धोका निर्माण होवू शकतो. सध्या तशी स्थिती दिसत आहे. आणि एकदा का अशी परिस्थिती निर्माण झाली तर सरकार कोणत्याही पक्षाचे असो ती सावरता सावरणार नाही.?

वरील परिस्थिती गांभीर्याने न घेता किंवा ताबडतोब त्यावर निर्णय न घेता अंदाजपत्रकात आकड्यांचा खेळ करून अर्थव्यवस्थेत पैसा ओतला गेला किंवा अंदाजपत्रकाचे गोडवे गाऊन किंवा कोणी योग्य सुचना केल्या म्हणून, किंवा कुणाला ‘पप्पू’ किंवा ‘अभी तो वह बच्चा है’ भाषण देना सीख रहा है म्हणून किंवा तज्ञांच्या सुचनाकडे दुर्लक्ष करून त्यांच्या मतांना फेटाळून लावणे आत्मघाती पणाचे ठरेल. म्हणून या बाबतीत नव्याने विचार करण्याची वेळ आलेली आहे. नाही तर स्वातंत्र्योत्तर काळात हळूवार गतिने का होईना देश प्रगतीकडे जात असतांना देशात असलेली शांतता व सुबत्ता नष्ट झाल्याशिवाय राहणार नाही याची आजच काळजी घेतलेली बरी.

म्हणूनच ज्या उद्देशाने सरकारने हा निर्णय घेतल्याचे सांगितले जाते तो पुर्णतः फसलेला आहे व म्हणूनच सरकारने तो मागे घेतल्याची घोषणा न करता त्याच्या सर्व जाचक बाबी सरकारला मागे घेणे भाग पडत आहे. यात सरकारची पुरती फजिती झालेली आहे हे मात्र खरे.



MIRROR VIEW OF DIASPORIC FICTION IN THE WORK OF JHUMPA LAHIRI AND KIRAN DESAI

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Abstract

The word, ‘diaspora’ means ‘to disperse’ in its original Greek context. Ashcroft, Griffith’s and Tiffin define it as the voluntary or forcible movement of peoples from their homelands into new regions... Cohen describes diaspora as the communities of peoples living together in one country who acknowledge that the old country – a nation often buried deep in language, religion, custom or folklore- always has some claim on their loyalty and emotions. (K. Rupinder qtd. in CDL). The literature of diaspora refers to the works written by those who live outside their native land. There are various types and kinds of diaspora literatures- African, Australian, Arab diaspora, and so on. Among these, Indian diasporic literature has caught ‘fancy of writers, literati, historians and sociologists. Since, foreign land offers many fold challenges in terms of adaptation and assimilation of various socio-cultural values, this paper, as such is an attempt to theorize some of the common issues reflected in the Indian diasporic fiction, annexed with a brief review of Jhumpa Lahiri and Kiran Desai’s works.

Keywords: *Diaspora, Indian diasporic fiction, Jhumpa Lahiri, Kiran Desai*

The Indian diasporic fiction which emerged out of several social, psychological and cultural backgrounds has achieved a unique and important place in the present day critical discourse. The fiction written by Indian writers who presently live in India or in other parts of the world have claimed global accolades for the handling of diverse subject matters, characterization, language and multiple thematic issues. The most important feature of this genre is that it is evolving day by day while extending the empire of Indian English fiction. From the very inception to simple experimentation, the Indian diasporic fiction is now globally recognized for the wide use of employed narrative techniques, hybrid language and undercurrents of contemporary issues. The widening gyre of diasporic writing has a phenomenal impact on the fast-changing global world. Understandably so, because by bridging cultural gaps between East-West global poles, it has rendered an immense service in acculturating the uncommon zones of different cultures. The Indian diasporic fiction besides bringing the lure of late capitalism to the forefront has also pictured trauma and tragedies of displaced groups living in the distant lands. As such, when one surveys Indian diasporic Fiction, the human soul awakens to respond the calls of dispersed in the wilderness of postmodern civilization. It is this soul’s awakening that Indian diasporic fiction is mostly remembered for. The new generation Indian diasporic fiction writers have touched all the possible spheres of human enterprise and as a result, the vast numbers of readers across the world, are tempted to experience the universe through the eyes of those who have beautifully observed it. In the recent years, Indian fiction writers have been widely recognized by the west. Writers like Salman Rushdie, Vikram Seth, Amitav Ghosh, Arundhati Roy, Rohinton Mistry, Aravind Adiga, Kiran Desai and Jhumpa Lahiri have either won the prestigious literary prizes or they have been short listed for it.

The contemporary India is blessed with legendary diasporic novelists, who cross all the labels of nationality, race or ethnicity and voice their inner most feelings through the immortal pages of fiction. Their firsthand experience and vast scholarship brought a renaissance and second coming to the Indian English fiction. The fiction of Indian diasporic writers celebrates diversity of cultures, races and ethnicities. Their fictional diversity is akin to what India itself represents. The well-known names in the Indian diasporic fiction writers include but are not limited to Salman Rushdie, Bharati Mukherjee, Anita Desai, Rohinton Mistry, Aravind Adiga, Jhumpa Lahiri and Kiran Desai along with some others. They have refined the Indian English fiction, giving it new dimensions, heights and magnitude. They all belong to the post-colonial era and employ either ‘magic Realism’ or ‘fragmented language’ to reveal their inner self.

Post-colonial literature has developed because of the dramatic shrinking of the world, due to the technology and transportation, and the increasing multicultural cast of our own country. The Post-colonial literature goes under various subheadings like Diasporic writing, Subaltern Studies, Cosmopolitan writing and so on. While assessing Indian diasporic fiction as a sub-genre of post-colonial literature, we observe that this field entitles the huge corpus of well recognized works widely read and rightly appreciated by global readers. The extraordinary representation of local-global, self-society and home-homelessness which form its core, inform us about the present-day futility of making geographical borders for confinement of the circulation of free ideas between civilized human races. The motif of the Indian diasporic fiction is not only to highlight the issues of nostalgia and alienation but also to eliminate manifest as well as latent boundaries, the geographical and well as mental. As the imaginary and well distributed concrete borders of nation, race and ethnicity, render an enormous disservice to the progressive world, the vanity of having them is questioned by diasporic fiction. The purpose of diasporic stance is simply to recognize and respect different socio-cultural values and lead the world towards the harmonious cultural, social, racial and religious synthesis. A more vital endeavor of it is to promote unbounded flow of new ideas for human progress rather than to survive on the colonial yoke and serve the devils purpose. This diasporic liberal stance has opened up new literary gates through which we can not only mirror our past but also can dream the distant dreams of future.

The word ‘diaspora’ as Somdatta Mandal observes, is derived from the Greek, meaning dispersal, distribution or spreading has been applied for many years to the worldwide scattering of the Jews; In more recent times, it has been applied to a number of ethnic and racial groups living distant from their traditional homelands; and it has been used with particular application to people from the former British India- a result of the colonization, though of late, one occasionally hears or reads of the African diaspora. When we speak of the Indian diaspora, writers generally refer to persons of Indian birth or ethnicity living abroad. (In earlier times often as a result of induced emigration or indenture but in more recent decades usually by free choice and often for economic, artistic or social advantages) (M. Somdatta qtd. in CDL).

However, in present times, there are African, Australian, Arab diasporas and so on, besides well established, south Asian diasporic writers, making their name and fame in the literary arena. These diasporic voices emerging from margins have established a literary canon in their respective home-host country. They in addition to presenting the perennial issues of loss and longing have also defined new goals for fiction.

Sudesh Mishra makes a distinction between the old and new Indian diasporas. This distinction is between, on the one hand, the semi-voluntary flight of indentured peasants to non-metropolitan plantation colonies such as Fiji, Trinidad, Mauritius, South Africa, Malaysia, Surinam, and Guyana, roughly between the years 1830 and 1917; and on the other

the late capital or postmodern dispersal of new migrants of all classes to thriving metropolitan centres such as Australia, The United States, Canada and Britain. (M. Sudesh qtd. in IHILE)

While tracing the recurrent thematic trends dealt within the Indian English diasporic fiction, we notice a striking divergence between these two old and new groups of writers, especially marked variations are found in the treatment of their experiences on the foreign soil. The writers of the old diaspora are very keen to record the experiences of their initial encounters with the alien culture. While doing so, they generally express anger, frustration and estrangement. The new diasporic writers on the other hand, freely examine the cross-cultural perspectives in more positive and affirmative sense. To specify the points of conversion and diversion between these two, Sudesh Mishra, in the same article, categorizes old and new diasporic writers as:

The writers of old diaspora like V.S Naipaul (India- Trinidad) Harold Lado (Trinidad-Canada) Subramani (Fiji), K.S. Maniam (Malaysia) tend to express panic, nausea, hysteria, estrangement, violence and nostalgia in their works, the writers of new diaspora such as Bharati Mukherjee (India- United States), Farrukh Dhondy (India-Britain), Agha Shahid Ali (India- United States), Rohinton Mistry (India-Canada), Sujata Bhatt (India-Germany) Kiran Desai (India-United States) and Jhumpa Lahiri (India-United States) are inclined to inhabit the liminal or threshold zone of intercutting subjectivities that defines the experience of migrancy. (M. Sudesh qtd. In IHILE)

Hence, when we examine Indian diasporic fiction as whole, it emerges that the themes of panic, nausea, hysteria, violence, nostalgia home, homeless, alienation, estrangement, identity, hybridity, cross-culturalism, local, global and longing belonging frequently recur in these writings. Apart from this, the self becomes a focal point in all major diasporic works to explore its various connotations with regard to the society. As the self as well as society is always in a continuous flux, the artistic representation as such portrays all these changes in an imaginative and creative manner. Since, woman are more prone and sensitive to subtle changes, happening around the self, and the surroundings, they present a very heart touching and exciting account of all these changes.

The two Indian-American women novelists-Jhumpa Lahiri and Kiran Desai are the representative writers in the genre of new Indian diasporic fiction. Their works keenly observe the experience of immigrants in multiple ways. Jhumpa Lahiri and Kiran Desai belong to the innovative new generation of diasporic writers. They share a variety of common and contrary viewpoints. Both are deeply rooted in the diasporic discourse of duality and dilemma. They experience the plural identity between the home culture and host culture. Their characters are drawn from rural India and placed in the promising cities of America, where they experience both nostalgia as well as the rejection of inherent value system and cultural roots. Apart from this, they have their own way of narrating the events. Jhumpa Lahiri's language is more touching and natural than her counterpart. She gives a psychological treatment to her characters without philosophizing them too much. Kiran, on the other hand, looks towards every minute detail with great philosophizing nature. The fiction of both of these novelists explores how the earliest modern notions of centre and margin home and exile and familiar and strange are falling apart. The borders defined in terms of geography, culture and ethnicity are being replaced by configuration of power, community space and time. Lahiri with Kiran are represented as new, progressive and innovative South Asian writers. Both are seen as a successful decedent of Rushdie centric, global South Asian literary diaspora or in other words, one of his “midnight's Grandchildren”(A phrase which denotes writers of mainly Indian decedent who take a realist as opposite to magical realist turn in their fiction).

Thus, in this review paper, an attempt was made to reflect some of the common themes frequently dealt, and recurrently taken by Indian diasporic fiction writers. The paper however, also carried an evolutionary history of Indian diasporic fiction, starting from the term diaspora itself with some appraisal of this genre. In the last section, few dissertations and selected articles were analysed to make a review how Jhumpa Lahiri and Kiran Desai’s fiction has been dealt or explored through the post-colonial and cultural literary discourse.

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मराठी दलित रंगभूमी आणि स्त्री नाट्यलेखिका

डॉ. जगतवाड शिवाजी पिराजी

सिद्धार्थ कला, वाणिज्य व विज्ञान महाविद्यालय, जाफ्राबाद, जिल्हा. जालना.

प्रस्तावना :

दलित रंगभूमी ही मराठी रंगभूमीचा उज्वल असा स्वतंत्र विभाग आहे. तिचे रूपसौंदर्य आगळेवेगळे आहे. तिच्या स्वरूपाची देखनेपनाची चिकित्सा आपल्याला थोडक्यात येथे करावयाची आहे. दलित रंगभूमीचा उदय 'जलसा' या कला प्रकारातून झालेला आहे. तमाशा, जलसे या प्रकाराला नवा रूपाशय देऊन दलित रंगभूमीचा उदय झाला आहे. खरे तर तमाशा रंगभूमी हीच मूल मराठी रंगभूमी आहे. या रंगभूमीची वाढ, तिचा विकास मांग, महार, कोल्हाटी यांनी केला. या जुन्या कलाप्रकारातून स्वतःचे मनोरंजन करण्याची एक रित शोधली. यातूनच पुढे दलित नाटक, दलित एकांकिका, दलित पथनाटके असा दलित नाटकांचा स्वातंत्र्यापासून ते आजपर्यंतचा प्रवास झालेला आहे.

दलित नाटकांच्या प्रवाहात पहिले दलित नाटक म्हणून महात्मा ज्योतिबा फुले यांच्या 'तृतीय रत्न' या नाटकाचे स्थान अढळ आहे. म्हणून महात्मा फुले दलित नाट्य चळवळीचे आदय होत. त्यांनी पुरोहित शाहीवर घणाघाती हल्ला चढविला. एक गरीब शेतकऱ्याच्या अडाणीपनाचा गैर फायदा घेऊन जोशीबुवा त्या गरीब शेतकऱ्याची व त्याच्या पत्नीची फसवणूक करतात हे अत्यंत प्रभावीपणे 'तृतीय रत्न' या नाटकात दाखविले आहे. सामाजिक अधिष्ठान असलेले मराठी रंगभूमीवरचे व दलित परंपरा असलेले या दोन्ही दृष्टीने हे पहिले नाटक ठरते. या नाटकातून त्यांनी समाजाला विद्येचे महत्व पटवून देण्यासाठी हे नाटक लिहिले. या नाटकाची प्रेरणा घेऊन शाहीर किशन फागू बनसोडे हे पहिले शिल्पकार ठरतात.

इ.स. 1920 मध्ये मोरेश्वर तांबे यांनी 'महारची सून' हे नाटक लिहून प्रस्थापित नाटक मंडळींना फार मोठा धक्का दिला. तो काळ बालगंधर्वाच्या समांतर रंगभूमीचा होता. इ. स. 1940 ते 1945 च्या दरम्यान दीनबंधू शेगांवकरांनी 'राजा आक्रोश', प्रभाकर वराळे यांनी 'सिद्धार्थ गौतम' ही नाटके लिहिली. याच काळात डॉ. बाबासाहेब आंबेडकर यांच्या चळवळीचा व विचारांचा प्रभाव दलितांवर होऊन काव्यकथा, नाटकातून विद्रोहाचे सुर उमटू लागले. 1950 मध्ये प्रभाकर यांनी 'जगाच्या कल्याणा' याच काळात भि. शि. शिंदे यांनी 'चंद्रहार' ही नाटके लिहिली. या नंतर रंगभूमीचा दुवा साधणारे नाटक म. भि. चिटणीस यांचे 'युगयात्रा' रंगभूमीवर आले. पुढे डॉ. गंगाधर पानतावणे यांनी 'माणुसकीचा बंड', 1958 साली मा. आ. करंडे गुरुजी यांनी 'नवी वाट', तर म. भि. चिटणीस यांनी पुन्हा जिवंत झाल्या सावल्या' हे नभोनाट्य लिहून डॉ. बाबासाहेब आंबेडकरांच्या विचारांचे चित्र उभे केले.

अशा प्रकारे महात्मा फुले यांच्या 'तृतीय रत्न' या नाटकपासून दलित नाटकांचा प्रवास गृहीत धरावा लागेल. स्वातंत्र्यानंतर ख-या अर्थाने दलित नाटक व दलित रंगभूमी या संकल्पना रूढ झाल्या. याच काळात दलित जाणिवा विकसित झाल्या. डॉ. आंबेडकरांचे विचार जनमानसात रुजू लागले. दलितांना आपल्या हक्कांची जाणीव होऊ लागली होती. लेखनी हाती आली होती. दलित साहित्याचा सूर्य उगवला होता. स्वातंत्र्योत्तर कालखंडात दलित साहित्याची संकल्पना स्पष्ट झाली होती. तमाशा, वगनाट्य, दलित शाहिरी इत्यादी लोककलांच्या माध्यमातून उगम पावलेली दलित रंगभूमी आज संपूर्ण महाराष्ट्रात स्वतेजाने उजळून निघत आहे. दलित स्त्रीनाट्यलेखिका बोटार मोजण्याइतक्या असल्या तरी त्यांच्या नाट्यकृतींच्या माध्यमातून दलित नाट्यचळवळीविषयी जवळीक साधण्याचा प्रयत्न येथे केला आहे.

दलित नाट्यलेखिका :

शिल्पा मुंब्रस्कर यांची झाडाझडती (1984) ही नाट्यकृती दलित स्त्रीच्या दुहेरी गुलामगिरीविरुद्ध प्रकर्षाने आवाज उठवून परिवर्तनाचा नवा विचार मांडते. अशा तऱ्हेने या नाटकातील दलित नाट्यविषयाचा तपशील हा केवळ अन्याय आणि आक्रोश यांचेच निदर्शक नसून तो सामाजिक समता, परिवर्तन आणि न्याय प्रस्थापनेसाठी चालना देणारा आहे. या नाटकात नाट्यलेखिकेने दलित स्त्रीच्या जीवनाशी निगडित असणाऱ्या समस्या व प्रश्न यांनाच अधिक प्राधान्य दिलेले दिसून येते. त्या दुष्टिकोणातून ही नाटक संघर्षप्रधान असण्यापेक्षा समस्याप्रधानच असलेले जाणवते. या नाटकातून दलितांच्या जीवनदर्शनाच्या अनुषंगाने प्रकट झालेला विद्रोह व नकार प्रामुख्याने दलित मुक्तीकडे झेपवणारा आहे.

प्रस्थापित समाज व संस्कृती यावर घणाघाती हल्ला चढविताना या नाटकातून विद्रोहाचा अंगारा ठसठशीतपणे प्रकट झाला आहे. दलीतांनी ज्या मूल्य संकल्पना स्वीकारल्या आहेत त्याच्यासाठी या नाटकातील संघर्ष निर्माण झाला, तो वास्तवपूर्ण पातळीवरचा असून त्या आधारे स्व त्वाचा शोध परंपरेला नकार, परंपरावादी दृष्टि, क्रांतिकारकत्व, जीवनात न्याय - स्वातंत्र्य - समता - बंधुता यांच्याशी बांधिलकी इ. लक्षणे प्रस्तुत दलित नाटकातून प्रकट होतात. या शिवाय प्रस्थापितांच्या विरोधी दलितांच्या मनात असलेली बेफाम चिड तिब्रतेने प्रकट होते. दलित स्त्रीचे जीवन, तिचे राहणीमान, तिचे दणकट, प्रखर, कठोर, तीव्र, उत्कट राग या बरोबरच दलित जाणिवेचे, स्त्री दुःखाचे, तिच्या वेदनांचे आणि व्यथांचे

ज्या दलित नाटकातून ती पुढे आली आहे त्या अनुभवाशी इमान राखून अधिकार वाणीने सत्य निरपेक्षतेने दलित स्त्रीची समस्या मांडण्यासाठी नाट्यलेखिकेची लेखनी वचनबद्ध झालेली दिसते.

निष्कर्ष:

दलित रंगभूमीने तळागळातल्या लोकांच्या आशा आणि आकांक्षा नाटका मध्ये मांडल्या आहेत. दलित रंगभूमीवरचे पहिले नाटक 'तृतीय रत्न' आहे. या नाटकपासून झालेली सुरुवात महत्वपूर्ण अशीच आहे. भारतीय समजव्यवस्थेतील अस्पृश्य, भटका, गुन्हेगार, अवहेलना, जुलूम, जबरदस्ती, अन्याय, अत्याचार असे अनेकानेक विषय घेवून दलित नाटककारांनी नाटके लिहिली आहेत. दलित नाटक हे मुळातच आंबेडकरी चळवळीतून निर्माण झाले आहे. त्यात समस्याप्रधान व दलितांचे वास्तव चित्रण पाहायला मिळते. समाज प्रबोधनाच्या तीव्र इच्छेमधूनच दलित रंगभूमी उदयाला आलेली आहे. दलित रंगभूमीच्या वाटचालीत लोकरंगभूमीवरील तमाशा - जलसा शहिरी या लोककलांनी मोलाचे योगदान दिले आहे.

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प्रस्तावना

आधुनिक महाराष्ट्राच्या इतिहासात १९ वे शतक हे सामाजिक, धार्मिक सुधारणांचे शतक म्हणून ओळखले जाते. इ.स १८१८ मध्ये पेशवाईचा अंत झाला. भारतात इंग्रजी सत्तेचा अंमल सुरु झाला. सुरुवातीपासुन इंग्रजांनी शिक्षण प्रसाराचे धोरण अवलंबल्यामुळे देशातील नवीन पिढी पाश्चात्य संस्कृतीच्या संपर्कात आली. त्यामुळे नवीन पिढीतील तरुणांनी आपल्या समाज व्यवस्थेतील कर्मकांड, अंधश्रद्धा व रुढी परंपरा या गोष्टीकडे लक्ष वेधले. समाजातील चुकीच्या अंधश्रद्धा व भ्रामक समजूती मुळे संपूर्ण समाजाचे नैतिक अधःपतन घडून आलेले आहे. समाजात धर्माच्या नावाखाली अनेक वाईट प्रथांचा उदय झाला. अनेक प्रकारचे धर्मसंस्कार यांच्या नावाखाली अनेक वाईट कृत्ये समाजात करण्यात येऊ लागले. त्यांना अशा वाईट प्रथांची जाणीव झाली. त्यातुन काही तरुण सामाजिक, धार्मिक सुधारणा घडवून आप्यासाठी पुढे सरसावले. यामध्ये बाळशास्त्री जांभेकर, महात्मा ज्योतीबा फुले, राजर्षी शाहू महाराज व डॉ. बाबासाहेब आंबेडकर आणि गोपाळ गणेश आगरकर इत्यादी चा समावेश होता.

गोपाळ गणेश आगरकरांनी केलेले सामाजिक आणि धार्मिक कार्य अतिशय उल्लेखनीय आहे. आगरकर यांनी सामाजिक सुधारणेबरोबर समाजातील धार्मिक सुधारणा करण्यासाठी आग्रही भूमिका घेतली. त्यांनी हिंदू धर्मातील मूर्तीपूजा सण-उत्सव, पशुबळी, प्रहाविषयी भ्रामक समजूती तसेच वेगवेगळ्या प्रकारचे धर्म संस्कार यांच्या नावाखाली वाईट कृत्ये करणाऱ्यावर कडाडून टिका केली. त्यांनी 'सुधारक' या पत्रातुन सामाजिक व धार्मिक प्रश्नावर विचार मांडून महाराष्ट्राचे वैचारिक प्रबोधन केले. आचार्य जावडेकर आगरकराबद्दल म्हणतात, "सर्व आयुष्यभर तीव्र विरोधाची, आणि निंदेची पर्वा न करता समाज सुधारणेची आणि धर्म सुधारणेची पताका राबवणारी व्यक्तीमत्व म्हणजेच आगरकर" अशा शब्दात आगरकरांचा गौरव केला. गोपाळ कृष्ण गोखले म्हणतात, "विद्वान पंडित, कळकळीचा देशभक्त, निर्भळ व जोरदार शिलाचा पुरुष म्हणजे आगरकर" अशा शब्दात आगरकराचे वर्णन करतात.

गोपाळ गणेश आगरकर यांचा जीवन परिचय : (जन्म १४ जुलै १८५६ - मृत्यू १७ जून १८९५)

गोपाळ गणेश आगरकर यांचा जन्म १४ जुलै १८५६ रोजी सातारा जिल्यातील कऱ्हाड जवळ टेंभू या गावी ब्राम्हण कुटूंबात झाला. त्यांचे प्राथमिक शिक्षण कऱ्हाड येथे तर पुढील शिक्षण रत्नागिरी व अकोला येथे झाले. घरची आर्थिक परिस्थिती नाजूक असल्यामुळे शिक्षण घेत असतांना त्यांनी कारकुन, कंपाऊंडर म्हणून काम करून शिक्षणाचा गाडा चालु ठेवला.

त्यासोबतच त्यांनी वकृत्व स्पर्धा, विविध निबंध स्पर्धेत बक्षिसे मिळवून तसेच 'वन्हाड समाचार' पत्रामध्ये नियमित लेख लिहून त्यांनी उपजिवीका भागवली. १८७५ साली मॅट्रीक पर्यंतचे शिक्षण पूर्ण केले. आणि महाविद्यालयीन शिक्षण घेण्यासाठी पुण्याला आले. १८७८ साली ते बी.ए पास झाले. त्या दरम्यान त्यांना दम्याचा आजार बळावला.पुण्याच्या डेक्कन कॉलेज मध्ये शिकत असतांना आगरकर आपला एकुलता एक सदरा दिवसा वापरायचा आणि तोच रात्रीला धुवून पुन्हा दुसऱ्या दिवशी वापरायचा.

पुढे १८७९ मध्ये एम. ए. चालु असतांना लोकमान्य टिळकांची ओळख झाली. लोकमान्य टिळकांशी त्यांचा स्नेह वाढला. इ.स १८८१ मध्ये ते इतिहास व तत्वज्ञान विषय घेऊन एम.ए पास झाले. १८८० मध्ये पुण्यात न्यु इंग्लिश स्कुल स्थापना करण्यात त्यांनी पुढाकार घेतला. त्यांनी न्यु इंग्लिश स्कुल मध्ये

शिक्षकाची नोकरी पत्करली. पुढे ते फर्ग्युसन कॉलेज मध्ये प्राध्यापक झाले. पुढील काळात ते याच कॉलेजमध्ये प्राचार्य झाले. त्यांनी आपले संपूर्ण आयुष्य निःस्वार्थ समाज सेवा करण्यात घातले.

१८८१ ते १८८७ या काळात 'केसरी' चे संपादक म्हणून आगरकरांनी काम पहिले. नंतर टिळकासोबतच्या वैचारिक मतभेदामुळे ऑक्टोबर १८८० ला 'केसरीचा' राजीनामा दिला. त्यांनी १८८८ ला 'सुधारक' नावाचे वृत्त पत्र काढले. त्यांनी १८८८ ते १८९५ या काळात 'सुधारक' पत्राचे संपादक होते. आधुनिक महाराष्ट्राच्या इतिहासात समाजात सामाजिक, धार्मिक जागृती घडवून आणण्यासाठी आगरकराचे योगदान खूप मोलाचे होते. त्यांच्यावर पाश्चात्य विचारवंत जॉन स्टुअर्स मिल, ऑगस्ट कांट आणि हर्बट स्पेन्सर या सामाजिक विचारवंतांचा प्रभाव आगरकरावर होता. सामाजिक समता, स्त्री-पुरुष समानता आणि विज्ञान निष्ठा ही त्यांची जीवन मूल्ये होती. बुद्धीप्रामाण्य वादाचे पुरस्कार करून महाराष्ट्रामध्ये समाज सुधारणा, धर्म सुधारणा करणाऱ्या समाज सुधारकामध्ये गोपाळ गणेश आगरकर यांचा समावेश होतो. त्यांनी केलेल्या सामाजिक सुधारणा व धार्मिक कधीही न विसरता येण्यासारखे आहेत.

गोपाळ गणेश आगरकर यांचे धार्मिक विचार

सामाजिक प्रश्नाबरोबरच आगरकरांने धार्मिक प्रश्नावर चिंतन केलेले होते. अंधश्रद्धा, कर्मकांड, मुर्तिपुजा, पशुबळी अशा हिंदू धर्मातील खुळचट प्रवृत्ती विरुद्ध आगरकरांनी सडकून टिका केलेली होती. एखादया धर्मशास्त्रात, पुराणात किंवा ऋषिमुनीने एखादी गोष्ट करण्यास सांगितली म्हणून ती गोष्ट सत्य आहे. असे समजण्यास ते तयार नव्हते. प्राचीन काळात धर्मशास्त्र काराने, ऋषिमुनीने जर काही अटी नियम घालून दिलेले असतील व ते आज रोजी आपणास जर अयोग्य वाटत असेल तर ते बदलण्याचा त्यांच्या इतकाच आपणास ही अधिकार आहे. असे आगरकरांनी ठणकावून सांगितले. आगरकरहे बुद्धी प्रामाण्यवादाचे पुरस्कर्ते होते. जे आपल्या बुद्धीला पटत असेल तेच आपण स्विकारावे असे त्यांचे म्हणणे होते.

१) मूर्तीपूजा :-

आगरकरांना मूर्तीपूजा मान्य नव्हती. त्यांनी 'मुर्तिपूजेचा उद्रेक' या शिर्षकाखाली एक लेख प्रसिध्द केला होता. त्यात ख्रिश्चन, इस्लाम या धर्मात फारसी मूर्तीपूजा नाही. मात्र बौध्द धर्मात बुध्द मूर्तीची पुजा करतात. परंतू हिंदू धर्माचे लोक विविध देवदेवतांचे मूर्तीच्या रुपाने पुजा करीत असत. परंतू आगरकराच्या मूर्तिपूजा ही निरर्थक आहे. त्यांनी 'सुधारक' या वृत्तपत्रातून 'मूर्तिपूजेचा उद्रेक' व 'मूर्तिपूजेचा प्रकार हे दोन लेख प्रसिध्द केले, 'मुर्तिपूजेचा उद्रेक' या लेखात त्यांनी वस्तुची, वनस्पतीची व प्राण्याची पुजा अशी तीन प्रकारची मूर्तीपूजा प्रचलित होती. 'मूर्तिपूजेचा प्रकार' या लेखात वनस्पती पुजा व प्राणी पुजा कशी अस्तित्वात आली हे त्यांनी स्पष्ट केले.

आगरकरांनी ईश्वराचे आस्तीत्व मान्य केले नाही आगरकर हे देव न मानणारा देव माणूस म्हणून ओळखले जातात.

२) शिमगा सणावर टिका :-

हिंदू धर्मात सण व उत्सव मोठया प्रमाणात साजरे केले जातात परंतू यापैकी काही सण व उत्सव आगरकरांना लज्जास्पद वाटतात. त्यांनी 'सुधारक' या वृत्तपत्रात 'पाचजन्यांचा हंगाम हा लेख प्रसारित केला. या लेखात त्यांनी देशातील जे विभत्स सण आहेत त्यामध्ये शिमगा या सणाचा उल्लेख केला ते म्हणतात हिंदू धर्माच्या नावाखाली अनेक लज्जास्पद आधार या देशात रुढ आहेत. त्यामध्ये शिमगा या सणाला पहिला क्रमांक दिला पाहीजे. शिमग्याच्या दिवशी उनाड मुले रस्त्यावरून अर्वाच्य शब्द उच्चारत फिरतात. त्यामुळे सभ्य स्त्री पुरुषांना शरमेने मान खाली घालावी लागते. धुळवडीचा दिवस तर अत्यंत

लाजिरवाणा दिवस आहे. शिमगा हा सण हिंदू धर्मावर फार मोठा कलंक आहे. त्यामुळे हा सण कायद्याने बंद केला पाहिजे असे मत आगरकर मांडतात. आजही हा सण विकृत पध्दतीनेच साजरा केला जातो.

३) पशुहत्या प्रतिबंध :-

हिंदू धर्मात अनेक देवदेवतांना प्रसन्न करण्यासाठी पशुबळी दिला जात असे. देवाच्या उत्सव प्रसंगी यज्ञविधित तसेच नवस इत्यादीसाठी पशुबळी दिला जात असे, म्हसोबा, मरिआई या ग्रामदेवतांना बकरा, रेडा आणि कोंबड्यांचा बळी दिला जात असे. पशुबळीचा प्रथा ही आगरकरांना मान्य नव्हती त्यांनी 'सुधारक' मध्ये 'धर्माचा सुकाळ आणि बकऱ्यांचा काळ' हा लेख प्रसिद्ध केला. या लेखात ते असे म्हणतात, "ज्यांना यज्ञ करून जन्ममरणापासून मुक्त व्हायचे आहे त्याने स्वताःच्या शरिराचा किंवा शरीराच्या काही भागाची आहूती देण्यास काय हरकत आहे ? यज्ञात बळी दिलेल्या पशुला यातना होत नाहीत आणि त्यास पुन्हा जन्म मिळतो. या कल्पनेस आगरकरांनी विरोध केला. पशुबळी देण्यास प्रतिबंध असावा असा त्यांनी विचार मांडला.

४) शनिग्रहाविषयीच्या भ्रामक समजूती :-

शनिग्रहाविषयी त्या काळात ज्या समजूती होत्या. त्या भ्रामक आणि खोट्या आहेत. हे गोपाळ गणेश आगरकरांनी समाजाला पटवून दिले. शनी हा ग्रह पृथ्वीपासून १० कोटी मैल अंतरावर असून तो पृथ्वीच्या तुलनेत शनिग्रह ७३४ पर आकाराने मोठा आहे. मग एवढ्या दुरवर असलेल्या पृथ्वीवरील व्यक्तींना शनिग्रह पीडा कसा काय देऊ शकतो? असा प्रश्न आगरकरांनी उपस्थित केला शनिग्रहाच्या अवकृपेमुळे राम, नल-दमयंती, पाच पांडव आणि विक्रमचरित्रात वर्णन केलेला राजा विक्रम यांना जी अवकृपा सहन करावी लागली ती समजूत साफ खोटी आहे, असेही गोपाळ गणेश आगरकरांनी म्हटले आहे.

५) ग्रहणासंबंधी असलेले गैरसमज :-

ग्रहणाविषयी त्याकाळात अनेक गैरसमज अस्तित्वात होते. ग्रहणाच्या काळात जर गरोदर स्त्रियांनी काही कामे केल्यास त्याचा परिणाम गर्भाशयातील बाळावर होतो आणि बाळ दिव्यांगावस्थेत जन्माला येऊ शकते, अशी लोकांमध्ये गैरसमज होता.

मात्र गोपाळ गणेश आगरकरांनी 'आमचे अजून ग्रहण सुटले नाही' हा लेख लिहून या गैरसमजूतीवर कडाडून टिका केली ग्रहणासंबंधी थंड पाण्याने स्नान करणे. दानधर्म, उपवास, मंत्राचा जप व सिध्दी केली जाते. त्याबद्दल गोपाळ गणेश आगरकर खेद व्यक्त केला. कोणत्याही कामासाठी बाहेर पडतांना ग्रहाची अनुकूलता पाहिली जात असे. त्यावर आगरकर टिका करतात.

६) अंत्यसंस्कार :-

गोपाळ गणेश आगरकरांनी १९ व २६ डिसेंबर १८९२ व १६ जानेवारी १८९३ रोजीच्या 'सुधारक' वृत्तपत्रातील अंकात 'प्रेत क्रिया व प्रेत संस्कार' या शिषकांचे दोन लेख लिहले. या लेखात अंत्यसंस्काराच्या विविध जातीतील प्रथाची माहिती दिली. हिंदू धर्मातील अंत्यसंस्कार पध्दती खुपच त्रास दायक व संताप जनक आहे असे आगरकरांनी म्हटले. प्रेताचे दहन केल्यावर त्याची राख व हाडे पाण्यात टाकुण पाणी अस्वच्छ केले जाते हे आगरकरांना मान्य नव्हते. राख व हाडे गोळा करण्याचे काम नगर पालिकांनी करावे असे त्यांनी तत्कालीन प्रशासनास सुचविले. मृत्यु झालेल्या माणसाचा पुनः जन्म होत नाही. त्यांच्या शरीराच्या नाशा बरोबर त्यांचा आत्म्याचा नाश देखील होतो. असे त्यांचे मत होते. मृत्यू नंतर मृत व्यक्तीच्या नावे दान धर्म करणे, केस काढणे, भोजन देणे, समाधी बांधणे या सर्व गोष्टीला आगरकरांनी विरोध दर्शविला.

७) सोवळे - ओवळ्यावर टिका :-

गो.ग आगरकरांना समाजात चाललेल्या सोवळे ओवळ्याचा बडेजाव पणा मान्य नव्हता. सोवळे ओवळ्या मुळे व्यवहारात अनेक अडचणी निर्माण होतात. तसेच वर्गावर्गात भेदभाव निर्माण होतात. असे त्यांचे मत होते त्यांनी 'सोवळ्याची मिमांसा' व 'सोवळ्या ओवळ्याची पुर्वणी' हे दोन लेख लिहून त्यांनी सोवळ्या ओवळ्याविषयी हास्यास्पद कल्पना मांडली. व ब्राम्हणाच्या सोवळ्या ओवळ्याच्या गैरसमजूतीवर टिका केली. उपनयन संस्कार नको असे आगरकर म्हणतात. स्वतः ब्राम्हण असून कधी त्यांनी श्रावणी केली नाही आणि जानवे घातले नाही. अशा चालीरीती त्यांना मान्य नव्हत्या.

८) संमती वयाचे बिलाबद्दल आगरकरांचे मत :-

विवाहित स्त्रीचे संभोग घेण्याचे वय वाढविण्यात मध्यवर्ती कायदेमंडळात सरकारकडून एक बिल मांडले होते. या बिलानुसार स्त्रीयाचे संभोग घेण्याचे वय १३ वर्ष केले जाणार होते. परंतू हे बिल सनातनी लोकांना मान्य नव्हते. सरकारने आमच्या धार्मिक जीवनात हस्तक्षेप करू नये असे त्यांचे मत होते. आगरकरांनी या प्रश्नावर 'सुधारक' मध्ये चार लेख लिहून संमती वयाच्या बिलावर प्रकाश टाकला. 'जुन्या लोकांचा 'खोटे पणा' व 'संमती वयास धर्मशास्त्रात बादक नाही' या दोन लेखात त्यांनी संमती वयाच्या बिलाचा पुरस्कार केला. त्यांनी सनातनी लोकांना असा प्रश्न केला की, स्त्रीला ऋतू प्राप्त झाल्यास १६ दिवसाच्या आत पतीला गर्भधान करण्यासाठी पत्नीस पतीकडे पाठविले पाहिजे अशी शास्त्राची आज्ञा कोठे आहे. हे धर्माभिमांनी लोकांनी आम्हाला दाखवावे असा सवाल देखील केला.

९) दत्तक पुत्राबद्दल आगरकरांचे विचार:-

तत्कालीन समाज व्यवस्थेत अपत्य नसलेल्या कुटूंबात दत्तक पुत्र घेण्याची प्रथा रूढ होती. आगरकरने मात्र दत्तक पुत्र घेण्याची आवश्यकता नाही असे म्हणतात. त्यांनी 'दत्तकांची आवश्यकता' या लेखात दत्तक पुत्राच्या संदर्भात विविध स्मृतीकरांची मते काय होती. याचे विस्तृत स्पष्टीकरण केले आहे. नाव चालविण्यासाठी फार प्राचीन काळाप्रमाणे दत्तक पुत्राची गरज नाही असे मत आगरकर मांडतात. दत्तक पुत्र घेतल्यामुळे घराण्याचे नांव चालते हे ते मान्य करीत नाही. नाना फडणविसाच्या दत्तक पुत्रांने इतिहासात नांव चालविले काय ? असा सवाल से विचारतात दत्तकाशिवाय स्वर्गात प्रवेश नाही हो खोटी समजूत आहे, असे आगरकरांचे मत होते.

१०) आत्म्याचे अमरत्व या बद्दल आगरकरांचे मत :-

गो. ग. आगरकरांना आत्म्याचे अमरत्व मान्य नाही. त्यांनी 'सुधारक' मध्ये 'धर्मकल्पना आली कोठून ?" हा लेख प्रसिध्द करून त्यात आत्म्याच्या अमरत्वावर मते मांडली. त्यांचे असे म्हणणे होते की, आत्मा एका शरीरातून दुसऱ्या शरीरात प्रवेश करीत नाही. आत्मा एका शरीरातून दुसऱ्या शरीरात प्रवेश करतांना कोणी पाहिले का? मनुष्याच्या मृत्युनंतर सर्व काही संपते असे त्यांचे मत होते. स्वर्ग, नरक, यम, यमपुरी व यम यातना या गोष्टी आगरकरांना मान्य नव्हत्या.

११) स्वधर्माबद्दल अभिमान :-

आगरकरांना स्वधर्माचा म्हणजेच हिंदू धर्माचा अभिमान होता. त्यांनी हिंदू धर्मावर कठोर टिका केली. परंतू स्वधर्मात स्वलोकात व स्वभूमीत राहूनच सुधारणा करणे या मध्येच खरे देश प्रेम आणि देशाचा अभिमान आहे असे त्यांचे मत होते. आगरकरांनी 'गुलामाचे राष्ट्र' या लेखात म्हटले की, हिंदू धर्मात बरीच व्यंगे आहेत. म्हणून जैन, इस्लाम, ख्रिश्चन धर्माचा स्विकार करणे हे न पटणारे आहे. आगरकरांना आर्य जाती, आर्यवंश व आर्य लोकांचा अभिमान होता. आर्य जातीला बलशाली बनविण्यासाठी बुध्दी वादाची आवश्यकता होती. असे आगरकरांना वाटत होते. आगरकरांना बुध्दीवादाचे जनक म्हटले जाते.

१२) भ्रामक कल्पनाबद्दल आगरकरांचे मत :-

तत्कालीन समाजव्यवस्थेत प्रचलित असलेल्या अनेक भ्रामक कल्पना आगरकरांना मान्य नव्हत्या. मृत्यू पावलेल्या व्यक्तीचा आत्मा हा घरी, गावातील स्मशनात किंवा तो ज्या प्रदेशात वास्तव्य करित होता त्या ठिकाणी असतो असे अनेक लोकांचे जे अनेक प्रकारचे मत आहे. ते खोटे व हास्यास्पद आहे असे आगरकर म्हणतात. स्वर्ग हे सत्पुरुषाच्या आश्रयाचे स्थान आहे. स्वर्ग म्हणजे चैनीचे माहेर घर जो स्वर्गात गेला त्याला कोणत्याही वस्तुसाठी श्रम करण्याची गरज नाही. स्वर्गात रोग, मृत्यू कधीच येत नाही अशा भ्रामक कल्पना या खोट्या अंधश्रद्धेवर आधारलेल्या आहेत असे आगरकर म्हणतात त्यांनी फलज्योतीष, किमया, शकुन, पिशाचयोनी आणि पुनःजन्मावर कधीच विश्वास ठेवला नाही. त्यांनी कोणत्या एका धर्माचा मोठेपणा सांगितला नाही. सर्व धर्म अपूर्ण असून त्यात सुधारणा होणे गरजेचे आहे असे आगरकरांचे मत होते. त्यांनी धर्माच्या बाबतीत तर्कशुद्ध, कठोर आणि निर्मळ भूमिका मांडली होती.

निष्कर्ष :-

- १) गो. ग. आगरकरांच्या धार्मिक विचारांच्या अभ्यासाअंती असे दिसून येते की. तत्कालीन समाजाच्या सर्वांगीण विकासासाठी पोषक असणाऱ्या बाबीसाठी अगदी मुलभूत विषयावर चिंतन करणारे समाजसुधारक गो. ग. आगरकर होते. त्यांनी समाजातील अमानुष प्रकारच्या प्रथा आणि परंपरा या बद्दल कडाडून विरोध केला. त्याचबरोबर धार्मिक सुधारणा घडवून आणण्यासाठी विज्ञानवादी भूमिका घेऊन समाजात धार्मिक जनजागृती केल्याची दिसून येते.
- २) गो. ग. आगरकरांनी हिंदू धर्मातील अंधश्रद्धा आणि कर्मकांडाबद्दल समाजात जागृती करत असतांना समाजातील सनातनी लोकांनी केलेल्या निंदेची कधीच पर्वा केली नाही. त्यांनी लेखनीच्या माध्यमातून सनातनी लोकांना सडेतोड उत्तरे दिली. त्यांनी धार्मिक सुधारणा करण्यासाठी 'सुधारक' या वृत्तपत्रात अनेक संपादकीय लेख लिहून लोकांमध्ये धार्मिक जागृती केली.
- ३) हिंदू धर्मातील मूर्तिपूजा, सण-उत्सव, पशुबळी, ग्रहाविषयी असलेले भ्रामक कल्पनाया बद्दल धार्मिक जागृती करण्यासाठी आगरकरांनी प्रामाणिक प्रयत्न केल्याचे दिसून येते. परंतु आजही बऱ्याच प्रमाणात हिंदू धर्मात मूर्तिपूजा, पशुबळी, नवस आणि ग्रहाविषयी भ्रामक कल्पना हिंदू धर्मात दिसून येतात. गो. ग. आगरकरांच्या धार्मिक विचाराने काही प्रमाणात अंधश्रद्धा आणि कर्मकांडाच्या फेऱ्यातून सर्व सामान्य माणसाला बाहेर येण्यास वाव मिळाला.
- ४) गो. ग. आगरकर हे बुध्दीवादी, विचारशील, तत्त्वनिष्ठ आणि विज्ञानाचे समर्थन करणारे थोर विचारवंत होते. आगरकरांच्या सामाजिक आणि धार्मिक विचारावर पाश्चात्य विचारवंताचा प्रभाव होता. समाजाने प्रामाण्यवादी दृष्टीकोण स्वीकारावा हा त्यांचा आग्रह होता.
- ५) आगरकरांनी १५० वर्षांपूर्वी जन्माधिष्ठित जातीव्यवस्था व धर्मव्यवस्था यामुळे व्यक्तीमत्त्व विकास कसा खुंटतो याचे त्यांनी असंख्य लेखामधून लिखान करून समाजाला जागे करण्याचे प्रयत्न केला. धर्मासंबंधी अत्यंत तर्कशुद्ध कठोर आणि निर्भय भूमिका आगरकरांनी १५० वर्षांपूर्वी मांडली. हे वास्तव नाकारता येत नाही. म्हणूनच त्यांनी धार्मिक जीवनातील दोष, उणीवा सूक्ष्मपणे मांडू शकले. गोपाळ गणेश आगरकरांचा धर्माभिमान आणि देशाभिमान अतिशय विलोभणीय होता.

संदर्भग्रंथ :-

- १) डॉ. अनिल कठारे- आधुनिक महाराष्ट्राचा इतिहास ५ वी आवृत्ती जून २०१८
- २) डॉ. एस. एस. गाठळ - महाराष्ट्रातील समाजसुधारक विचारधारा व कार्य प्रथमावृत्ती जुलै २०१४
- ३) दि. य. देशपांडे- आगरकर वाङ्मय खंड १ संपादक म.गं. नातू प्रथमावृत्ती जानेवारी १९८४ (४) गो.ग आगरकर यांचे 'सुधारक' या वृत्तपत्रात प्रसिध्द झालेले सामाजिक, धार्मिक आणि राजकीय विषयावरील निवडक निबंध भाग-१ ला शिराळकर आणि कंपनी पुणे.

“पं.दीनदयाळ उपाध्याय यांचा एकात्म मानवतावाद सिध्दांताचे विश्लेषण”

सोनु बबन गवळी, प्रा. डॉ. व्ही बी. लांब

संशोधक विद्यार्थी मार्गदर्शक व विभाग प्रमुख,

इतिहास विभाग, इतिहास विभाग

विवेकांनद कला, सरदार दलिपसिंग विज्ञानइंद्रराज कला, विज्ञान व वाणिज्य

व वाणिज्य महाविद्यालय, छत्रपती संभाजीनगरमहाविद्यालय, सिल्लोड, छत्रपती संभाजीनगर

गोषवारा :

पं.दीनदयाळ उपाध्याय यांनी १९४२ राष्ट्रीय स्वयंसेवक संघाच्या माध्यामातून सामाजिक कार्याला सुरुवात केली. उत्कृष्ट संघटक, पत्रकार आणि वक्ता म्हणून त्यांनी संघाच्या कार्यावर भर दिला. भारतीय एकात्मता व अखंडतेसाठी त्यांनी कार्य केले तसेच एकात्मवादाचा विचार दिला. प्रस्तुत शोध निबंधात पं.दीनदयाळ उपाध्याय यांच्याएकात्म मानवतावादविचाराचा आढावा घेण्यात आला आहे.

आधुनिक काळात सर्व काही यांत्रिक होत चालले आहे. परंतु आजही मानवी समस्यांचे काही निवारण झाले नाही. जेव्हा मानवी समस्यांचा विषय येतो. तेव्हा मानवतावाद हे तत्त्वज्ञान अस्तित्वात येते. मानवतावाद म्हणजे अशा प्रकारचे तत्त्वज्ञान ज्यांचा केंद्रबिंदू मानव आहे. या तत्त्वज्ञानात मानवी समस्यांचा अभ्यास करून त्या समस्या सोडवण्याचा प्रयत्न केला जातो. प्रसिद्ध विचारवंत एफ.सी.एस. शिलर हा मानवतावाद म्हणजे पूर्णपणे मानव केंद्रित विचारधारामानतात. त्यांच्यानुसार सर्वसाधारणपणे मानवतावाद एक तात्विक प्रवृत्ती असून यात माणूस जसे आहे तसे स्वीकारतो. आणि माणसाच्या आनुभवाचे जग त्याला दिसते, हा एक नैसर्गिक प्रारंभिक बिंदू आहे जो कोणत्याही दिशेने जाऊ शकतो आणि आपल्या अनुभवाच्या दुष्टीने वाढीव शक्तीसह विज्ञानाच्या सर्व प्रवासानंतर त्याच ठिकाणी परत येऊ शकतो.

मानवतावाद विचारसरणीचा मुख्य उद्देश मानवाला पूर्ण समाधान प्रदान करणे हा आहे. दुसऱ्या शब्दांत मनुष्याने मानवासाठी केलेल्या प्रत्येक कार्याचा उद्देश मानव कल्याण आहे. आधुनिक युगात मानवी जीवनाच्या प्रत्येक पैलूंना मानवतावादाने विकसित केले आहे. मानवतावादाने मानवी जीवनाच्या प्रत्येक बाबींवर परीणाम केला आहे.

भारताच्या बाबतीमध्ये मानवतावाद विचारसरणी खूप पूर्वीपासून अस्तित्वात होती. परंतु स्वातंत्र्यापूर्वी ही विचारसरणी प्रबल होऊ लागली. या विचारसरणीमध्ये प्रामुख्याने महात्मा गांधी, डॉ. सर्वपल्ली राधाकृष्ण, पं. जवाहरलाल नेहरू, डॉ. बाबासाहेब आंबेडकर, महात्मा ज्योतिबा फुले व पंडित दीनदयाळ उपाध्याय या महापुरुषांचे विचार प्रभावी होते. यातीलपं.दीनदयाळ उपाध्याय यांचे विचार आजही आधुनिक युगात लागू होतात. या शोध निबंधात पं.दीनदयाळ उपाध्याय यांच्यामानवतावाद संकल्पने विषयी विचारांचा आढावा घेण्यात आला आहे.

पं.दीनदयाळ उपाध्याय यांचे बालपण खुप कठिण परिस्थितीमध्ये गेले परंतु ते एक प्रभावी व हुशार विद्यार्थी होते. त्यांनी १९४२ मध्ये राष्ट्रीय स्वयंसेवक संघाच्या माध्यामातून सामाजिक कार्याला सुरुवात केली. उत्कृष्ट संघटक, साहित्यिक, पत्रकार आणि वक्ता म्हणून त्यांनी संघाच्या कार्यावर भर दिला. जेव्हा १९५१ मध्ये डॉ.श्यामा प्रसाद मुखर्जी यांच्या नेतृत्वाखाली भारतीय जनसंघाची स्थापना झाली. तेव्हाच त्यांनी राजकारणात प्रवेश केला. देशाच्या अखंडतेसाठी काश्मीर चळवळ, गोवा मुक्ती चळवळ आणि

बेरुबारीच्या हस्तांतरणाविरुद्ध चळवळ चालवून त्यांनी भारताच्या राजकारणात स्वातंत्र्यलढ्यांचे मुद्दे जीवंत ठेवले. भारताच्या अखंडतेसाठी त्यांनी संपूर्ण आयुष्य पणाला लावले. ज्यावेळीदेशाच्या लोकशाहीला प्रबळ विरोधी पक्षाची गरज होती. त्यावेळी पहिल्या तीन लोकसभा निवडणुकीमध्ये भारतीय जनसंघ एक शक्तीशाली विरोधी पक्ष म्हणून उदयास आला. दीर्घकाळात सत्ताधारी पक्षाला पर्याय बनता यावा यासाठी त्यांनी प्रयत्न केले आहे. यासाठी तंत्राचा नाही तर मंत्राचाही पर्याय आवश्यक होता. परकीय आशवासनाच्या जागी त्यांनी अखंड मानवतावाद, सांस्कृतिक राष्ट्रवाद आणि भारतीयीकरणाचे आवाहन केले. यातील त्यांचा एकात्म मानवतावादाचा मंत्र पुढीलप्रमाणे आहे.

पं.दीनदयाळ उपाध्याय यांचे नाव त्यांच्या समकालीन मानवतावादीविचारवंतांमध्ये अग्रगण्य आहे. त्यांच्या विचारधारांचा आधार मानव आहे. त्यांचा मानवतावादी विचारांची सुरुवात शरीराच्या विकासापासून करून मन आणि बुद्धिच्या विकासाच्या मार्गावर चालत राहते. आत्म्याच्या विकासापर्यंत मानवाच्या अनेक टप्प्यात विकास झालेला त्यांनी पाहिला. त्यांच्या मानवतावादी दृष्टीकोनाला अभिन्न मानवतावादी असे म्हणू शकतो आहे. याचे कारण असे की त्यांच्या दर्शनात व्याप्त आणि प्रकट होणारे एकत्वरूप आहे. परत्म्याचा जो अंश माझ्यामध्ये आहे. तो इतर लोकांमध्येही राहतो अशी व्यक्तीची भावना आहे. पं.दीनदयाळजींच्या एकात्म मानवतावाद सामान्य माणसाला सामान्य म्हणून नव्हे तर त्याला संपूर्णपणे पाहतो. त्यांच्या मते जीवनात ४ सुख आहेत. शरीराचे सुख, मनाचे सुख, बुद्धीचे सुख आणि आत्म्याचे सुख. यात शरीराचे सुख आवश्यक आहे पण ते पूर्ण सुख नाही. तो फक्त एकतर्फीचा आनंद आहे ज्यामध्ये केवळ इच्छांचे समाधान होत असते. इच्छांना अंत नाही. यापेक्षाही जास्त आनंद व्यक्तिला शुभविचारांनी मिळतो. हा आनंद केवळ शरीर आणि मन यापर्यंत मर्यादित न राहता यातून काव्यनिर्मिती, कलानिर्मिती, कार्यक्षमता आणि इतर बौद्धिक कार्य करतात. त्यातून मानवाच्या बुद्धिला आनंद मिळतो.

बुद्धी जीवनातील रहस्ये प्रकट करते. अखंड मानवतावाद बुद्धीच्या सुखापर्यंत पोहचून समाप्त होत नाही. बुद्धीच्या सुखापेक्षा आत्म्याचे सुख श्रेष्ठ आहे. मानवाला मानवी शरीर मन, बुद्धी सोबत आत्मा देखील आहे. दीनदयाळजींच्या आत्म्याच्या अमरत्वावर विश्वास होता. परमात्म्याशी एकरूप होणे हा आत्म्याचा आनंद आहे. स्वतःच्या मुळ स्वभावाचे स्वरूप बनने आणि निर्गुण, निराकर, सर्वव्यापी परमात्म्याची जाणीव होणे यातच अध्यात्मिक आनंद आहे. अशा प्रकारे पं.दीनदयाळ उपाध्याय यांनी एकात्म मानवतावाद सिध्दांत मांडला.

थोडक्यात मानवी प्रगती म्हणजे शरीर, मन, बुद्धी आणि आत्मा यांच्या गरजा पूर्ण करण्यासाठी पुरुषार्थाची कल्पना करण्यात आली आहे. यासाठी अध्यात्मिक आनंद हा अत्यंत आवश्यक आहे. ज्यामाध्यामातून मानवाचे सर्वसुख व आनंदीमय जीवन होईल. असा एकात्म मानवतावादाचा विचार पं.दीनदयाळ उपाध्याय यांनी मांडला आहे.

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GOOD AND EVIL IN WILLIAM GOLDING’S ‘LORD OF THE FLIES’

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Abstract:

This research paper explores how evil is portrayed through varied forms of events, characters and symbols. Golding depicts a picture within the readers mind as he ventures out to imitate how savagery will take over if there's no civilization intact. Golding explores the evil within all humans though the beast, because it's their only chance for survival and survival instinct takes over. In doing so, this paper will prove that Lord of the Flies exemplifies the innate evil that exists within all humans.

Keywords: evil, savagery, civilization and humanism.

Introduction:

Everyone is born with both good and bad within them. We, as humans, must choose which one we want to be “Good or evil”. Good and evil is the most common dichotomy in studies related to ethics, religion and philosophy. There is no holy scriptures that does not talk about good and evil. It is the most prevalent topic of ethics and philosophies. Though they are the main concepts of moral studies there is no definite meaning for both good and evil, whatever things that doesn't harm any living and non- living things are good while evil is the exact opposite of it. Good things will make the creations of God happy and also the God himself but evil things will never do any favour for fellow creatures. Evil is also represents immorality and malignity as it is against the moral values of world ethics.

Both Good and evil is mutually dependant. Both of them will not exist without each other. This is because; one will never know what is good without the existence of bad and the same goes for evil. Some critics have claimed that these two are mutually exclusive and they have no connection with each other which means good survive in its own way so does evil. But the question here is how could one differentiate what is good and what is evil without the existence of each other? Because in the absence of good there is nothing as evil could expose itself and everything will remain neutral.

William Golding exercises the one of the most typical orthodox themes in literature which is the battle between good and evil. It is one of his main themes of his very first novel *Lord of the Flies*. Being a believer of Christianity he made use of some motifs of Christianity like *fall* in his books. Inclusion of violence, cruelty, dark myth with moral values in his work *Lord of the Flies* is the plot developer. He also believes in *fall of man due to his past mistakes and disobedience*. So he included this in *Lord of the Flies* but in a varied sense like how Adam and Eve entered the Garden of Eden with purity and innocence but because of their disobedience their innocence and purity vanished and they fall to the earth as sinned human beings. The same way the twelve year old kids set foot in the Island with angelic faces with pure heart but later their silly mistakes which slowly turn into greater crimes and covet for power make them lose innocence completely. It does not mean that all of them become savages and some of them turn into the victims of the corrupted society.

In *Lord of the Flies*, children around the age 6- to 12 that are stranded on an island by plane crash. As these children search the island they discover there are no surviving adults to

lead them to survive. Because of that Ralph is elected leader, he was best fit for the job and with his lead the survivors survived peacefully for a while until one of the kids named Jack who was a bit power hungry and bored of doing boring work to survive got some kids and convinced them to join him in having

Jack versus Ralph

In *The Lord of the Flies*, Ralph is good while Jack is evil. Ralph represents the good side of us while Jack represents the evil side. Although sometimes it is easier to be evil, it pays off to be good. The novel is a perfect example of how all people are born with both sides. At the beginning, the boys choose the good side, with morals and civilization. But as the story moves on, the boys find it more exciting to be on the bad side. It shows that all the boys are torn between good and bad and there is a very thin line that separates both. We realize that people are born inherently good and bad because in life there are always right and wrong choices, children are born good but are easily influenced to do badly, and it is always harder to do what is right than what is wrong.

“The loss of innocence for which Ralph weeps at the novel's close is not, however, a matter of transformation from childish goodness to adolescent depravity, is not a growing into wickedness. It is rather the coming of an awareness of darkness, of the evil in man's heart that was present in the children all along,” (Boyd).

The two representatives of good and evil in the novel *Lord of the Flies* are Ralph and Jack respectively. Ralph characterizes righteousness while Jack characterizes evilness. They are like opposite poles occupying complete opposite positions, having different opinions and are totally against each other. They start off as good friends but gradually grow hate for each other because of their variation in opinions and actions. The actual story starts with the election held for selecting the leader and Ralph gets majority votes to be the leader.

“Him with the shell”

“Ralph! Ralph!”

“Let him be the chief with the trumpet thing”

Ralph raised a hand for silence

“All right. Who wants Jack for chief?”

With dreary obedience the choir raised their hands.

“Who wants me?” [19]

Every hand outside the choir except Piggy was raised immediately. Then Piggy, too, raised his hand grudgingly into the air. Ralph counted. *“I'm chief then”* [20] during the voting session, majority of the boys choose Ralph as their chief, thinking he could make a perfect leader and also will plan for their rescue. This makes Jack Merridew feel little so he himself suggested being the leader for hunters which is actually a group of choir boys. He cleverly insert in the minds of the boys that they are hunters who enjoy seeing blood, flesh and they should dedicate themselves for hunting. This action of him itself shows that Jack is not a suitable leader because he is making people go in a wrong way.

Golding portrays Ralph as the qualified one to be the leader while Jack lacks the leadership quality though he is the head for choir aka hunters. Jack is not bad from the beginning but his inner thirst for power and dominance lead him to choose the wrong path. He also makes the others to join his path of violence. Ralph uses his smartness and practical

knowledge while Jack always uses violence and savagery to attain what he desire. Though they begin as friends unknowingly they become enemies with mutual hate for each other.

In Lord of the Flies by William Golding, the protagonist Ralph symbolizes leadership, civilization, as well as the loss of innocence. Ralph is the closest resemblance to authority that the boys have on the island. His appearance plays an important role in him signifying authority,

“You could see now that he might make a boxer, as far as width and heaviness of shoulders went, but there was a mildness about his mouth and eyes that proclaimed no evil” (Golding, 10).

His appearance changes throughout the novel as well as his character. Ralph portrays the most significant character because the majority of the novel revolves around him. He becomes the leader of the group of boys in the beginning of the novel, until he starts to struggle for power with the antagonist, Jack. Ralph experiences a journey that causes him to lose his innocence and he discovers many things about humanity. Ralph’s symbolism of leadership, civilization, and the loss of innocence reveals what can become of society. Evil is within all of humanity, humanity can transition from civilization to savagery without the walls of society present.

Ralph has an idealistic view of the world and he always strives for righteousness and perfection in himself and in others. I think that because he expects perfection in this world, he is disappointed with the imperfections in himself and in others as well as the unfairness in the world. Facing difficult situations, one after another in his life, has affected him deeply because of his idealistic view of the world.

Jack has shown the darkness inside his heart by expressing his satisfaction after his barbarous bloodshed because he was satisfied choosing to hunt and killing it. Jack’s violent action fits into the result of a research on a gene that makes a person be homicidal. In Warriors’ gene, an organization known as the GWAS discovers genes that lead to violence and murder. These Genes are identified as murder Genes and the author Barbara Oakley states, *“Those people who are wired to be unethical march to their own tune, no matter what they are taught” (Oakley 2).*

Lord of Flies illustrates a theme that evil is always inside a human’s heart and is shown throughout Jack’s obsession with hunting and Simon’s philosophy of evil. All mankind possesses evil characteristics and practices wicked deeds without any support from peers or parents when men face difficult situations, they are put into a condition where they have to choose between good and evil.

The first ever controversy between Jack and Ralph happen when Jack took SamnEric for hunting and the fire went out as they were the one who is in charge for the fire. Also the most awaited thing for Ralph is ruined because of that; at the same time Jack’s dream to hunt pigs is fulfilled on the same day. It is the first win for evilness and loss for morality. *“You and your blood, Jack Merridew! You and your hunting! We might have gone home-”* Ralph pushed Piggy on one side and said:

“I was chief; and you were going to do what said. You talk. But you can’t even build huts- then you go off hunting and let out the fire” [76]

This is the stage where Jack starts to suppress Ralph and his power. Though he is the chief he constantly has to remind Jack in every chance he got that he has power and they should listen to him. However Jack's dominance over the situation makes the issue change in a different way; more like favourable for him.

At the end of the novel, Ralph cries for a few reasons. He cries because he has lost his friend Piggy. He also cries because he has lost his innocence. He now realizes that there is evil in every man. Before Ralph ended up on this island, he thought everyone was good, and bad was just a foreign concept. But now he sees that there is evil even within himself.

To be sum up, this paper explores the three elements of innate evil within William Golding's, *Lord of the Flies*, the change from civilization to savagery, the beast, and the battle on the island. Golding represents evil through his character's, their actions, and symbolism. The island becomes the biggest representation of evil because it's where the entire novel takes place. The change from civilization to savagery is another representation of how easily people can change from good to evil under unusual circumstances.

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JUDICIAL ACTIVISM AND CONSTITUTIONALISM IN INDIA

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Abstract:

Constitutionalism is a contemporary idea that promotes the supremacy of the law above people. In this sense, constitutionalism seeks a political system with constrained governmental authority. The creation of the constitutional state is primarily the outcome of a protracted battle against monarchy, absolutism, and feudalism. These conflicts mostly occurred in western nations before spreading to other nations across the world. To ensure such balance of power and supremacy of constitution, Judiciary has responsibility to minimize the risk of overruling by executive or legislatives. The Proactive stance to interpret and establish rule of law, is known as judicial activism. In India we have witnessed such incidents where the power peripheries are come close to about clash and intersect each other. In this article I tried to underscore reasoning behind such attempts of judiciary.

Key Words: Constitutionalism, Judicial Activism

Introduction:

A constitution is made up of a set of norms (laws, values, or principles) that create, organize, and perhaps specify the boundaries of a government's power or authority. When seen in this light, all states are constitutional states and have constitutions. Any entity that can be recognized as a state; must have a method of establishing the three primary organs of the governmental authority , i.e. legislative power (creating new laws), executive power (putting laws into effect), and judicial power (resolving legal issues). In a democracy, the judiciary's independence is crucial. India adheres to the separation of powers philosophy; hence the judiciary shouldn't be responsible to or accountable to the legislature. Any measure that interferes with the maintenance of constitutionalism in India is deemed unlawful and unconstitutional. During recent past our Judiciary being proactive to ensure rule of law by accommodating number of public interest litigations against the Executive and Legislative in India. And of course, this is the point where the actual clash between power territories occurs, when Judiciary takes action against executive and instructs or criticizes them for ignorance of public interest and reviewing laws of legislative by judicial review. Judicial activism is modern way to stabilize the democracy as well as the rule of law in leading nations of the world.

Constitutionalism in India:

Constitutionalism is a contemporary idea that promotes the supremacy of the law above people. In this sense, constitutionalism seeks a political system with constrained governmental authority. Greek thinkers like Aristotle and Plato studied constitutionalism exclusively from a normative and moral perspective. Constitutionalism gained more momentum with the foundation of the great Roman empires. According to Article 16 of the French Declaration of Rights of Men and Citizen of 1789, “Any society in which the

guarantee of rights is not assured, nor the separation of powers determined, has no constitution.”¹

As per the theory of constitutionalism it is quite clear that our forefathers and national leader were well aware about the risk of human tendency to become authoritarian and accumulating and articulating power centralization. Therefore, composers of our constitution had wisely adopted composite form of separation of power, where the cycle of checks and balances will revolve through all three organs of government i.e. Executive, Legislative and Judiciary. There are provisions to empower judiciary to accommodate PIL to exercise their power of interpretation of Constitution as well as complementing values and moral standard set by preamble and directive principles along with article 32 for constitutional remedies and article 21 of right to live. The nexus of legislative and executive most of time takes it as interference, so they try limiting power of judiciary by constitutional amendments. Judiciary has one more tool in the form of judicial review but it has limited scope to intervene directly in the course of action of rest two.

Creators of our constitution followed one more principle to ensure rule of law i.e. Process established by law. This process makes clear that every judgment, decisions, interpretations and references acknowledged by the judiciary should be on the basis of following of the meaning of written words in the constitution.

Another very important principle of our constitution had adopted is the judiciary is not directly responsible to the Legislative or Executive i.e. **it is independent**. It draws out our constitutionalism in reality. Many other independent structures and institutions help to form our constitutionalism like Election Commission, CAG, CBI, RBI etc.

One Historic Case was landmark in the history of Indian Constitutionalism was Keshvanand Bharati Case, where, The Supreme Court cited the Kesavananda decision and affirmed the separation of powers concept in Indira Nehru Gandhi v. Raj Narain 4, making it a landmark decision. In this instance, there was a disagreement about the Prime Minister's elections, and the constituent body, acting in a judicial role, decided that the elections were valid. The activities of the component body became ultra-virus as a result. Thus, it was determined that a parliament cannot assume the job of the judiciary under any constitutional modifying power or similar authority. Thus, in this instance, the doctrine of separation of powers was supported and affirmed.^{2&3}

Justice **B. K. Mukherjee** correctly said, “In India it is the Constitution that is Supreme and Parliament as well as State legislatures must not only act within the limits of their respective legislative spheres as demarcated in the three lists occurring in the Seventh Schedule of the Constitution, but Part 111 of the Constitution guarantees to the citizen certain fundamental rights which the legislative authority can on no account transgress. A statute or law to be valid must, in all cases, be in conformity with the constitutional requirements and it is for the judiciary to decide whether any enactment is unconstitutional or not”.⁴

Judicial Activism:

The state's principal duty under the Indian Constitution is to protect citizens' rights to justice, liberty, equality, and fraternity. The state is required to uphold each person's fundamental rights and to carry out the directive principles. The Indian Constitution gives the courts inherent authority to examine the state's activities in order to prevent the state from avoiding its obligations. The Indian Judiciary has been viewed in this light as the protector of the Indian Constitution. In this regard the Judiciary has very wide scope for becoming active as a guardian of constitution by Judicial Activism. Judicial activism also can be seen as a response against judicial restraint. “Judicial activism is an approach to the exercise of power of judicial review, or a description of a judicial decision, in which a judge is generally

considered more willing to decide constitutional issues and to invalidate legislative or executive actions.

In his essay *The Supreme Court: 1947* from January 1947 in *Fortune Magazine*, **Arthur Schlesinger Jr.** coined the term "judicial activism."⁵

In Indian Context this term is being started adopting in action first and then scholars, analysts found trying to define it. As Supreme Court judge Bhagwati introduced the concept of PIL and absolute liability to the Indian Judicial System. He is therefore held, along with Justice V.R. Krishna Iyer, to have pioneered judicial activism in India. It is mainly associated with public interest litigations and the interpretation of **Article 21**. Also it is very much close to **writ** petitions where The Supreme Court has a special power to protect fundamental rights proactively.

In making decisions in matters before the Court, judges occasionally seem to go beyond their authority. The Constitution mandates that they use discretion when interpreting the law. However, judicial activists appear to use their power to change the law in reaction to cases that are before the Court. Judges ought to be more daring when deciding cases because:

1. The law ought to be implemented and construed in light of evolving situations and standards.

2. Courts ought to render judgments in instances that take into account how society and people's ideas and values are changing. (Negi, 2017)⁶ Judicial activism holds that judges should exercise their authority to avenge injustices, particularly when the other arms of government fail to do so.

Every judge is an activist, either in the forward or retrograde gear, as Justice Krishna Iyer remarked. Making judicial policy can be done in favor of or against decisions made by the legislative and executive branches of government. The latter, however, is more frequently referred to as judicial activism. Making decisions, that are in step with the spirit and pace of the times is the core of authentic judicial activism. Activism in the development of judicial policy promotes societal change or clarifies ideas like liberty, equality, or justice. Undoubtedly, it belongs to the social revolution. The legal system is activated by an activist judge who makes it play a crucial part in socioeconomic processes.⁷

The right to education, for example, was read into Article 21 in the **Unni Krishan** case¹³, which shows how frequently the Indian Supreme Court has used this tactic to uphold many of these fundamental rights. Even in the **Minerva Mills** case, the Supreme Court recognized the protection of laws established to carry out directive principles, even though such laws infringe upon the basic freedoms guaranteed by Articles 14 and 19 of the Constitution. Because of the dishonest conduct of the other two branches of government, the theory of judicial activism was born when the period of judicial restraint came to an end.^{8 & 9}

There are plenty of examples including from the municipal corporation to the union government has been criticized, fined, instructed; by the courts, out of the practicing judicial activism in India.

Conclusion:

As we discussed in this article the main aim of the creators of our constitution was to provide such structure of government where each and every citizen should get the assurance of Justice, Equality, Liberty and life with dignity. Any failure in this respect with any malfunction or misconduct of power inherited in all of the organs of government; would lead to the violation of the values and sentiments of constitution. And that should be considered and consequently should be treated as challenge to the constitutionalism in India.

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संयुक्त महाराष्ट्र चळवळ : एक अवलोकन

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प्रस्तावना-

ब्रिटिश भारतात असताना ब्रिटिशांनी आपल्या सोयीनुसार भारतातील प्रांतांची रचना केली होती. यामध्ये अनेक भाषिक लोकांना एका प्रांतामध्ये एकत्रित आणण्यात आले होते. ब्रिटिशांविरुद्धांमध्ये स्वातंत्र्याचा लढा उभारताना राष्ट्रीय काँग्रेसने काँग्रेसची बांधणी बहुभाषिक तत्त्वानुसारच केली होती. त्यामुळे भारतातील सामान्य माणसाला काँग्रेसची भाषा समजण्यास मदत झाली. भारतीय स्वातंत्र्यासाठी लढा देत असताना स्वातंत्र्यानंतर भाषावार प्रांतरचनेला काँग्रेसचा पाठिंबा होता. 1924 साली कलकत्ता या ठिकाणी भरलेल्या काँग्रेसच्या अधिवेशनात भाषावार प्रांतरचनेला गांधीजींनीही पाठिंबा दिला होता. व 1935 च्या कायद्यानुसार स्थापन झालेल्या प्रांतिक सरकारांमध्ये काम करणारे श्री रामराव देशमुख यांनीही 1938 मध्ये मुंबई प्रांत विधिमंडळासमोर असा प्रस्ताव मांडला होता. म्हणजेच काँग्रेसच्या बहुसंख्य नेत्यांनी स्वातंत्र्यप्राप्तीनंतर भाषावार प्रांतरचना करण्याचे मान्य केले होते. 1939 मध्ये जेव्हा दुसरे महायुद्ध सुरू झाले तेव्हा साऱ्या जगाचे लक्ष महायुद्धाकडे लागले. जगभर महायुद्धाने भडका उडाला, त्याचाच परिणाम भारतामध्ये देखील स्वातंत्र्याची चळवळ झाला. चळवळ आणखी तीव्र होण्यामध्ये झाला. भारतीय स्वातंत्र्याच्या मुद्द्यासमोर भाषावार प्रांतरचनेचा मुद्दा गौन ठरल्यामुळे मागे पडला.

15 ऑगस्ट 1947 ला स्वातंत्र्य मिळाल्यानंतर भारतातील अनेक प्रांतांमधून प्रांतांच्या पुनर्रचनेची मागणी पुढे येऊ लागली. मराठी भाषिकांमधून देखील संपूर्ण मराठी भाषिकांचा एक प्रदेश असायला हवा यासाठी मागणी होऊ लागली. स्वातंत्र्यापूर्वी भाषावार प्रांतरचनेला अनुकूल असलेले काँग्रेसचे नेतृत्व स्वातंत्र्यानंतर व देशाची फाळणी झाल्यानंतर फाळणी मधला अनुभव पाठीशी आल्यामुळे भाषावार प्रश्न संकुचित वाटून नेतृत्व भाषावार प्रांत रचनेला प्रतिकूल बनले. शिवाय मुंबई, कोलकत्ता, मद्रास यासारख्या मोठ्या शहरावर एखाद्या भाषिक गटाचे वर्चस्व मान्य करून ही मोठी शहरे एखाद्या भाषा प्रांताला जोडणे देशाच्या अर्थव्यवस्थेच्या दृष्टीने भविष्यात बरे नव्हे. ही गोष्ट काँग्रेस नेतृत्ववाला सतावत होती. स्वातंत्र्य मिळाल्यानंतर भारतीय राज्यघटना बनवण्यासाठी डॉ. राजेंद्र प्रसाद यांच्या नेतृत्वाखाली घटना समिती बनवण्यात आली. घटना समितीचे कामकाज ही सुरळीत चालू होते. भाषावार प्रांत रचना प्रत्यक्षात यायची असेल तर पंडित जवाहरलाल नेहरू, महात्मा गांधी व सरदार वल्लभभाई पटेल यांना काय वाटते हे महत्त्वाचे होते. व या तीनही नेत्यांची भाषावार प्रांत रचनेसंबंधी विचार परस्परविरोधी होते.

पुढे जनतेचा रेटा आणि संविधान सभेचे अध्यक्ष डॉ. राजेंद्र प्रसाद यांच्या आग्रहामुळे पंडित जवाहरलाल नेहरू आणि सरदार पटेल यांना भाषावार प्रांत रचनेच्या मुद्द्याचा अभ्यास करण्यासाठी एक आयोग नेमावा लागला. त्यालाच दार कमिशन असे म्हटले जाते.

अलाबाद उच्च न्यायालयाचे निवृत्त न्यायाधीश एस.के.दार यांच्या अध्यक्षतेखाली 1948 ला दार कमिशन नेमण्यात आले. बिहारमधील एक प्रख्यात वकील जगत नारायण लाल आणि निवृत्त आयपीएस अधिकारी पन्नालाल असे दोघे या कमिशनचे सदस्य होते. दार कमिशनने एक प्रश्नपत्रिका बनवून तिच्या आधारे देशभरातील लोकांच्या प्रतिक्रिया भाषावार प्रांतरचनेसंबंधी जाणून घेतल्या. या कमिशनने देशभर दौरा करून देशभरातील जनतेचा या मुद्द्यासंबंधी कौल जाणून घेतला. हे कमिशन जेव्हा महाराष्ट्रात आले, तेव्हा

महाराष्ट्रामध्ये सर्व मराठी भाषिकांची प्रतिनिधी बैठक अकोला या ठिकाणी बोलवण्यात आली.याच ठिकाणी मराठी भाषिकांमध्ये अकोला करार झाला. दार कमिशन ने आपला अहवाल 10 डिसेंबर 1948 रोजी सादर केला. दार कमिशन ने आपल्या अहवालामध्ये भाषावार प्रांत रचनेला लोकांचा मोठा पाठिंबा असल्याचे मान्य केले. परंतु भाषेवर प्रांत रचनेपेक्षा देशासमोर अनेक मोठ्या समस्या आहेत, त्यामुळे भाषावार प्रांत रचनासारख्या गौण मुद्द्याकडे आत्ताच लक्ष देण्याची गरज नाही. असे प्रामुख्याने आपल्या शिफारशी मध्ये सुचवले.दार कमिशनचा हा अहवाल वाचून संपूर्ण देशभरामध्ये दार कमिशनच्या विरोधामध्ये जनक्षोभ तयार झाला. देशभरामधून होणारा विरोध लक्षात घेऊन काँग्रेसने एक शककल लढवली आणि भाषावार प्रांतरचनेसाठी आणखी एक पक्षीय समिती नेमली. या पक्षीय समिती लाच जे. व्ही .पी .समिती असेही म्हटले जाते.

यामध्ये काँग्रेस वर्किंग कमिटीचे पंडित जवाहरलाल नेहरू, सरदार वल्लभभाई पटेल आणि त्यावर्षीचे काँग्रेसचे अध्यक्ष श्री पट्टाभी सितारमैय्या हे होते. जे व्ही पी समितीने अभ्यास करून आपला अहवाल 9 एप्रिल 1949 रोजी प्रसिद्ध केला. या अहवालामध्ये देखील भाषेवर प्रांत रचना काँग्रेसला मान्य आहे परंतु तसे करण्याचे आज वेळ नाही. असे सुचवले आणि भविष्यामध्ये कोणकोणत्या भाषा नुसार कोणकोणते प्रांत निर्माण केले जातील यासाठी वेगवेगळ्या शिफारसी सुचवल्या. महाराष्ट्राच्या संदर्भामध्ये वऱ्हाड प्रांताची मागणी होत होती.ती जेवीपी समितीने स्पष्टपणे एकट्या वऱ्हाडचा निराळा प्रांत होणार नाही अशी स्पष्ट सांगितले त्यामुळे महाराष्ट्रातील तत्कालीन काँग्रेस जणांची देखील पंचायत झाली.स्वतंत्र वऱ्हाड मागणारयांना चांगली चपराक बसली. 1953 मध्ये नेहरूंनी याच प्रश्नावर पुन्हा आपला स्वतंत्र महाराष्ट्र दौरा केला. महाराष्ट्र दौरा बेळगावपासून सुरू झाला. या दौऱ्यामध्ये पंडित नेहरूंना मराठी भाषिकांचे महाराष्ट्र राज्य स्थापन व्हावे यासाठी सर्व मराठी भाषिकांच्या वतीने एकच निवेदन देण्यात यावे. यासाठी वेगळा वराड प्रांत मागणारे, मुंबई, मराठवाड्यासह सर्वांनी एक मराठी भाषिक प्रांत झाला पाहिजे याची मागणी एकमुखाने करण्यासाठी मराठी भाषिकांचे सर्व पुढारी नागपूर या ठिकाणी जमले. व त्यांनी प्रसिद्ध असा नागपूर करार 28 सप्टेंबर 1953 ला केला. अकोला करार रद्द करून नागपूर करार करण्यात आला होता.या नागपूर करारा मध्ये मुंबई,मध्य प्रदेश, हैदराबाद राज्यातील मराठी भाषिक प्रदेशांचा मिळून मराठी राज्य किंवा महाराष्ट्र राज्य स्थापन केले जावे. या प्रदेशाची महाविदर्भ ,मराठवाडा आणि बाकीचा प्रदेश असे तीन भागात असावेत. लोकसंख्येच्या प्रमाणात खर्च वाटप पण मराठवाड्याकडे विशेष लक्ष, सरकारच्या रचनेत त्या त्या विभागाच्या लोकसंख्येनुसार स्थान ,उच्च न्यायालयाचे खंडपीठ मुंबई व नागपूर येथे, नागपूर ही उपराजधानी, एक अधिवेशन तेथे घेण्याचे ठरले, तसेच खेडे हा घटक धरून जिल्ह्याच्या सीमा निश्चित केल्या जातील. असेही या करारामध्ये ठरले. नागपूर कराराचे सर्व मराठी भाषेत प्रदेशांमध्ये स्वागत झाले.

आंध्रा प्रदेशाच्या निर्मिती साठी प्राणांतिक उपोषण करणारे श्रीराम वल्लू यांच्या बलिदानानंतर 1 ऑक्टोबर 1953 रोजी मद्रास राज्याचे विभाजन करून आंध्र प्रदेशची निर्मिती झाली.आंध्रप्रदेशच्या निर्मितीनंतर संपूर्ण देशभरातूनच भाषावार प्रांतरचनेसाठी पुन्हा जोरदार मागणी होऊ लागली. या पार्श्वभूमीवर राज्य पुनर्रचना समितीची घोषणा 22 डिसेंबर 1953 रोजी करण्यात आली.

राज्य पुनर्रचना आयोग किंवा उच्च अधिकार समिती. भारत सरकार अशा निर्णयाला आले होते की, भारतीय संघातील राज्यांच्या पुनर्रचनेचा समग्र प्रश्नांची फेर तपासणी पूर्वग्रह रहित वास्तविक बुद्धीने व्हावी जेणेकरून प्रत्येक घटक राज्याची प्रजा तसेच समग्र भारत राष्ट्र या दोघांचेही कल्याण साधता येईल या दृष्टीने सरकारने कमिशन नेमण्याचे ठरविले होते. याच कमिशनला राज्य पुनर्रचना आयोग किंवा उच्च अधिकार समिती असेही म्हटले जाते. या कमिशनचे फाजल आली हे अध्यक्ष होते त्यांच्या नावावरून या

कमिशनला फाजल अली कमिशन देखील म्हटले जायचे. फाजल अली यांच्या व्यतिरिक्त यामध्ये श्री पंन्नीकर आणि श्री कुंजरू हे दोन जण सदस्य होते. राज्य पुनर्रचना आयोगाला देशभरातून आपापल्या मांडण्याची निवेदन देण्यासाठी लोकांमध्ये उत्साह संचारला होता. मराठी भाषिकांचे निवेदन तयार करण्याची जबाबदारी श्री धनंजय गाडगिळ यांच्यावर टाकण्यात आली होती. त्यांनी सर्व समावेशक निवेदन तयार केले. कमिशन ने देश भर दौरा केल्यानंतर सर्वांच्या मागण्यांचा सविस्तर उहापोह झाल्यानंतर आपला अहवाल 10 ऑक्टोबर 1955 रोजी प्रसिद्ध केला. फजल अली कमिशन ने आपला अहवाल प्रसिद्ध करताच संपूर्ण महाराष्ट्रामध्ये त्याच्या विरोधामध्ये जनक्षोभ तयार झाला. कारण इतर प्रांतांना भाषेच्या आधारे प्रांत निर्माण करण्यास सहमती दर्शवणारे आयोगाणे मराठी भाषिकांसोबत मात्र अन्याय केला. मराठी भाषेत विदर्भ स्वतंत्र राज्य सूचवून गुजराती भाषिक प्रदेशासह मराठवाडा धरून मुंबईचे भाषिक राज्य करण्याची शिफारस या कमिशन ने केली. मुंबई सह सुचवलेल्या द्विभाषिक राज्याला सर्वांनीच कडाडून विरोध केला. गुजराती भाषिकांचा तर वराड प्रांताला द्विभाषिकमध्ये घेण्यास विरोध होता. त्यामुळे मराठी भाषिक आणि गुजराती भाषिक यांच्यामध्ये प्रचंड आसंतोष निर्माण झाला होता. काँग्रेस वर्किंग कमिटीने मुंबई काँग्रेसला संयुक्त महाराष्ट्र परिषदेपासून दूर राहून राज्य पुनर्रचना आयोगाने सुचवलेल्या शिफारशींना मान्यता देण्यासाठी दबाव आणला. मात्र डॉ.नरवणे श्री चिंतामणराव देशमुख यांनी आपल्या मंत्रिपदाचा राजीनामा देऊन मराठी बाण्याचे दर्शन घडवले.

द्विभाषिक राज्याला सर्व स्तरातून होणारा प्रखर विरोध लक्षात घेता केंद्रीय नेतृत्वाने तडजोडीचे राजकारण सुरू केले. हा प्रश्न सोडवण्यासाठी पंडित नेहरूंनी मुंबईत येऊन त्रिराज्य योजनेची घोषणा केली. यामध्ये गुजराती भाषिकांचा एक, मराठवाड्यासह महाराष्ट्र व मुंबईचे एक वेगळे राज्य अशी सूचना होती. विदर्भाने महाराष्ट्रात सामील व्हायचे की नाही याची सूट देण्यात आली होती. मुंबई स्वतंत्र राज्य होणार अशी त्रिराज्य योजना नेहरूंनी सांगितली. याला देखील प्रचंड विरोध झाला व एका महिन्याच्या आतच 90 माणसे पोलिसांच्या गोळीबाराला बळी पडली लोकांच्या अशा प्रकारे विरोधामुळे त्रिराज्य योजना देखील बारगळी व पुन्हा बराच संघर्ष झाल्यानंतर द्विभाषिक राज्याची घोषणा झाली. या द्विभाषिकांमध्ये सौराष्ट्र, कच्छ, मुंबई, गुजरात, हैदराबाद व मध्य प्रदेशातील विदर्भ यांचा समावेश असेल. लोकसभेत 66 व राज्यसभेत 27 जागा असतील. याचे क्षेत्रफळ एक लाख 88 हजार 240 चौरस मैल असेल व नव्या राज्याचा मुहूर्त 01 नोव्हेंबर 1956 असेल अशी घोषणा करण्यात आली. गुजराती भाषिक व मराठी भाषिकांच्या विरोधाला डावलून द्विभाषिक राज्य जनतेच्या माती मारण्यात आले व त्याला जनमान्यता मिळवण्यासाठी निवडणुका घेण्याची घोषित करण्यात आले. काँग्रेस जणांनी द्विभाषिक राज्याला जनतेची मान्यता मिळवण्यासाठी निवडणूक जिंकण्याची रणनीती आखली. तर सगळे विरोधक संयुक्त महाराष्ट्र समितीमध्ये भाषिक नको म्हणून निवडणुकांमध्ये उतरले. निवडणुकांमध्ये थोड्या फरकाने काँग्रेसच्या हातामध्ये सत्ता गेली. निवडणुकांमध्ये समितीला मिळालेल्या यशामुळे सर्वच लोकांमध्ये संयुक्त महाराष्ट्रासाठी पुन्हा नवा जोश संचारला. द्विभाषिक राज्य स्थापन झाल्यामुळे मुंबई मिळवण्याच्या नादामध्ये गुजराती भाषिकांच्या हाती काहीच लागली नाही. गुजराती भाषिकांना स्वतंत्र गुजरात हवाच होता. यासाठी संयुक्त महाराष्ट्र समिती व गुजरात परिषद एकत्र आले. त्यांनी आपसामध्ये काही वाटाघाटी केल्या व संयुक्तरीत्या एक भाषिक राज्य स्थापनेसाठी लढण्याचे ठरले. १३ नोव्हेंबर 1958 ला जयप्रकाश यांनी एक पत्र काढून द्विभाषिक राज्याचे विभाजन करून भाषिक तत्त्वावर राज्य करण्याचे आवाहन खासदारांकडे केले. सप्टेंबर 1959 मध्ये काँग्रेसचे वार्षिक अधिवेशन होऊन श्री देबर अध्यक्षपदावरून मावळले व श्रीमती इंदिरा गांधी अध्यक्ष झाल्या. अध्यक्ष झाल्यावर थोड्याच दिवसात इंदिरा गांधींनी महाराष्ट्राचा दौरा केला व द्विभाषिक राज्याचा पुनर्विचार करत असल्याचा इशारा दिला. 14 मार्च 1960 रोजी द्विभाषिक भंग करण्याचे बिल यशवंतराव चव्हाण यांनी

मांडले. बिलामध्ये असणाऱ्या काही कलमांना समितीने विरोध केला ल.लोकसभेमध्ये 28 मार्च 1960 ला द्विभाषिक भंगाचे बिल मांडण्यात आले.21 एप्रिलला लोकसभेने बिलाला मंजुरी दिली व 23 एप्रिलला राज्यसभेने बिलाला मंजुरी दिली. अशा प्रकारे 01 मे 1960 रोजी भारताच्या नकाशावर महाराष्ट्र झळकला.

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ना.धों.महानोर यांच्या 'रानातल्या कविता'तील निसर्ग चेतना

प्रा.डॉ.अनिरुद्ध मोरे,

मराठी विभाग प्रमुख,

इंद्राराज महाविद्यालय, सिल्लोड, जि. छत्रपती संभाजीनगर

निसर्गकवी म्हणून ना.धों.महानोर यांनी मराठी कवितेमध्ये महत्त्वाचे स्थान प्राप्त केले आहे. याबरोबरच चित्रपट क्षेत्राला गीताच्या माध्यमातून दिलेल्या बहारदार व खास मौखिक परंपरेच्या लोकगीतात्मक शैली,लय,ताल व प्रादेशिक शब्दकळमुळे त्यांची कविता / गाणी सतत ओठांवर रुंजी घालताना दिसते. महानोर यांनी एकीकडे प्रत्यक्ष शेतीमध्ये कष्ट करून निसर्ग फुलविला, तर दुसरीकडे शब्दांच्या सांस्कृतिक संचितातून निसर्ग कविता संपन्न केली. महानोरांच्या पूर्वीच्या व समकालीन कवी आणि समीक्षकांनी त्यांच्या कवितेची जातकुळी ओळखून तिला भरभरून दाद दिली. कुसुमाग्रज,बोरकर, ना. घ. देशपांडे, फडके, खांडेकर, कुरुंदकर.... अशा अनेक जाणकारांनी तिची बलस्थाने अधोरेखित केली. महानोरांच्या काव्यक्षेत्रातील नवतीच्या पाऊलालाच त्यांच्या अस्सल कवितेने बळ मिळवून दिले. ना.धों.महानोर यांच्या पहिल्याच 'रानातल्या कविता' या संग्रहातील कवितेच्या संदर्भात पु.ल.देशपांडे यांनी व्यक्त केलेली भावना अतिशय बोलकी असून, ती प्रातिनिधिक अभिप्रायाची नोंद म्हणून सांगता येईल. पुलं म्हणतात, "रानातल्या कवितांनी माझी दिवाळीच काय पण हे साल साजरे झाले..... उदयाच्या कवीचे माझे चित्र शेतात राबता राबता बालकवीची कविता गुणगुणनारा कवी अशी आहे. तुम्ही पळसखेडयास कवितेच्या जोडीला खरीखुरी हिरवळ उगवत असता..... धन्य वाटले".१ हा पत्रात्मक अभिप्राय खूप बोलका आहे. कविता ही सभोवतालच्या अंतःस्तरातून सहज पाझरत असते. तशी ती असावी,(जशी तुकोबांची कविता) या अर्थाने निसर्ग आणि निसर्ग कविता जपणारा व जगणारा, मातीची पोषणद्रव्य घेऊन उगवून येणारा कवी पुलं यांना अपेक्षित आहे. या अर्थाने महानोरांची कविता निसर्गाशी सुसंवादी अशी आहे. 'रानातल्या कविते'ने महानोरांचे काव्य क्षेत्रातील पदार्पण आणि भविष्यातील मराठी कवितेची अपेक्षा या दोन्ही गोष्टी उंचाविल्या.

काव्यनिर्मितीच्या प्रेरणा

साहित्यिक हा सभोवतालच्या वातावरणातील जीवनसत्व घेऊन अभिव्यक्त होत असतो. संवेदनेचे स्वरूप त्याच्या अभिव्यक्तीला सघन बनवते. महानोर यांच्या काव्यनिर्मितीच्या प्रेरणा व संस्कार यांचा शोध तत्कालीन खेड्याच्या एकूण सांस्कृतिक व सामाजिक परिप्रेक्षात घ्यावा लागतो. यासंदर्भात स्वतः महानोर दै.लोकसत्तेला दिलेल्या मुलाखतीत आपली लेखन प्रेरणा सांगताना म्हणतात, "त्याकाळी खेडं भजन, कीर्तन, भारुड, प्रवचन, नामस्मरण, सण-उत्सव, पालखी उत्सव अशा अनेक चांगल्या मौखिक साहित्याने समृद्ध असं होतं. तमाशा, लोककला, जलसा, लोकनृत्य, पोवाडा व अनेक लोककलांनी खेडी, जत्रा छान व्यापलेल्या होत्या. रात्र-रात्र हे उत्सव चालायचे. सूर्योदयाला जात्यावरील प्रसन्न ओवी, संसाराच सुखदुःख गाणारी जात्याची घरघर, लय, हलक संगीत आणि अस्सल भाव असलेली कविता म्हणजे ओवी. झोपाळ्यावरील झिम्मा फुगडीची गाणी, गपसप गोष्टी हे सगळं लोकसंस्कृतीच लेण थेट लहानपणापासून मी ऐकलं. त्यात मीही सहभागी असायचो. या सगळ्या सांस्कृतिक जगतात उत्तम गीत, संगीत आणि शब्दकळा माझ्यावर संस्कार करून गेली होती. लिखित साहित्याच्या आधी हे मौखिक असं साहित्य, कला माझ्या मनात बीज रोऊन होती".२ हे संस्कार आणि शेती करताना निसर्गाचे अनुभवलेले विविध अविष्कार महानोरांच्या कवितेत ठाई ठाई टिपलेले दिसून येतात. या अनौपचारिक संस्काराबरोबरच औपचारिक प्रेरणेच्या संदर्भात महानोर म्हणतात, "दिवसभर शेतीचं कष्टाचं काम, रात्री पुस्तकाचं वाचन. नव्या कथा, कविता, कादंबऱ्या, ललित सगळं वाचलं. राजकीय-सामाजिक वैचारिकही खूप वाचलं. संत साहित्यही खूप वाचलं. संबंध

आधुनिक मराठी कविता पुन्हा पुन्हा वाचली".३ यातूनच कवितेचं 'नेमकेपण' व 'असतेपण' काय असतं? हे त्यांच्या नीट लक्षात आल्याच ते सांगतात.

१९६० नंतर मराठी कवितेमध्ये अमुलाग्न बदल झाला. कुसुमाग्रज, बा.भ. बोरकर., अनिल, ना.घ.देशपांडे, इंदिरा संत, आरती प्रभू, सुरेश भट, मधुकर केचे, ग्रेस, आनंद यादव यांच्या कवितेतून हा बदल ठळकपणे अधोरेखित झाला. हा सगळा वाचनाचा संस्कार महानोर यांनी जाणीवपूर्वक करून घेतला. तरीही अनुकरण न करता स्वतःची स्वतंत्र वाट शोधली व ती निर्माण केली. कवितेमध्ये केशवसुत, बालकवी, ना.घ. देशपांडे, भालचंद्र जोगळेकर, बोरकर, इंदिरा संत, बहिणाबाई चौधरी, मंगेश पाडगावकर अशा अनेक कवींनी समृद्ध अशी निसर्ग कविता मराठीला दिली. महानोरांनी हे पूर्वसुरीचे भांडार तर जपलेचं आणखी यात शेती, शेतीसंस्कृती, सृष्टी, शेतकरी, तिथल्या विशेष प्रतिमा, शब्दकळा, लय, ताल, नाद आणि गंध यांचा बेमालूमपणे उपयोग केल्यामुळे त्यांची कविता रसिक श्रोत्यांना जशी भावली. तशीच ती या काव्यविषेषामुळे अनेक मराठी चित्रपटांमधून जशीच्या तशी घेतली गेली. यानिमित्ताने गीत आणि कविता यामधील धूसर रेषा मिटविण्याचे काम झाले असे म्हटले तरी वावगे ठरणार नाही.

आई ही पहिला गुरू असते असं आपण अनेकवेळा म्हणतो. महानोरांच्या काव्यनिर्मितीच्या बाबतीतही याचा शोध घेता येतो. जात्यावर दळण दळताना आई ज्या ओव्या गायची तो संस्कार महानोर यांच्या कवितेवर दिसून येतो. ते म्हणतात,

"पीठ गळे जात्यातून
तसं पाणी डोळ्यातून
आई करपले हात
तुझे भाकरी भाजून
शिळ्या भाकरीन उभा
माझ्या संसाराचा जीव
तुझ्या ओवीच्या शब्दांन
मला केलं चिरंजीव " ४

शब्दांच हे चिरंजीवित्त्व आईकडूनच मिळाल्याचं ते सांगतात.

कुठलाही कलावंत आपल्या अभिव्यक्तीचा शोध विविध माध्यमातून घेत असतो. अनुरूप फॉर्म मिळाल्याशिवाय त्याला अभिव्यक्तीचं समाधान मिळत नाही. ना.धों.महानोर यांनी आपल्या साहित्य लेखनाचा शोध कवितेशिवाय कथा,कादंबरी, ललित गद्य अशा विविध साहित्यप्रकारातून घेतला.

महानोरांच्या साहित्य लेखनाला सुरुवात झाली ती कवितेने. १९६०-६१ मध्ये त्यांनी काही कविता लिहिल्या. त्या नियतकालिकांकडे पाठविल्या, परंतु त्यातील नवेपणामुळे त्या साभार परतही आल्या. याचं वाईट वाटून न घेता मूळचा कवीचा पिंड असल्याने त्यांनी प्रयत्नांती अनेक बदल आपल्या कवितेमध्ये केले. हळूहळू त्यांच्या कवितेला स्वतःची पायवाट सापडत गेली. याच दरम्यान पॉप्युलर प्रकाशनाने 'नवे कवी.... नवी कविता' ही माला सुरू केली होती. यामध्ये ना.धों.महानोर यांच्या 'रानातल्या कविता' (१९६७) हा पहिला कवितासंग्रह प्रकाशित झाला, आणि महानोर यांचा कवी म्हणून सर्वदूर परिचय झाला. यानंतर 'वही' (ही पावसाळी कविता) 'अजिंठा' (दीर्घ कविता) 'प्रार्थना दया घना' (सहा दीर्घ कविता) 'पानझड' 'ही गाथा शिवरायांची' (दीर्घ कविता) 'पळसखेडची गाणी' (लोकगीतांचं संपादन) हे कवितासंग्रह, तर 'गांधारी' ही कादंबरी, 'गावातल्या गोष्टी', 'गपसप' या कथा, 'यशवंतराव चव्हाण', 'ऐसी कळवळ्याची जाती', 'शेतकरी दिंडी' हे ललित गद्य, 'पुन्हा कविता', 'पुन्हा एकदा कविता' ही श्री. चंद्रकांत पाटील यांच्यासोबतची संपादने व 'शेतीसाठी पाणी', 'जलसंधारण', 'फलोत्पादन', 'ठिबक सिंचन' अशी शेतीशी निगडित

माहितीपर पुस्तकही त्यांनी लिहिली. परंतु त्यांचा मूळ पिंड कवीचा असल्याने ते कवितेत विशेष रमले. कविता हाच त्यांच्या 'हिरव्या बोलीचा शब्द' झालेली आहे.

शेती, निसर्ग हा महानोरांच्या उपजीविकेचा भाग आहे. त्यामुळे 'चरितार्थ' आणि 'कृतज्ञता' यांचा संगम त्यांच्या व्यक्तिमत्त्वामध्ये दिसून येतो. 'जे पिंडी ते ब्रम्हांडी' या उक्तीप्रमाणे महानोरांच्या कवितेतील निसर्ग एवढा एकरूप व एकजिनसी असतो की तो वेगळा करता येत नाही. तो अपरिहार्यपणे त्यांच्या जगण्याचा आणि कवितेचा भाग झालेला असतो. कवितेमागची त्यांची भूमिका स्पष्ट आहे. ते म्हणतात,

"ह्या शेताने लळा लाविला असा की सुखदुःखाला परस्परंशी हसलो रडलो
आता तर हा जीवच अवघा असा जखडला
मी त्याच्या हिरव्या बोलीचा शब्द झालो"

ही निसर्गासोबतची त्यांची एकरूपता व अभिव्यक्तीची अपरिहार्यता कवितेला अक्षर बनवते.

निर्मितीची हीच सेंद्रियता शब्दाला आणि कवितेला जगण्याचा श्वास बनवते

"सारेच पांगती
दूर कुठे ना साद
शब्दाविना कोणी
नुरते कवळायास (पृष्ठ ३)
किंवा

"मज कळेना चालताना
दुःख कैसे फूल झाले
अन उदयाच्या जीवनाची
सांगता घेऊन आले" (पृष्ठ ५)

कृषी, कृषिजीवन, निसर्ग यावर त्यांचं निस्सीम प्रेम आहे. त्यामुळेच निसर्गातील चैतन्य, सृजनशीलता यांची सकारात्मक ऊर्जा ते कवितेतून साकारतात. कृषी जीवनातील अभावग्रस्तता, ओढग्रस्तता यांचे भांडवल ते करत नाहीत,

" ह्या नभाने ह्या भुईला दान द्यावे
आणि या मातीतून चैतन्य गावे
कोणती पुण्ये अशी येती फळाला
जोंधळ्याला चांदणे लगडून जावे...
गुंतलेले प्राण या रानात माझे
फाटकी ही झोपडी काळीज माझे
मी असा आनंदुनी बेहोष होता
शब्दगंधे तू मला बाहूत घ्यावे" (पृष्ठ २)

महानोरांचे प्राण रानात अडकलेले आहे. सुख- दुःखाच्या गोष्टी बोलण्या इतपत त्यांचे संबंध दृढ झालेले आहेत. महानोर आणि रानाचे जगणे- भोगणे एका समान पातळीवर येते आणि हा परिघ वाढतो. यामुळे रानाचे अनेक अनुभवजन्य पदर महानोरांना अवगत होतात. 'नभ' आणि 'भुई' यांचे भावसंबंध त्यांना उलगडू लागतात.

महानोर यांच्या कवितेतील निसर्ग सचेतन होऊन तो सगुण रूपात प्रकट होतो. स्त्री देहाच्या व सौंदर्याच्या प्रतिमांनी तो प्रत्यक्ष भेटतो. अनेकवेळा निसर्ग आणि स्त्री यांच्या जैविकतेतून तो साकार झाल्यामुळे एखाद्या स्त्री सौंदर्याचे वर्णन निसर्गाच्या माध्यमातून महानोर करतात असे वाटते. त्यामुळे त्यांची कविता जशी निसर्गकविता असते तशीच ती स्त्री सौंदर्याची व आदिमतेच्या नैसर्गिक प्रतिकात्मकतेचीही असते.

"आंब्याच्या झाडाला मोहराचा वास झेपता झेपेना
गाभुळ्या चिंचेला नवतीचा भार पोटी धरवेना
मघातले ऊन झेलताना अंग झाले निळेभोर
पानमळ्यातील शेलाट्या वेलींचे नव्याने उभार
कोण्या बसंतीचे पाऊल लचके इथे चंद्रगौर
डोळ्यात फुलांच्या राजसपणाचा झडे शिनगार" (पृष्ठ १३)

किंवा

चवळीची शेंग पिवळी धम्मक अशी झळकते
तिपीतिपी ऊन, श्रावणाचे गान कंठात झुलते" (पृष्ठ १४)

किंवा

'हिवर्या पानांत पानांत काही चावळ चालते
भर ज्वानीतली ज्वार अंग मोडीत बोलते
पोट्यातल्या गव्हाचे हसू आंब्यात दाटते
केळ कातीव रुपाची छाया पाण्यात शोधते" (पृष्ठ १६)

वरील कवितेतील आंबा, चिंच, वेली, चवळी, ज्वारी, गहू, केळी यांना देहरूप देताना वापरलेल्या स्त्री प्रतिमा वाचकांना निसर्गाबरोबरच स्त्री देहाच्या गुणधर्मीय संवेदनांनी मोहून टाकतात. 'रानातल्या कविता' संग्रहातील अनु क्रमांक १५, १८, १९, २०, २४, २५, २६, २७, २८, २९, ३०, ३२, ३३, ३४ या कविता या दृष्टीने आणखी बघण्यासारख्या आहेत.

काही कवितांमध्ये मात्र स्त्री प्रतिमांचा वापर केला असला तरी त्या जैविक पातळीवर निसर्गकविता ठरतात. जैविक पातळीवर नैसर्गिक गुणधर्मीय अंगाने 'नर' आणि 'मादी' यांची नैसर्गिक प्रवृत्ती समान असते. महानोरांची निसर्ग कविता या अर्थाचा सहज बोध घडवते. जैविक गुणधर्माच्या अंगाने त्यांची निसर्ग कविता स्त्री प्रतिमांतून घडत असली, तरी ती ज्यावर आरोपित केलेली आहे ते गुणधर्म त्या-त्या निसर्गातील घटकांमध्येही अनुस्यूत आहेत. त्यामुळे या संग्रहातील काही कविता स्त्री प्रतिमातून घडत असल्या तरी त्या स्वतंत्र निसर्गाच्या जैविकतेला प्रकट करतात.

"कानोसा घेताना केळ अंगात कापते

सीताफळीच्या कानात

काही हळूच सांगते

बोरी बाभळी मायेच्या झाल्या नारी

केळ कमळण झाली प्रसूत दुपारी

सूने माळरान डोळा रुखे रुखे ऊन

पोटी लपेटून निघे सासुरवाशीन" (पृष्ठ ३२)

या कवितेतील वर्णन स्त्रीप्रतिमातून येत असले तरी ते खास केळीच्या जैविकतेशी संबंधित आहे. कवी मनाची सर्जनशील कल्पकता त्याला देह भावनांनीशी प्रकट करते.

निसर्ग कवितेत जशा स्त्रीप्रतिमा येतात तशाच स्त्री मनाचे विभ्रम दाखवितांना निसर्ग प्रतिमा यांची पेरणी महानोर करतात.

"काय करू बाई आता जीव माझा उधाणलेला

कळ्या फुलांच्या पाहून रंग गालिचा भिजला (पृष्ठ ४७)

किंवा

"डोळे थकून थकून गेले

पाखरासारखा येऊन जा

रान भलतच भरात

जरा पिकात धुडगूस घालून जा”

या कवितेतील स्त्रीमनाच्या अभिव्यक्तीसाठी वापरलेल्या निसर्ग प्रतिमा व्यापक स्तरावर नैसर्गिक भाव व्यक्त करणाऱ्या आहेत. महानोरांच्या देहधारी निसर्गकवीतेसंदर्भात डॉ.विजया राजाध्यक्ष म्हणतात, "महानोरांनी निसर्गाला एक शक्ती न मानता त्याला देह दिलेला आहे. त्याचे अनुभव व संवेदना यांचे दर्शन त्यांना देहाच्या माध्यमातून घडले आहे. हा निसर्ग देहधारी असल्यामुळे तो प्रतिमित होते हेही अधिक सुकर झाले आहे. महानोरांनी त्याचे केवळ चेतनीकरण न करता त्याला एक स्वयंपूर्ण अस्तित्वच दिले आहे." (पृष्ठ क्र ५६) 'रानातल्या कविता'त स्वतः निसर्ग शेतीशी नातं जोडून असल्यामुळे कदाचित महानोर यांना निसर्ग शक्ती न वाटता सखा, सोबती वाटत असावा. त्यामुळेच त्यांच्या कवितेतील निसर्ग व्यक्तिमत्व घेऊन भेटतो. डॉ.राजाध्यक्ष म्हणतात त्याप्रमाणे 'त्याला एक स्वयंपूर्ण अस्तित्व' प्राप्त होते.

महानोर यांच्या कवितेतील निसर्ग एखाद्या सिद्धहस्त चित्रकाराने कुंचल्याच्या साह्याने कॅनव्हासवर जिवंत करावा या पद्धतीचा आहे. तो साक्षात वाचकांच्या मनःचक्षुसमोर उभा राहतो. हे सौंदर्य वाचकांनीही कधीतरी, कुठेतरी अनुभवलेले असते. महानोरांच्या सहज, नेटक्या व चित्रदर्शी शब्दकळामुळे तो पुनःप्रत्ययाचा आनंद देतो.

"झाडे झाली हिरवीशी

शिळ घुमते रानात

ओळ जांभळ्या मेघांची

वाहे नदीच्या पाण्यात

वाट झुंजुंजुं होते

पीक मावेना शेतात

लक्ष पाखरांचे थवे

खेळ मांडती पाण्यात" (पृष्ठ १७)

'रानातल्या कविता' मध्ये निसर्ग आणि शृंगार यांचाही बेमालूमपणे मिलाप झाला आहे. निसर्गसौंदर्याच्या निखळ भावनेबरोबरच इथला शृंगारही 'भरात' आलेला आहे. कधी प्रत्यक्षपणे, कधी सूचकतेने, तर कधी प्रतिमांतून तो व्यक्त होतो. स्त्रीदेहमनाची प्राकृतिकता व लैंगिक भावना ते प्रतिमांच्या माध्यमातून सहज टिपतात.

"सये किती गऽ तुला कसे सांगू शब्दात

साऽजन दिवसा अडून बसला (मीहि भरात)

देहावरती चळ भरलेले अवखळ हात

भर दुपार.... उघड्या रानात...." (पृष्ठ ३६)

'रानातल्या कविता' मधून आलेल्या प्रेमकविता या गावाच्या मातीचा मृदगंध घेऊन आलेल्या आहेत. अगदी बालपणीचा काळ संपवून नुकत्याच तारुण्यात प्रवेश केलेल्या मित्र-मैत्रिणीच्या भावावस्था 'ओले हळदीचे अंग/ पोरी खेळण्यात दंग/ ओट्यावरल्या डोळ्यात/ जुने घोटाळले छंद' (पृष्ठ २१), असो किंवा 'सजलेली रात माझी फुलतोरणाची/ अमृताच्या गोडव्याची ओथंबलेली रती' (पृष्ठ १२) ही लग्नघडी असो किंवा 'ढळत्या शब्दांना लगाम नाहीत कसे सावरू/ शेंद्री उन्हात रुसले रानात राजसपाखरू' (पृष्ठ ३३) असो, लग्नानंतर दुसऱ्या स्त्रीकडे पाहिल्यामुळे आलेले पती-पत्नीतील रुसवे-फुगवे असो किंवा 'ही फुले गळत पाकळ्या नभी जांभळ्या भरून येतात/ डोळ्यात काजळ जड झाली ग रात' (पृष्ठ ३८) ही प्रियकराची मृदुल भावावस्था असो, महानोर ते अलगद टिपतात.

निसर्गातील 'चेतना' आणि 'सौंदर्य' महानोरांना सतत खुणावत असते. त्याची हिरवी बोली ते जाणतात. यामुळेच निसर्गाला शब्दरूप देताना त्यांची लेखणी अधिक चित्रदर्शी होते. हसरा निसर्ग, रोमॅण्टिक निसर्ग असे

प्राकृतिक व्यक्तिमत्व त्याला प्राप्त होते. पण हाच निसर्ग जेव्हा कोपतो तेव्हा शेती आणि शेतकरी हवालदिल होतात. 'जगाचा पोशिंदा' हे बिरुदाचं ओझं पिढ्यानपिढ्या वागविणाऱ्या शेतकऱ्याची 'आबादानी' कधीच होत नाही. अशावेळी महानोरांना गहीवरून येते. आसमानी आणि सुलतानी संकटांनी हवालदिल झालेल्या शेतकऱ्यांच्या दुःखाची 'सल' त्यांची कविता बोलू लागते. तांबड्या मातीचा साक्षात्कार स्वप्नात पाहून काबाडकष्ट करून सोन्याचा कोंब रुजवून काढणाऱ्या गावाची अवस्था पिसाटते, राजकारणी आश्वासनांची खैरात वाटून निघून जातात, दुष्काळाची भेसुरता अधिक गडद होते.ते म्हणतात,

“मी एकटा स्तब्ध उभा झाडाच्या बुंध्याशी
उघड्या डोळ्यांनी पाहिली मी भुकेने तडफडून मेलेली कार्टी
पानवटल्या डोळ्यांनी गोऱ्या राजाचे महिमान गाणारी जख्ख म्हातारी
मी पाहिल्या पासरीभर ज्वारीवर भोग देणाऱ्या रूपवंत पोरी
नांगरून पडलेली जमीन सर्वत्र नुसताच शुकशुकाट
एखादेच चुकार वासरू कुठेतरी उद्ध्वस्त घाट” (पृष्ठ ६)

दुःखाची भीषणता व सार्वत्रिकता टिपताना महानोरांची लेखणी अधिक टोकदार होते. स्तब्ध उभा राहण्याशिवाय शेतकऱ्यांकडे आजही काही पर्याय शिल्लक राहिलेला नाही, भुकेने तडफडून मरने असो, पोटासाठी अब्रू जाणे असो हे सर्व प्रातिनिधिक स्वरूपाचे आहे.या अर्थाने ही कविता समस्त शेतकऱ्यांची होते. इंग्रज बरे असे म्हणण्याची वेळ जेव्हा येते, तेव्हा स्वकीय सत्ता व सत्ताधीशांचे बेगडी मुखवटे टरटरा फाडले जातात.

'रानातल्या कविता' मध्ये अनुक्रमांक ३४ ते ६० पर्यंतच्या २६ रचना या अल्पाक्षरी स्वरूपाच्या आहेत. अगदी चार,सहा, आठ ओळींच्या या रचना आहेत. 'घागर मे सागर' अशा आशयात्मक पातळीवर त्या जातात. 'ज्वार, उभार, गर्भार/ हिरव्या पदराला जर/ निऱ्या चाळताना वारा/ घुसमटे अंगभर'(३९) हुरडा भरलेल्या या ज्वारीच एवढं सुंदर वर्णन, तेही एवढ्या कमी शब्दात हे महानोरांना साधते. ओवी या प्रकाराचा संस्कार इथे दिसून येतो.

ओवीमध्ये अभिव्यक्त झालेले लोकजीवन ओवी गंथबद्ध झाल्यावर लोकगीतातून मात्र तसेच मौखिक रूपात प्रवाहित राहिले. महानोर हा धागा कवितेतून अधिक गडद करतात. त्यांच्या कवितेतील स्वाभाविक लय, प्रतिमा, शब्दकळा यामधून ती सतत पाझरत राहते. या संदर्भात डॉ.नागनाथ कोत्तापल्ले म्हणतात,“.....लोकगीतांमधून व्यक्त होणारे प्राकृतिक मनच..... महानोरांच्या कवितेतून व्यक्त होते. म्हणून महानोरांची कविता ही या रानातली या मातीतली वाटते. त्याचे कारण मुळी लोकगीतांचे सगळे सामर्थ्य महानोरांच्या कवितेने पचविले आहे”.५ (मराठी कविता आकलन आणि आस्वाद, पृष्ठ १६८) याची यथार्थता पटते.

शब्दांची मितव्ययता व आशयाचा घट्टपणा हे त्यांच्या कवितेचे विशेष आहे. लोकगीत, लोकभाषा यामुळे शब्दांचे उपयोजन आणि लयीची प्रासंगिकता सहज कवितेत येते. फुलवण,बिंदोली,झिम्माड, हूल, थेंबुटे, चावळ, हिंदळ, हळदिवे, डोळुले अशा शब्दकळा आणि सोन्याचे हसू, स्वप्नांची झुंबर, स्वप्नांचं इंधन, केशरी गंध, मेंदीचे अंग, डाळिंबीचे फूल, रानभूल अशा प्रतिमा बोलीभाषेतील 'अरूपाचे रूप' दाखवू लागतात. महानोरांची भाषा साधी, सोपी, सहज व प्रवाही स्वरूपाची आहे. शब्दांबरोबरच छंदांची नावताही ते सहज गुंफतात. निसर्गकवितेचं लेणं त्यांच्या 'रानातल्या कवितांनी' निर्माण केलं आहे.

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- २) दैनिक लोकसत्ता २६ फेब्रुवारी २०१७
- ३) दैनिक लोकसत्ता २६ फेब्रुवारी २०१७
- ४) महानोर ना.धों., पानझड,पॉप्युलर प्रकाशन, मुंबई, आवृत्ती १९९७,
- ५) कोत्तापल्ले नागनाथ,मराठी कविता आकलन आणि आस्वाद, स्वरूप प्रकाशन औरंगाबाद प्रथम आवृत्ती २००५, पृष्ठ १६८.
- ६) महानोर ना.धों., रानातल्या कविता, पॉप्युलर प्रकाशन, मुंबई, आवृत्ती २०११.

ABSTRACTS: PSEUDO PURSUE OF HAPPINESS- GENEROSITY: AN ENHANCEMENT BY RICHARD POWERS

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Richard Powers as usual used his scientific recipe with literature spices. “Generosity: An Enhancement” is one of the masterpiece of the Richard Powers in which he demonstrated the human nature and hunger for happiness with help of science. All the creations by the human or discoveries are nothing but the result of the human’s passion for the happiness. We are ready to pay any price for the happiness. In the search of happiness human forget that life itself is the real happiness. Happiness never reside in the external things or facts, it is reside deep inside our soul. We have to experience it and live it of our own; no one can make you happy except you yourself. There is another side of the novel, which shows that sometime we suffered in our life so much that there is nothing in the world that hurts us. We get stable and irrelevant to all calamities of the life. There is something like this happen with the Thassadit Amzwar. Which rise as the miracle and the ray of happiness in the suffered human life.

Keywords: Happiness, genes, science, passion, compassion, depression.

The concept of "happiness genes" has been a topic of debate in the field of genetics and genetic engineering. Richard Powers' novel "Generosity-Enhancement" explores the implications and consequences of manipulating these genes in order to enhance an individual's emotions. This research paper aims to analyze the novel in order to understand the concept of happiness genes as a pseudo pursuit of happiness and its potential effects on human behavior and emotions. The novel depicts the story of Thomas Kurton a scientist who wants to create a gene therapy to enhance the emotion of generosity in individuals. Through the characters' experiences, the novel portrays that the pursuit of happiness through genetic manipulation is a pseudo pursuit as it leads to emotional dependence and a loss of authenticity in the characters' emotions, rather than true happiness.

The novel portrays potential consequences of manipulating emotions through genetic engineering. It highlights the importance of considering the ethical implications of such therapies and the potential impact on individuals and society as a whole. The novel also raises important questions about the nature of emotions and the relationship between genetics and behavior. The analysis of Richard Powers' novel "Generosity-Enhancement" provides valuable insights into the potential effects of happiness gene therapy on human emotions and behavior. The novel serves as a cautionary tale that highlights the importance of considering

the ethical implications of genetic engineering and the potential consequences for individuals and society.

The main character of the novel, Thassa passed through such a complex condition in her life that now she is not affected by any odd or critical condition. She set her mentality in such way that she remains happy in any condition, her that appearance mislead Russell Stone that she is suffered by euphoria. Thomas Kurton a scientist wants to use her for his experiment to discover the happiness genes. The message conveyed by Richard Powers in his novel "Generosity-Enhancement" is that the pursuit of happiness through genetic manipulation is a pseud pursuit, as it leads to the meaningless life and there is nothing in this world, which provide satisfaction to human. The novel also highlights the dangers of seeking happiness through genetic manipulation. Additionally, it raises important questions about the nature of happiness and the relationship between genetics and behavior.

Happiness is a complex and multi-faceted emotion that has been a topic of discussion in various fields, including psychology and philosophy. Richard Powers' novel "Generosity-Enhancement" explores the nature of happiness and its relationship with genetics and external factors. This research paper aims to analyze the novel in order to understand the concept of happiness as an internal, rather than external, state and its potential effects on human behavior and emotions. The novel depicts the story of a scientist who creates a gene therapy to enhance the emotion of generosity in individuals. Through the characters' experiences, the novel portrays that we have to create true happiness by our behaviour and reaction to the action in real life. Thassa doesn't have happiness gene, but she has that set of mind which makes her happy even in the toughest situation of life. The novel also raises important questions about the nature of happiness and the relationship between human.

Although it's in everyone's instinct to want to be happy, very little is known about the science of happiness. The chemical processes that underlie how emotion is processed by the human brain, as well as how these processes impact our thoughts and behaviours, are still largely unknown to scientists. What exactly does happiness entail? In addition, when they are, what exactly takes place in people's brains? Life as most creatures know it is driven by the evolutionary imperatives of survival and propagation and their accompanying rewards. Humans are maybe the only species that can consciously enjoy these pleasures and even consider the elusive possibility of happiness. As John Steinbeck noted in his essay on "the tragic miracle of consciousness" and how our "species is not set, has not jelled, but is still in a state of becoming," the advanced human capacity to consciously predict and anticipate the outcome of decisions and actions confers on our species an evolutionary advantage (Steinbeck and Ricketts 1941). Even if consciousness enables us to feel joys, desires, and possibly even happiness, these feelings are always accompanied by the knowledge that they will eventually end.

The concept of a "happiness gene" refers to the idea that there may be a specific gene or set of genes that influence a person's overall level of happiness or well-being. However, it is important to note that the relationship between genetics and happiness is complex and not fully understood. Studies have shown that certain genetic variations may be associated with a greater risk for depression or anxiety, but it is not clear whether these variations directly cause these conditions. Additionally, environmental factors, such as upbringing, social support, and life experiences, also play a significant role in determining a person's overall level of happiness. The study by Richard Powers provides valuable insights into the effects of a newly developed generosity-enhancement gene on human behavior. The results show that the gene therapy significantly increases levels of generosity in individuals. The study highlights the potential of genetic engineering to promote positive traits, but also the need for further research and consideration of ethical implications.

A "happiness gene" is a topic of ongoing research and debate in the field of genetics and psychology. It's worth to mention that the concept of "happiness" is quite subjective and can be defined in different ways, therefore the "happiness gene" is not a well-established concept in the scientific community. Recent advancements in the field of genetic engineering have made it possible to manipulate specific genes in order to enhance certain traits or behaviors in individuals. One such trait that has gained attention in recent years is generosity. In this study, Richard Powers investigates the effects of a newly developed generosity-enhancement gene on the behavior of human subjects.

If scientists were to discover and isolate "happiness genes," it could potentially lead to new treatments for mental health conditions such as depression and anxiety. However, it is important to note that genetics is only one factor in determining an individual's overall well-being and happiness, and environmental and lifestyle factors also play a significant role. Additionally, there may be ethical concerns surrounding the manipulation of these genes and the potential impact on individuals and society as a whole. The invention of so-called "happiness genes" is a hypothetical scenario and not currently possible with current technology. However, if such a thing were to exist, it could potentially create problems in human life in several ways. For example, people may become dependent on the gene to feel happy, rather than learning to find happiness through life experiences. Additionally, some people may not have access to the gene, leading to increased inequality and societal issues. It could also be used as a means of control by certain groups. It's important to consider the potential consequences of any technology before it's widely implemented.

The complex and multifaceted feeling of happiness has been discussed in a variety of disciplines, including psychology and philosophy. In his book "Generosity-Enhancement," Richard Powers examines the nature of pleasure and how it relates to external and genetic causes. In order to comprehend the idea of happiness as an internal state as opposed to an external one and its potential impacts on human behaviour and emotions, this research paper will evaluate the novel. In his book "Generosity-Enhancement," Richard Powers describes a scientist who develops a gene treatment to heighten people's feelings of generosity. The book illustrates through the experiences of the protagonists that genuine happiness is an interior state that cannot be attained through outside influences or genetic engineering. The novel also emphasises the significance of comprehending emotional complexity and the effects of genetic modification on people and society.

The novel depicts the characters struggling with the effects of the gene therapy, as they become emotionally dependent on it and lose authenticity in their emotions. Furthermore, the novel emphasizes the importance of understanding the complexity of emotions and how true happiness is an internal state. It suggests that happiness is not a singular emotion, but rather a combination of different emotions and experiences that are shaped by one's perspective, values, and beliefs. Additionally, the novel raises important questions about the nature of happiness and the relationship between genetics and behavior. It highlights the potential consequences of genetic engineering for individuals and society, and the importance of considering the ethical implications of such advancements.

In conclusion, Richard Powers' book "Generosity-Enhancement" offers important insights into the idea of happiness as an internal state and its possible impacts on people's emotions and conduct. The book serves as a warning by highlighting how crucial it is to think through the moral ramifications of genetic engineering and its possible effects on both people and society. It also highlights the need of comprehending the complexity of emotions and the fact that genuine happiness is an inside rather than an external condition. Here Richard Powers examines the ramifications and effects of changing certain genes to improve a person's emotions. To grasp the ideas, characters, and plot of the book, an analysis of it was

done by reading and interpreting the text. The therapy has both beneficial and detrimental impacts on the characters in the book. The therapy increases the characters' compassion and altruism on the one hand, but it also makes them emotionally reliant and takes away their emotional authenticity on the other. To sum up happiness is not inherited, it has to be created.

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ROLE OF NEW NEP-2020 IN THE DEVELOPMENT OF HIGHER EDUCATION

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Abstract

Education is the overall development of the human being. Education is a basic human right that works to raise men and women out of poverty, level inequalities and ensure sustainable development. Education is a fundamental right for achieving full human potential, developing an equitable and just society, and promoting national development. Providing universal access to quality education is the key to India's continued ascent, and leadership on the global stage in terms of economic growth, social justice and equality, scientific advancement, national integration, and cultural preservation. Universal high-quality education is the best way forward for developing and maximizing our country's rich talents and resources for the good of the individual, the society, the country, and the world. India will have the highest population of young people in the world over the next decade, and our ability to provide high-quality educational opportunities to them will determine the future of our country. So for sustainable development, we need reforms in education from the bottom to the apex of the educational system. There are a lot of reforms and new developments which have been introduced by NEP in the higher education sector. This article focuses on the outline of the role of the new NEP-2020 in the development of higher education

Keywords: *Education, National education policy, Development, Higher Education*

Introduction

A New National education policy called NEP is a comprehensive framework to guide the development of education in the country. The urge for such a framework was first realized in the year 1968 which was then revisited and revised in the year 1986. This was again reviewed and updated in 1992 as per the need of the hour. Since then, the entire world and the overall sector have witnessed massive changes. Hence, this year, the government decided to revise these policies to make them more relevant and compelling for the education ecosystem.

The New National Education Policy announced by the Government of India (NEP 2020) was a welcoming change and fresh news amidst all the negativities surrounding the world due to the challenges posed by the Covid-19 pandemic. The announcement of NEP 2020 was purely unexpected by many. Recently many changes have been introduced in the academic system of India starting from the school to college level. New National Education Policy has been approved by the Union Cabinet reflecting all the changes. The changes that NEP 2020 has recommended were something that many educationists never saw coming. Though the education policy has impacted school and college education equally, this article mainly focuses on NEP 2020 and its impact on Higher Education. This newly approved plan talks about major transformational reforms in the Indian academic sector which are appreciated by many. Along with appreciation, there is also criticism that focuses on the drawbacks of this new education policy.

Implementation

Many people are interested to change the education policy so that they can cope with the new technology. The new education policy in 2020 came after 30 years and is all set to change the existing academic system of India to make it at par with the international standard of academics. The Government of India aims to set up the NEP by the year 2040. Till the targeted year, the key point of the plan is to be implemented one by one. The proposed reform by NEP 2020 will come into effect through the collaboration of the Central and State Governments. Subject-wise committees will set up the GOI with both central and state-level ministries to discuss the implementation strategy.

The new NEP has advantages and disadvantages. The followings are the advantages and disadvantages of the New NEP-2020

Advantages

1. The Government aims to make schooling available to everyone with the help of NEP 2020.
2. According to the national education policy 2020, the 5+3+3+4 structure will replace the existing 10+2 structure. This structure is focused on students' formative years of learning.
3. According to the national education policy 2020, the Education Ministry is to set up a National Mission on Foundational Literacy and Numeracy. The responsibility for the successful implementation for achieving the foundation of numeracy and literacy for all students till class three falls upon the states of India. This implementation is scheduled to be done by 2025.
4. One of the merits of NEP 2020 is the formation of the National Book promotion Policy in India.
5. According to the national education policy 2020, an Academic Bank of Credit will be established. The credits earned by the students can be stored and when the final degree gets completed, those can be counted.
6. According to the national education policy 2020, Multidisciplinary Education and Research Universities at par with the IITs and IIMs will be set up in the country. These are scheduled to be set up for introducing multidisciplinary academics.
7. The same list of accreditation and regulation rules will be used for guiding both the public and private academic bodies.
8. Phased-out college affiliation and autonomy will be granted to colleges.
9. By the year 2030, it will be mandatory to have at least a four-year B. Ed degree for joining the occupation of teaching.
10. To make the students prepared for future pandemic situations, online academics will be promoted on a larger scale.

Disadvantages

1. In the National Education Policy 2020, language is a negative factor as there is a problematic teacher-to-student ratio in India, thus introducing mother languages for each subject in academic institutes is a problem. Sometimes, finding a competent teacher becomes a problem and now another challenge comes with the introduction of the NEP 2020, which is bringing study material in mother languages.
2. According to the national education policy 2020, students willing to complete their graduation have to study for four years while one can easily complete his/ her diploma degree in two years. This might encourage the pupil to leave the course midway.

3. According to the national education policy 2020, students of private schools will be introduced to English at a much earlier age than the students in Government schools. The academic syllabus will be taught in the respective regional languages of the Government school students. This is one of the major new education policy drawbacks as this will increase the number of students uncomfortable communicating in English thus widening the gap between sections of the societies.

The structure and lengths of the degree program

The new NEP is introduced with a planned structure. In the context of the National Education Policy 2020 scheme, any undergraduate degree in any institution will be of duration of three or four years. One can leave the degree within this period. Any educational institution will have to give the student a diploma degree after the student completes two years of study, a degree after the student completes three years of study, and a certificate to those students who complete one year of study in any professional or vocational course of their choice. The Government of India will also help in establishing an Academic Bank of Credit for storing the academic scores digitally. This will enable the institutions to count the credit at the end and put it in the degree of the student. This will be helpful for those individuals who might have to leave the course mid-way. They can start the course later on from where they left off and not start from the beginning once again. Even though NEP 2020 says that Higher education institutions will be given the freedom to start PG courses there maybe some difficulty in designing One Year PG Degree for students who have completed 4 Year UG Degree and a Two Year PG Degree for students who have completed 3 Year UG Degree.

Conclusion

The new NEP-2020 policy introduces development in education. Education for a new generation of learners has to essentially engage with the increasing dematerialization and digitalization of economies, which requires a completely new set of capabilities to be able to keep up. This seems to be an even more vital prerequisite now, with the trend towards digitalization and disruptive automation being quickened by the pandemic. Overall, the NEP 2020 addresses the need to develop professionals in a variety of fields ranging from Agriculture to Artificial Intelligence. India needs to be ready for the future. And the NEP 2020 paves the way ahead for many young aspiring students to be equipped with the right skill set. The new education policy has a laudable vision, but its strength will depend on whether it can effectively integrate with the other policy initiatives of the government like Digital India, Skill India, and the New Industrial Policy to name a few, to effect a coherent structural transformation. Hence, policy linkages can ensure that education policy addresses and learns from Skill India's experience in engaging more dynamically with the corporate sector to shape vocational education curriculum to make it a success. There is also a necessity for more evidence-based decision-making, to adapt to rapidly evolving transmutations and disruptions. The NEP has reassuringly provisioned real-time evaluation systems and a consultative monitoring and review framework. This shall empower the education system to constantly reform itself, instead of expecting a new education policy every decade for a shift in curriculum. This, in itself, will be a remarkable achievement. The NEP 2020 is a defining moment for higher education. Effective and time-bound implementation is what will make it truly path-breaking.

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विकास प्रक्रिया : विस्थापन आणि पुर्नवसनाच्या संदर्भात पेच आणि प्रतिसाद

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सारांश:-

समाजांनी व्यक्तिगत हक्क आणि राज्यसंस्थेची सत्ता यांमध्ये संतुलन साधण्याचा प्रयत्न केला आहे असे इतिहासाकडे नजर टाकल्यास लक्षात येते. शहरीकरण, जलद आर्थिक विकास, पायाभूत सुविधांच्या वाढत्या गरजा यामुळे जमिनीवर अतिरिक्त ताण येत आहे. खासकरून भारतासारख्या जलद गतीने फोफावणा-या अर्थव्यवस्थेमध्ये शासन मोठ्या प्रमाणावर जमिनी संपादित करत आहे. भारत सरकारने “प्राधान्य क्षेत्र” सिध्दांताच्या नावाखाली “व्यापक हित” आणि विकास साधण्याच्या हेतूने शेतक-यांच्या जमिनी ताब्यात घेतल्या, आणि परिणामी, लाखो लोक बेघर झाले. आंतरराष्ट्रीय पातळीवरील नितिनियमांनुसार, हा मानवी हक्कांचा भंग आहे. प्रस्तुत शोधनिबंधात या अनुषंगाने येणा-या प्रश्नांची चर्चा केली जाणार आहे.

महत्त्वपूर्ण शब्द:- प्राधान्य क्षेत्र, विकास, मानवी हक्क.

प्रस्तावना:-

जमीन विस्थापनाची समस्या-

विस्थापनाचे दोन प्रकार आहेत:-

- 1) दुष्काळ, पूर, भूकंप आणि वादळ यासारख्या नैसर्गिक संकटामुळे विस्थापन होते.
- 2) धरण बांधणी, खाणी, औष्णिक प्रकल्प, उदयोग, रेल्वे, रस्ते, बंदरे आणि अशा अन्य सुविधा आणि वाढत्या गरजांमधून विस्थापन होते.

यातील पहिल्या प्रकारातील विस्थापन मानवी आवाक्याबाहेरील आहे, दुसरे मात्र मानव निर्मित आहे, कारण ते पुर्वनियोजित किंवा सक्तीने घडवून आणलेले असते. या दोन्ही प्रकारच्या विस्थापनामध्ये याचे बळी ठरणारे लोक हे गरीब आणि समाजातील दुर्बल घटक असतात. आर्थिक अस्थैर्यामुळे किंवा पुरेसे शिक्षण न झाल्याने सुरक्षित ठिकाणी जाण्यास ते सक्षम नसतात.

धरण बांधणी, उदयोग उभारणी, रस्ते आणि रस्त्यांची उभारणी यांमुळे लोकांचे विस्थापन त्यांच्या अनिच्छेने होते. सहसा गरीब लोक या प्रकारच्या विस्थापनाचे शिकार होतात. कारण अशा महाप्रकल्पांमुळे त्यांच्या उदरनिर्वाहाची साधने, राहण्याची जागा, आणि मालकीच्या वस्तूंचे नुकसान होते किंवा त्या नाश

पावतात.शासनाने केलेल्या “सक्तीच्या पुनर्वसनाची” समाजाने, स्वयंसेवी किंवा माध्यमांमार्फत दखल घेण्यास सुरुवात केल्यानंतर राज्य प्रशासनाला उत्तरदायित्व स्वीकारणे भाग पाडले.यातून लोकांची उदरनिर्वाहाची साधने आणि निवारा नष्ट झाला असल्याची अनेक उदाहरणे दिसून येतात.पुनर्वसन आणि पुनःस्थापन, परिघावरील किंवा स्थानिक भागाचा विकास हे विकास प्रक्रियेतील महत्वाचे मुद्दे आहेत.1

संशोधन पध्दतीशास्त्र:-

शोधनिबंधाची उद्दिष्ट्ये:-

- 1) विकास, विस्थापन आणि पुनर्वसन संकल्पनेचे अध्ययन करणे.
- 2) पुनर्वसनाच्या अडचणी उपाययोजना जाणून घेणे.

तथ्य संकलन:-

प्रस्तुत शोधनिबंध पुर्णपणे द्वितीयक स्रोतांवर आधारीत आहे. शोधनिबंधासाठी विषयाशी संबंधित संदर्भग्रंथ, पुस्तके, वर्तमानपत्रे, मासिके,शासकिय अहवाल प्रकाशित व अप्रकाशित साहित्य यांचा वापर करण्यात आला आहे.

संशोधन आराखडा :-

प्रस्तुत शोधनिबंधासाठी वर्णनात्मक आणि विश्लेषणात्मक संशोधन आराखड्याचीनिवड करण्यात आली आहे.

संकल्पनात्मक मांडणी:-

विकास, विस्थापन व पुनर्वसन :व्याख्या:

विकास:-

सुरवातीला विकास म्हणजे केवळ आर्थिक विकास या अर्थाने विकास या संकल्पनेचे अध्ययन केले जात होते.विकासाचा अर्थ आर्थिक विकास आणि सामाजिक परिवर्तन यांच्यातील संबंधाचा अभ्यास होईपर्यंत कायम होता.त्यानंतर विकास संकल्पनेत मानवी जीवनाच्या विविध पैलूंचा समावेश होऊ लागला.

विकास म्हणजे केवळ आर्थिक वृद्धी किंवा प्रगती एवढेच अभिप्रेत नाही तर माणसांचा (समाजाचा) विचार विकासात होतो.

मानवी विकास साधण्यासाठी अनेक योजना, प्रकल्पाबविले जातात.अशा वेळेस ज्या लोकांच्या जमिनी,शेती घेतली जाते अशा लोकांना विस्थापित असे म्हणतात.2

विस्थापन म्हणजे :-

- 1) डॉ.जी सत्यनारायण:-

“विस्थापन म्हणजे राहते घर,शेतजमिन आणि पारंपारिक व्यवसाय सोडणे आणि उदरनिर्वाहासाठी दुसरी पर्यायी व्यवस्था करणे, नवीन घर तयार करणे,नवे नातेसंबंध जोडणे,आणि नवीन संस्कृती व पर्यावरणाशी जुळवून घेणे होय”.3

पुनर्वसन म्हणजे:-

पुनर्वसन म्हणजे लोकसंख्येची एका क्षेत्रातून दुस-या क्षेत्रात नियोजनाच्या आधारावर बदली करणे होय.

विकास,विस्थापन आणि पुनर्वसन या तिन्ही संकल्पना एकमेकावर आधारित आहेत. विकास साधतांना ज्या लोकांना विस्थापीत व्हावे लागते त्यांचे पुनर्वसन करावे लागते,अन्यथा प्रकल्प चळवळी वाढीस लागतात.

विश्लेषणात्मक चर्चा

विकास आणि विस्थापनाची समस्या:-

भारतासारख्या विकसनशील देशात मागील अनेक पंचवर्षिक योजनांमधून सर्व क्षेत्रांच्या विकासावर भर देण्यात आलेला आहे.विकास करणे ही अपरिहार्य प्रक्रिया आहे.परंतु ही प्रक्रिया राबवतांना त्यातून होणारी प्रगती आणि नुकसान या दोन्ही गोष्टी लक्षात घ्याव्या लागतात.

याबाबतीत ठळक दोन विचारप्रवाह दिसून येतात.

- 1) एका विचारप्रवाहानुसार विकास करावयाचा झाल्यास नैसर्गिक संपत्ती आणि मानवांच्या सांस्कृतिक जीवनाचे नुकसान होणार हे गृहीत धरले पाहिजे.परंतू ह्या तोटयापेक्षा लाभाचे प्रमाण जास्त असते हे सुध्दा लक्षात घेणे आवश्यक आहे.
- 2) दुस-या विचारप्रवाहानुसार विकास जरूर करावा, विकासाला विरोध नाही. परंतू ज्या विकास योजनांमुळे जमिन, जंगल आणि पाण्याची/जलाची अपरिमित हानी होत असेल तर त्या परिसरातील मानवी जीवन धोक्यात येत असेल तर अशा योजनांच्या आखणीचा पुर्नविचार करावा जेणे करुन विस्थापितांचा प्रश्न निर्माण होणार नाही.4

विस्थापनाची कारणे:-

- 1) भूकंप.
- 2) औद्योगिक वसाहती.
- 3) सुरक्षित वन प्रकल्प.
- 4) राजकीय कारणे.
- 5) मोठी धरणे.

स्थलांतर आणि पुर्नवसनाचा प्रश्न:-

जमिनीचा वाढता वापर-

वाढत्या नागरीकरणांमुळे आणि औद्योगिकीकरणामुळे जमिनीचा तुटवडा निर्माण झालेला आहे.शहरांचा विस्तार अत्यंत मोठया प्रमाणात होत आहे.अशा या मोठया शहरात लोकसंख्येचे प्रमाणही वाढले आहे. ग्रामिण भागातील लोक शहराकडे नोकरी व्यवसायाच्या निमित्ताने स्थलांतर करीत आहे.त्यामुळे शहरालगतची शेतीची पिकांची जमीन आता बिगर शेतीत रुपांतरीत होत असून जमिनीचे प्लॉटस पाडून त्यावर मोठ मोठया गगनचुंबी इमारती उभारल्या जात आहे.त्यामुळे पर्यावरणाची झालेली हानी हे भिषण वास्तव नाकारता येत नाही.

पुर्नवसन:-

पुर्नवसन हा नव्याने निर्माण झालेला सामाजिक प्रश्न आहे. मोठ मोठया प्रकल्प उभारणीमुळे हा प्रश्न निर्माण होतो.मोठ मोठी धरणे, मोठे विज प्रकल्प, अणू भटटयांची उभारणी इ. कारणामुळे हा प्रश्न निर्माण झाला आहे.लक्षावधी लोकांनाया कारणांमुळे विस्थापित व्हावे लागत आहे. अशा विस्थापितांचे पुर्नपसन करणे हा त्यांचा हक्कच आहे.6

पुर्नवसनाच्या हक्कासाठी खालील तत्वांची अंमलबजावणी करणे गरजेचे आहे.

- 1) विस्थापितांचे पुर्नवसन करणे ही त्या राज्य सरकारची जबाबदारी आहे.
- 2) पुर्नवसनास प्रथम प्राधान्य देऊन ठराविक वेळेत पुर्नवसन प्रक्रिया पुर्ण करावयास हवी.
- 3) स्थलातरीतांच्या मागण्या ऐकून घेतल्या जाव्यात व मान्य केलेल्या मागण्यांची पुर्तता विना तक्रार करावी.
- 4) पुर्नवसन प्रक्रियेवरती लक्ष्य ठेवण्यासाठी सामाजिक संस्थांना उदयुक्त करावे.7

विस्थापितांच्या पुर्नवसनासाठी येणा-या अडचणी:-

विस्थापितांचे पुर्नवसन करणे शासनाची जबाबदारी असते.या शासनात काम करणारे नोकर हे विस्थापित नसतात.त्यांना या विस्थापितांचे प्रश्न समजावून घेणे जमत नाही.

वेळेत प्रकल्प पुर्ण होत नाहीत.20,20 वर्षे झाली तरी ती योजना प्रकल्प पूर्ण होत नाही, काही वेळेस तो प्रकल्प अर्धवट राहिला जातो त्यामुळे विस्थापितांना त्या जमिनीचा योग्य तो आर्थिक मोबदलामिळत नाहीकिंवा कोणताही फायदा त्यांना होत नाही.

पुर्नवसना संबंधी उपाय:-

- 1) घरे.
- 2) जमिनी.
- 3) भरपाई वेळेवर देणे.
- 4) नागरी सोयी पुरविणे.
- 5) इतर सुविधा.

निष्कर्ष :-

- 1) मानव हक्क जाहीरनाम्यानुसार, प्रत्येक व्यक्तीला जगण्याचा अधिकार असतो. सर्व शासनांनी नागरिकांची स्थिती सुधारणे हे सामाजिक, आर्थिक आणि सांस्कृतिक हक्क देण्यामध्ये अपेक्षित आहे.
- 2) सक्तीने केलेल्या विस्थापनामुळे अनेक जोखीमा निर्माण झाल्या आहेत. जसे की, विस्थापित लोक किंवा शेतक-यांमध्ये भूमिहीन, बेघर, सीमांतीकरण, वाढते रोग आणि मृत्युदर, अन्न टंचाई, सार्वजनिक संपत्ती उपभोगण्याचा समान अधिकार नसणे, सामाजिक विभाजन आणि वाढते दारिद्र्य या समस्या प्रामुख्याने दिसून येतात.
- 3) विकासासाठी झालेल्या विस्थापनाला सामाजाच्या विविध स्तरातून विविध प्रकारचे प्रतिसाद येतात आणि त्यांचा लोकांच्या जीवनावर वेगळा ठसा उमटतो. विकासामुळे लोकांचे नुकसान होत नसून त्यांचे स्वास्थ सुधारते तसेच शिक्षण आणि उत्पन्न सहभागी तत्वाने होते.
- 4) बहुतांश विकास प्रकल्पांमध्ये विस्थापित लोकांच्या पुर्नवनाचे नियोजन आणि अंमलबजावणी योग्य पध्दतीने होत नाही आणि पुनःस्थापनेच्या योजना अयोग्य आणि अपु-या असतात. ही याची दुसरी बाजू आहे.

समारोप:-

मानवीविकास साधत असतांना मोठमोठे प्रकल्प व उदयोगधंदे स्थापन करावे लागतात. त्यात सार्वजनिक व खाजगी क्षेत्रातील कारणाने रेल्वे, रस्ते, धरणे बांधणे यांचा समावेश होतो. ज्या परिसरात या योजना किंवा प्रकल्प उभारण्यात येतात तेथील जमिनी सरकारला ताब्यात घ्याव्या लागतात. त्यात अनेक गांवे, खेडी, आदिवासी वस्ती, शेत जमिनी व घरे यांच्यावर प्रतिकूल परिणाम होतो. तेथील लोक विस्थापित होतात. त्यांचे योग्य ठिकाणी पुर्नवसन करणे आवश्यक असते. विस्थापनाची अनेक कारणे आहेत. नैसर्गिक आणि मानवनिर्मित कारणांमुळे समाज, समूह, खेडी, गांव विस्थापित होतात. त्यांचे पुर्नवसन केले जाते.

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SCIENCE & TECHNOLOGY

X-RAY DIFFRACTION STUDIES OF MN(II) FE (III) CO (II), NI (II) AND CU (II) COMPLEXES WITH OXYGEN DONOR CHALCONE LIGAND.

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Abstract

In the present paper, the some of first transition series metal complexes derived from (4-hydroxy-3-[3-(1H-indole-3-yl)-acryloyl]-6-methyl-2H-pyran-2-one) were synthesized from Dehydroacetic acid and Indole-2-carboxaldehyde. They correspond well with the general formula $[M(L)_2(H_2O)_2]$, where $M = Mn(II), Co(II), Ni(II)$ and $Cu(II)$ and $[M(L)_2(Cl)(H_2O)]$, where $M = Fe(III)$ and $L = C_{17}H_{13}NO_4$. The X-ray diffraction studies of newly prepared Copper(II), Nickel(II), Cobalt(II) Manganese(II) and Iron(III) complex with ligand(L2) was taken from Instrumentation Centre of Solapur University, Solapur. The powder X-ray diffractograms of the all chelates was recorded in 2θ range of $5-70^\circ$ by copper $K\alpha$ radiation initiator at a wavelength of 1.540598 \AA at normal temperature.

Introduction

Chalcones constitute an important class of natural products belonging to the flavonoid family, which have been reported to possess a wide spectrum of biological activities, including antibacterial, antifungal, anti-inflammatory, antitumor, insect antifeedant and antimutagenic[1-3]. Additionally, some of chalcone derivatives have been found to inhibit several important enzymes in cellular systems, such as xanthine oxidase[4] and protein tyrosine kinase[5-6]. Chalcones are also key precursors in the synthesis of many biologically important heterocycles such as benzothiazepine[7], pyrazolines[8], 1,4-diketones[9] and flavones[10]. Hence, the synthesis of chalcones has generated vast interest among organic as well as medicinal chemists.

Chalcones are one of the major classes of natural products with widespread distribution in fruits, vegetables, spices, tea and soy based foodstuff, have been recently subjects of great interest for their interesting pharmacological activities[11]. Chalcones are belonged to the flavonoids family. A vast number of naturally occurring chalcones are polyhydroxylated in the aryl rings. The radical quenching properties of the phenolic groups present in many chalcones have raised interest in using the compounds or chalcone rich plant extracts as drugs or food preservatives [12]. Chalcones have been reported to possess many useful properties, including anti-inflammatory, antimicrobial, antifungal, antioxidant, cytotoxic, antitumor and anticancer activities. A number of chalcone derivatives, have also been found to inhibit several important enzymes in cellular systems, including xanthine oxidase [13], aldose reductase, epoxide hydrolase[14] protein tyrosine kinase [15] and quinone reductase[16].

Chalcones having an α, β -unsaturated carbonyl group are one of the important biocides and versatile synthons for various chemical transformations. Most of the chalcones are highly biologically active with a number of pharmacological and medicinal applications [17]. Chalcones have been used as anti AIDS agents [18], cytotoxic agents with antimalarials[19], antiangiogenic activity [20], anti-infective and anti-

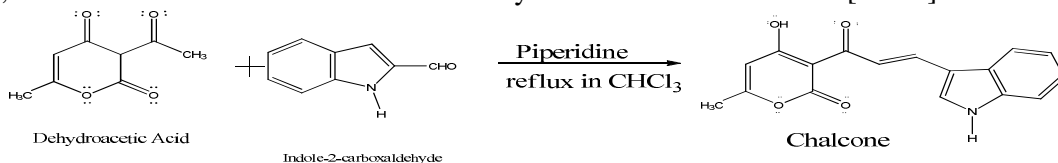
inflammatory [21] and anti-tumor agents [22]. Some chalcones were found to increase the level of the tumor suppressor protein p53 in various cancer cell lines by disrupting its complexes with the oncoprotein MDM2 [23]. Chalcones are also key precursors in the synthesis of many biologically important heterocycles such as benzothiazepine [24], pyrazolines [25], 1,4-diketones and flavones. Some heterocyclic systems based on chalcone precursors are benzothiazepines, benzodiazepines, benzoxazepines, pyrimidines, pyrazoles, and oxazoles [26]. Various substituted chalcones possess antioxidant [27], radical-scavenging [28], anticancer [29], antileishmanial [30], antimitotic [31], antitumor [32] and antibacterial [33] properties, as well as P-glycoprotein mediated multidrug resistance [34].

Several strategies for the synthesis of the system based on the formation of carbon-carbon bond have been reported. Among them the direct aldol condensation and Claisen-Schmidt condensation still occurs prominent position. The main method for the synthesis of chalcones is the classical Claisen-Schmidt condensation in the presence of aqueous alkali [35], Ba(OH)₂ [36], ultra sound irradiation. However many of these methods suffered from harsh reaction conditions, toxic reagents, strong acidic / basic conditions, prolonged reaction time, poor yield and low selectivity. Although, several modifications have been made to counter these problems. There is still a need for the development of selective and better strategies for the synthesis of α , β -unsaturated carbonyl compounds.

A search of the literature revealed that no work has been done on transition metal complexes of the chalcone derived from dehydroacetic acid and Indole-2-carboxaldehyde. The complexes of Ni(II), Cu(II), Mn(II), Co(II) and Fe(III) with this ligand were also prepared in the solid state and characterized by different physico-chemical methods.

General procedure for the synthesis of the ligand (HL)

A solution of 0.01 mol of Dehydroacetic acid (DHA), 8-10 drops of piperidine & 0.01 mole of 4-isopropyl benzaldehyde in 25 ml chloroform were refluxed for 8-10 hrs, 10 ml of the chloroform-water azeotrope mixture was separated by distillation. Crystal of product separated on slow evaporation of the remaining chloroform. The resulting precipitate was filtered, washed several times with ethanol & recrystallized from chloroform [37-38].



Scheme 1: Synthesis of Ligand

General procedure for the synthesis of metal complexes

To a chloroform solution (30ml) of the ligand (2mmol), methanolic solution (20ml) of metal chlorides was added with constant stirring. The PH of the reaction mixture was maintained around 7.5 by adding 10% methanolic solution of ammonia. It was then refluxed for 2hr. the resulting metal complex was filtered in hot condition & washed with ethyl acetate methanol, pet-ether & dried over calcium chloride in vacuum desiccator.

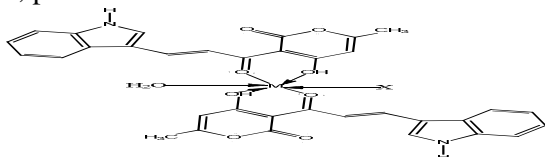


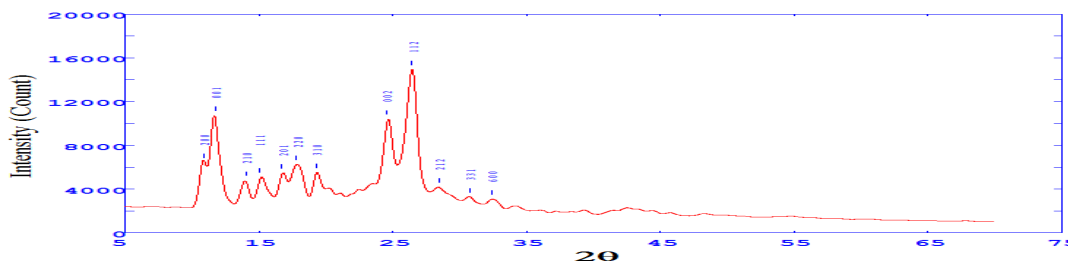
Fig. 1: Proposed structure of complex, when X= Cl, M=Fe(III) and X=H₂O M=Mn(II), Co(II), Cu(II), Ni(II)

Results and discussion

The X-ray diffraction studies of newly prepared Copper(II), Nickel(II), Cobalt(II) Manganese(II) and Iron(III) complex with ligand(L2) was taken from Instrumentation Centre of Solapur University, Solapur. The powder X-ray diffractograms of the all chelates was recorded in 2θ range of 5-70° by copper Ka radiation initiator at a wavelength of 1.540598 Å at normal temperature.

The leading reflexes remained used to conclude resultant inter planar distances. The XRD was then indexed individually, miller indices were measured, lattice parameter a, b, c in addition to interfacial angles α, β, γ remained define by powder-X computer software programme (*Balaji H. Jawale, et al.,2017;Patange, 2008*). The all above X-ray diffraction data of transition metal complexes has been tabulated in the following Fig. A3.20-3.24 and tables A3.04-A3.08 are as fallows.

Fig.A3.20 : X-ray Diffractogram of Cu-L2



CRYSTAL SYSTEM : Monoclinic LATTICE TYPE : P 2/m
 RADIATION : Cu WAVELENGTH : 1.540598 Å⁰
 VOLUME : 2186.25Å³ LAMBDA : 1.54060 Å⁰
 RECIP. LATTICE : 0.06133 0.06133 0.14041 90.000 90.000 60.000
 LATTICE PARAMETER :
 a= 4.9168 α= 90
 b= 4.9168 β= 90
 c= 5.4089 γ=120
 2Theta Start= 5 2Theta End= 70

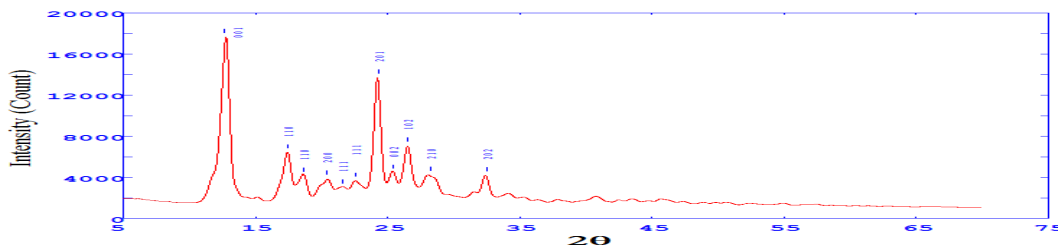
Table A3.04 :XRD data of Cu-L2 Complex

H	K	L	TH(OBS)	TH-ZERO	TH(CALC)	D(OBS)	D(CALC)
			RI%				
2	0	0	5.41986	5.62366	5.42190	7.86069	8.15228
			33.2				
0	0	1	5.87839	6.08218	6.20896	7.27008	7.12219
			54.2				
2	1	0	7.02469	7.22848	7.18058	6.12192	6.16254
			23.1				
1	1	1	7.52906	7.73285	7.79464	5.72482	5.67971
			23.6				
2	0	1	8.35440	8.55819	8.25715	5.17626	5.36360
			24.2				
2	2	0	8.90463	9.10842	9.41937	4.86597	4.70672
			30.0				
3	1	0	9.63826	9.84205	9.80771	4.50645	4.52207
			24.1				
0	0	2	12.25183	12.45562	12.49237	3.57143	3.56110
			52.8				

1	1	2	13.21473	13.41852	13.37187	3.31936	3.33073
			76.5				
2	1	2	14.22348	14.42727	14.46734	3.09170	3.08332
			17.4				
3	3	1	15.36978	15.57357	15.56064	2.86916	2.87149
			13.4				
6	0	0	16.19512	16.39891	16.46720	2.72843	2.71743
			12.4				

From the X-ray diffraction spectrum analyzed data were illustrated in above Table A3.04 that the Cu(II) complex have a Monoclinic crystal system (AmelDjedouani, et al., 2006).

Fig.A3.21 : X-ray Diffractogram of Ni-L2



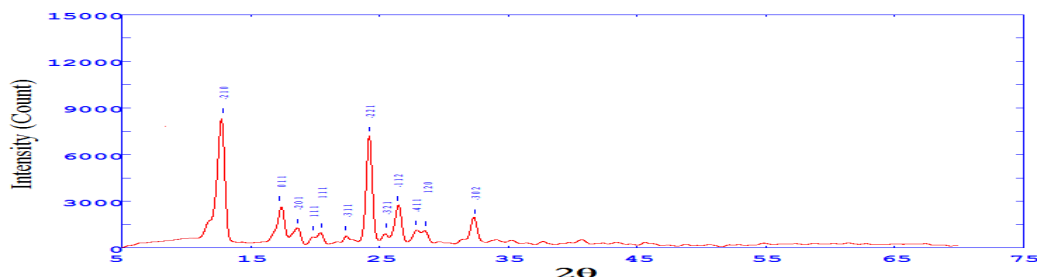
CRYSTAL SYSTEM : Monoclinic LATTICE TYPE : P 2/m
 RADIATION : Cu WAVELENGTH : 1.540598 Å⁰
 VOLUME : 640.57Å³ LAMBDA : 1.54060 Å⁰
 RECIP. LATTICE : 0.11466 0.11466 0.13712 90.000 90.000 60.000
 LATTICE PARAMETER :
 a= 4.9168 α= 90
 b= 4.9168 β= 90
 c= 5.4089 γ=120
 2Theta Start= 5 2Theta End= 70

Table A3.05 :XRD data of Ni-L2 Complex

H	K	L	TH(OBS)	TH-ZERO	TH(CALC)	D(OBS)	D(CALC)
							RI%
0	0	1	6.29106	6.01588	6.06295	7.34989	88.9
1	1	0	8.72122	8.44605	8.79947	5.24448	32.9
1	1	0	9.31730	9.04212	8.79947	4.90135	20.1
2	0	0	10.18849	9.91331	10.17424	4.47437	17.8
1	1	1	10.78456	10.50939	10.71343	4.22321	14.6
1	1	1	11.28894	11.01376	10.71343	4.03203	16.3
2	0	1	12.16013	11.88496	11.87699	3.74027	69.6
0	0	2	12.71035	12.43518	12.19515	3.57721	20.4
1	0	2	13.26058	12.98541	13.23600	3.42808	34.2
2	1	0	14.13177	13.85660	13.51357	3.21638	17.2
2	0	2	16.24097	15.96580	15.98375	2.80044	17.1

The above facts of cell records and crystal lattice considerations of Ni(II) chelate recognized to a Monoclinic crystal arrangement (S.D.Salunke, 2001).

Fig.A3.22 : X-ray Diffractogram of Co-L2



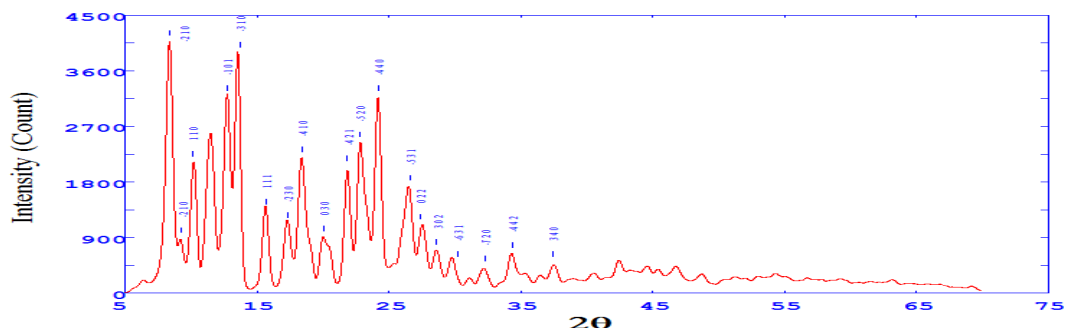
CRYSTAL SYSTEM : Monoclinic LATTICE TYPE : P 2/m
 RADIATION : Cu WAVELENGTH : 1.540598 Å⁰
 VOLUME : 794.38Å³ LAMBDA : 1.54060Å⁰
 RECIP. LATTICE : 0.07953 0.13583 0.13463 90.000 91.591 60.000
 LATTICE PARAMETER :
 a= 4.9168 α= 90
 b= 4.9168 β= 90
 c= 5.4089 γ=120
 2Theta Start= 5 2Theta End= 70

Table A3.06 :XRD data of Co-L2 Complex

H	K	L	TH(OBS)	TH-ZERO	TH(CALC)	D(OBS)	D(CALC)	RI%
-2	1	0	6.42861	6.48406	6.58208	6.82122	6.72008	55.7
0	1	1	8.62951	8.68496	8.47149	5.10127	5.22884	17.6
-2	0	1	9.31730	9.37275	9.36375	4.72992	4.73442	8.5
1	1	1	9.91337	9.96882	10.22511	4.44971	4.33932	7.2
1	1	1	10.23434	10.28979	10.22511	4.31234	4.33932	7.8
-3	1	1	11.19723	11.25268	11.13670	3.94749	3.98808	4.2
-2	2	1	12.11428	12.16973	12.19505	3.65403	3.64655	48.9
-3	2	1	12.75621	12.81166	13.04138	3.47378	3.41362	5.1
-1	1	2	13.16888	13.22433	13.18356	3.36722	3.37744	17.9
-4	1	1	13.90251	13.95796	13.87668	3.19348	3.21181	8.1
1	2	0	14.31518	14.37063	14.22228	3.10362	3.13532	8.1
-3	0	2	16.19512	16.25057	16.31474	2.75266	2.74212	12.3

The cell data as well as crystal lattice considerations of Co(II) chelate shows that chelate have a monoclinic crystal system (*AmelDjedouani, et al., 2006*) through lattice type-P.

Fig.A3.23 : X-ray Diffractogram of Mn-L2



CRYSTAL SYSTEM : Monoclinic LATTICE TYPE : P 2/m
 RADIATION : Cu WAVELENGTH : 1.540598 Å⁰
 VOLUME : 1915.83Å³ LAMBDA : 1.54060Å⁰

Table A3.08 :XRD data of Fe-L2 Complex

H	K	L	TH(OBS)	TH-ZERO	TH(CALC)	D(OBS)	D(CALC)	RI%
1	1	0	6.42861	6.84757	7.13027	6.46070	6.20579	96.2
0	0	1	8.03344	8.45240	8.57728	5.24057	5.16483	22.2
0	0	1	8.58366	9.00262	8.57728	4.92268	5.16483	22.1
2	0	1	11.05968	11.47864	11.77453	3.87080	3.77485	20.2
0	2	0	11.56405	11.98301	11.85897	3.71011	3.74835	23.4
1	2	0	12.16013	12.57909	12.53180	3.53694	3.55007	39.8
3	1	0	13.30643	13.72539	13.46270	3.24653	3.30867	63.4
1	2	1	14.86540	15.28436	15.26571	2.92212	2.92560	12.6
2	2	1	16.24097	16.65993	16.83446	2.68687	2.65980	26.8

The cell information and crystal lattice consideration of Iron (III) complex shows that complex have orthorhombic crystal system (*Carugo, O., et al., 1990*).

Conclusion

The analytical data shows 1:2 metal to ligand stoichiometry, we have proposed distorted octahedral geometry for Cu(II), Mn(II) & Fe(III), other Ni(II), Co(II) are octahedral geometry. The X-ray diffractogram outcomes of the chelates shown monoclinic crystal system for Cu(II), Ni(II), Mn(II) and Co(II) chelates while hexagonal for Fe(III) chelate with P-type lattice.

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UTILITY OF ZINGIBERACEAE FAMILY PLANTS OF NIZAMABAD AND KAMAREDDY DISTRICTS OF TELANGANA STATE, INDIA.

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Abstract:

Since long time, plants are being used for treating different diseases in different parts of world by different communities. The Utility of Zingiberaceae family plant explorations conducted in forest areas of Nizamabad and Kamareddy districts resulted in the information on the plants used in treating many diseases. For which about 04 plants species belonging to 03 genera of Zingiberaceae family are used. Of these. Information gathered from Nizamabad and Kamareddy districts indicates that the indigenous and other village people of this region have good knowledge of plants in treating different ailments, but their continuous and progressive exposure to modernization may result in extinction of the rich heritage of knowledge in the course of time. Majority of preparation are from Rhizome.

Keywords: Nizamabad, Kamareddy, Utility, Zingiberaceae.

Introduction:

Both districts are lies between 18-5' and 19' of the northern latitudes, 77-40' and 78-37' of the eastern longitudes. The districts is bounded on the North by Nirmal district, East Bay Jagityal District, South by Medak district and West by Bidar District of Karnataka and Nanded district of Maharashtra. The geographical area is 7956 Sq. Km's i.e. 19, 80,586 acres spread over 923 villages in 36 mandals. Major rivers, such as, Godavari and Manjeera crosses Nizamabad district with some other streams Kalyani, Kaulas, Peddavagu also exist in the district. Lambada, Naikpod, Yerukalas are major tribal groups in the area. Besides these tribal groups, several other communities are residing as forest dwellers.

Zingiberaceae is one of the largest families of the plant kingdom. It is important natural resources that provide many useful products for food, spices, medicines, dyes, perfume and aesthetics to man.

Materials And Methodology:

For documentation of ethno-botanical information and collection of plant material, several tours were undertaken during the period 2017-2022. Data presented here is based on personal observations and interviews with traditional healers (Viz. medicine men, hakims and old aged people) and methodology used is based on the methods available in literature (Jain 1989) and (Jain and Mudgal 1999). Ethno medico botanical information gathered was documented in data sheets prepared. For collection of plant material, local informer accompanied to authors. Plant identification was done by using regional flora and flora of adjoining districts (Naik 1998), (Cooke 1958).

Medicinal uses of plants were compared with major published literature (Ambasta 1992), (Chopra et. al. 1956 & 1969), (Jain 1991), (Jain 1996), (Jain 1999), (Kapur 2001), (Kirtikar & Basu 1933), (Sharma & Singh 2001) and (Vijigiri & Sharma 2010).

Enumeration

The present Study Utility of Zingiberaceae family plant explorations conducted in forest areas of Nizamabad and Kamareddy districts resulted in the traditional plant uses of 04 plants species belonging to 03 genera. Following data includes botanical name of species, family, local name and uses.

Costus speciosus (Koen.) J. E. Sm. in Trans. Linn. Soc. 1: 249. 1800; *Banksia speciosa* Koen. apud Retz. Obs. Bot. 3: 75. 1783. ‘Sugar chettu’

Herbs, rootstock tuberous; stems more or less woody at base. Leaves subsessile, oblong or oblanceolate oblong. Inflorescence of dense spikes. Flowers white. Capsules globose 3-gonous, red. Seeds black, aril white.

Fls. & Frts. : August-February.

Illus. : Wight, Ic. t. 2014. 1853.

Distrib. : Rare, planted in house garden; Velpur, HDCA 1473.

Uses : **Med:**

1. *Diabetes: One leaf taken orally once a day early morning empty stomach control diabetes.

Curcuma decipiens Dalz. in Hook. Kew J. Bot. 2: 144. 1850. ‘Adavipasupu’.

Herbs, root stock small, Leaves broadly elliptic, shortly deltoid-acuminate. Spikes, Flowers twin flowering bracts, ovate, saccate, purple. Fruits ovoid, hairy.

Fls. & Frts. : June-September.

Distrib. : Common in forest under growth & stream edges; Tallakottapally, HDCA 1556.

Uses : **Med:**

- *Painful menstruation: 1 teaspoon powder of rhizome with 1 glass milk taken orally twice a day three days for menstrual pain.

Curcuma longa L. Sp. Pl. 2. 1753. ‘Pasupu’.

Herbs, tall; rootstock ovoid; sessile tubers cylindrical. Leaves oblong-lanceolate. Spikes. Corolla white; flowering bracts pale green; bracts of coma tinged with pink.

Fls. & Frts. : June-November.

Distrib. : Cultivated; Manthani, HDCA 1557.

Uses : **Med:**

1. Pimple: Fresh rhizome crushed with *Ocimum tenuiflorum* leaves, paste prepared and applied externally.
2. Stomach ache: Rhizome powder and ‘jaggery’ taken in equal pills of 6 gm each prepared, one pill given orally once for stomach ache for 2-3 days.
3. *Hernia: Rhizome powder with cow urine made in to 5 gm pills taken orally once a day, one pill for 40 days.
4. *Boils: Rhizome powder with *Citrullus colocynthis* leaves and salt 5:4:1 proportion crushed to prepare paste which is applied externally on boils.
5. Jaundice: Rhizome juice applied externally on eyes once a day for 15 days (or) Fresh rhizome with jaggery each in similar proportion made in to 5 gm pills, taken orally with butter milk once a day for 3 to 4 days.

6. Cough: 20-40 ml juice of rhizome with *Piper nigrum* seeds taken orally once to control cough.

Vet:

1. Fever: 200 ml decoction of 100 gm rhizome given orally twice a day for two days to cattle.
2. Wounds: Rhizome powder with coconut oil applied externally on wounds.

Ed: Rhizome powder used as condiment.

Misc:

1. Dry rhizome used in religious ceremonies. Rhizome tied to the broom at the time of marriage and worshiped.

Zingiberofficinale Rosc. in Trans. Linn. Soc. 8: 348. 1807. ‘Allamu’

Herbs; stems leafy, perennial. Leaves lanceolate to linear-lanceolate, sessile, narrowed to the base. Inflorescence ovoid.

Illus. : Burt & R. M. Smith in Dassan. & Fosb. *op. cit.*

Distrib. : Cultivated and pot herb; Ankapur, HDCA 1088.

Uses : **Med:**

1. Cold, cough and headache: one table spoon powder of rhizome with jaggery taken in 2:1 proportion taken orally twice a day until cure.
2. *Spines on tongue: Wet rhizome powder paste prepared with goat milk and applied on tongue twice a day until cure.
3. *Pains: Rhizome powder with *Piper longum* seeds, *Piper nigrum* seeds, *Acorus calamus* rhizome, *Cuminum cyminum* seeds, hing, each taken in equal proportion made into pills with *Azadirachta indica* leaves juice or *Zingiber officinale* rhizome juice, taken orally one or two pills daily thrice for 15 days.
4. *Jaundice: 10 gm powder of its rhizome with *Piper nigrum* fruits and jaggery taken in 2:1:2 proportions made into 1 gm pills taken orally one or two pills daily thrice for 10-15 days.

Ed: Rhizome powder used as condiments.

Literature : Jain, 1991-(rh) cough & throat ache; Jain, 1996-(rh) cold and cough; Kapoor, 2001-(rh) cold and cough; Chattarjee & Satyesh, 2003-09-(rh) cold and cough.

Results And Discussion:

Information gathered from Nizamabad and Kamareddy districts indicates that the tribals, and other village people of this region possess good knowledge of herbal drugs, but their continuous and progressive exposure to modernization may result in extinction of such rich heritage of knowledge in the course of time. The collective efforts of ethnobotanists, phytochemists, pharmacognostists, and pharmacologists are needed to document and evaluate the efficacy and safety of the claims. Majority of preparations are from Rhizomes (10) and Leaf (01). Most prevalent diseases/ailments found in the areas are Cough and Jaundice. Two plants are used as a Veterinary Medicine and Two plants Rhizome used as a condiment. To test the scientific validity of the herbal preparations or drugs, clinical studies are required, which can establish therapeutic properties of these preparations for safe use.

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APPLICATION OF *ARTHROSPIRAPLANTENSIS* GOMONT (SPIRULINA) AS A BIOFERTILIZER

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Abstract:

Arthrospiraplatensis filamentous blue - green algae which are used as a biofertilizer in farming field for their potential role in protection and sustainable crop production. The ecological approaches motivate an extensive range of application of plant growth promoting cyanobacteria and many other useful microscopic organisms lead to improved nutrient uptake, plant development and plant tolerance to abiotic and biotic stress. In this present study, *Arthrospiraplatensis* used as bio-fertilizer to evaluate soil fertility and growth of *Coriandrumsativum*

Key Words: Bio-fertilizer, Plant growth, Soil fertility, *rthrospiraplatensis*Gomont(spirulina), *Coriandrumsativum*L.

Introduction:

Chemical fertilizers are being used in increasing high yielding varieties of crop plants. However, chemical fertilizers cause pollution of water bodies as well as ground water, besides getting stored in crop plants. Use of these chemical fertilizers cause soil erosion or decrease the soil fertility. Therefore organic farming used for raising unpolluted crops through the use of manures, biofertilizers. Biofertilizers are natural compounds that contain micro-organisms to enrich soil fertility to increase crop yield and plant growth through enhancing photosynthesis, endogenous hormones, ion uptake, nucleic acid, and protein synthesis. Microbial inoculants like bacteria, algae, and fungi can be used in biofertilizers. The biofertilizers having algae as inoculants in them are known as algal biofertilizers. Biofertilizers can be used to fix nitrogen in the soil or they are also used to grow soil micro-flora to improve soil health. *Arthrospiraplatensis* (Spirulina) is multi-cellular and filamentous cyanobacteria that achieved a significant status in the health sector, food industry and aquacultures. It develops and grows in water, can be harvested and processed easily. Spirulina is filled with chlorophyll and very high content of macro and micronutrients such as essential amino acids, proteins, lipids, vitamins, minerals and anti-oxidants. *Arthrospiraplatensis*, is a Cyanobacteria which is protein loaded substance taken as a dietary supplement. It has also been suggested as a good alternative to chemical fertilizers. The main element responsible for the plant growth is Nitrogen which is most mainly present in atmosphere (79% of total gases) but cannot be directly absorbed by the plants. Microbes present in the soil metabolize nitrogen into ammonia which is biological nitrogen fixation. Where as spirulina is quite different from others which it is not nitrogen fixing blue-green algae. Although it will produce oxygen to the bacteria and improving the productivity of the crops. In the present study, *Arthrospiraplatensis* is used as a bio-fertilizer to enhance plant growth of *Coriandrumsativum* and soil fertility. The outcome of plant growth and soil fertility was predictable and the study results indicated that there was considerable development in plant growth and soil fertility. Following are the works done on biofertilizers by Bhardwaj, D, 2014; Gehan A., 2017; Aly, and Esawy, 2008 and Soni, 20017.

Materials and Methods:

Sample Collection: Spirulina culture sample were collected from the “Ajinkya Herbals” manufacturing and processing unit present in Parner Tehsil, Ahmednagar (MH)

Experimental Setup:

The experiment was carried out in plot with equal shape and size with equal no of seed sown in it. Observation was taken on four sets of plant samples. The main plot was *A. platensis* consisted of two levels, i.e., without *A. platensis* and with *A. platensis* application.

Test 1- Soil without spirulina and cow dung

Test 2-Soil supplemented with Spirulina 25g

Test 3- Soil supplemented with cow dung 25gm

Test 4- Soil supplemented with 25gm cow dung and Spirulina 25gm

Morphological Analysis (Growth parameters):

a) **Germination Percentage:** The number of seeds germinated was calculated on 10th day.

The germination percentage was calculated by using the following formula:

Germination percentage = Number of seeds germinated x 100 / Total number of seeds sown

b) **For Shoots:** The length of the shoot of each plant in each (plot) treatment was measured on 20th day after sowing and recorded on the data sheet. Inter node distance was also recorded.

c) **For Roots:** The plants were smoothly uprooted from the pots, cleaned from soil residues and ready for measurements. The length of the root of each plant in each plot was measured on 20th day after sowing and recorded on the data sheet.

Gahlout et al.researched showsthat the effects of the extracts of different cyanobacteria on wheat and mung bean seed germination and seedling development in their studies and they detected that extracts increased the percentage of seed germination (at the end of the 3rd day, more germination percentage -70% excess-was observed than the control group) and extract has a positive effect on seedling development

Table 1: Morphological Parameters of *Coriandrumsativum* in soil

Sr.No.	Treatment	Germination date	Germination %	Shoot length (cm)	Root length (cm)
1	Test 1: Soil without cow dung and Spirulina	16/12/2022	53	13.3	4.5
2	Test 2: Soil supplemented with Spirulina	16/12/2022	86	27.2	7.1
3	Test 3- Soil supplemented with cow dung	16/12/2022	70	21	5.1
4	Test 4- Soil supplemented with cow dung + Spirulina	16/12/2022	76	24	5.9

In our present study, When all the data related to *Coriandrumsativum* seeds, on the basis of observations it is observed that test 2 spirullina application has positive effects on seed

germination (germination rate, 85%) and seedling development. It can be said that *A. platensis* accelerates the seed germination and have bio-stimulant effect in plant growth.

Conclusion: On the basis of present study analysis, among all the different variations and combinations of *A. platensis* treated plants, the effect was best observed in the plants. At the end it is concluded that *A. platensis* is a blue green algae can be useful in farming as an enhancer of plant growth. All these data shows that the bio-fertilizers containing Cyanobacterium that are natural and dissolve in nature suddenly should be chosen instead of chemical fertilizers because of their positive effects on plant growth and non-destructive properties.

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BIOLOGICALLY IMPORTANT SYNTHESIS OF 2-AMINO-3-CYANOPYRIDINE MOTIFS: AN OVERVIEW

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Abstract: -

Pyridine ring is most important heterocyclic structural moieties which is important for pharmaceutical and natural products. 2-amino-3-cyanopyridine which exhibit optical and biological activities such as anti-fungal, antimicrobial, antitumor, anti-inflammatory activities, cannabinoid receptor agonists and kinase inhibitors. This motif is a ubiquitous and important building block in the field of medicinal chemistry and drug discovery, with applications ranging from antimicrobial agents to kinase inhibitors. The article provides a comprehensive overview of the various synthetic routes and strategies employed for the construction of this motif, including traditional chemical methods and more recent advances in catalysis and green chemistry. The most general route for the synthesis of 2-amino-3-cyanopyridine derivatives using multicomponent reaction (MCR) of ketone, aldehyde, malononitrile, and ammonium acetate. 2-amino-3-cyanopyridine is a nitrogen containing heterocyclic compounds which is important in coordination chemistry, organocatalysis, supramolecular structure, polymers and electrical materials.

Introduction:

Multi-component reactions (MCRs), is a chemical reaction where three or more compounds react to form a single product [1]. The MCRs is the most efficient tools in organic chemistry, such as ideal synthesis: bond making or bond breaking in one step with high atom economy, quick and simple implementation, time and energy saving, environment-friendly and diversity-oriented synthesis [2]. The MCRs are intramolecular cycloaddition reactions, Knoevenagel condensations, metathesis reactions, aza-Wittig reactions, Mitsunobu reaction [3].

Heterocyclic compounds are organic compounds containing at least one atom of carbon and at least one element other than carbon, such as Sulphur (S), Oxygen (O), or Nitrogen (N) within a ring structure. The best known of the simple heterocyclic compounds are pyridine, pyrrole, furan, and thiophene [4]. Nitrogen containing heterocyclic compounds that are broadly distributed in nature, possess physiological and pharmacological properties and are important of many biologically molecules, like many vitamins, nucleic acids, pharmaceuticals, antibiotics, dyes and agrochemicals, and many others [5-9]. The DNA and RNA (guanine, cytosine, adenine, and thymine) are also made up of N-heterocyclic compounds, via purines, pyrimidines etc. This nitrogen containing heterocyclic compounds are many more important of organic, medicinal and pharmaceutical industry [10-12].

The pyridine is nitrogen containing heterocycles which is found in natural products, pharmaceuticals, and functional materials [13-16]. The pyridine containing derivatives also used in various intermediates in organic synthesis to create more complex nitrogen containing heterocycles. 2-Amino-3-cyanopyridine is an important heterocyclic compound that has a wide range of applications in medicinal and agricultural chemistry. The synthesis of this compound has attracted significant attention from synthetic chemists due to its potential pharmaceutical and agrochemical applications. In this connection, 2-amino-3-cyanopyridine derivative core possesses antiviral, antibacterial, and fungicidal activities [17-20], and also

reported as novel IKK- β inhibitors [21], A_{2A} adenosine receptor [22], and potent inhibitor of HIV-1 integrase [23]. The derivatives of 2-amino-3-cyanopyridine are act as reactant as well as useful intermediates in the synthesis of heterocyclic compounds [24-26].

2-Amino-3-cyanopyridine (ACP) is a heterocyclic compound that belongs to the pyridine family. ACP has been found to have a number of biological activities, including antimicrobial, antifungal, and anticancer properties. One study investigated the antimicrobial activity of ACP against a variety of pathogenic bacteria, including *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, and *Klebsiella pneumoniae*. The study found that ACP exhibited strong antimicrobial activity against all of the tested strains, suggesting its potential as a broad-spectrum antimicrobial agent (Kumar et al., 2016). (Kumar, V., Nair, A. K., Sharma, P., & Gupta, Y. K. (2016). Antimicrobial activity of 2-amino-3-cyanopyridine derivatives. *Medicinal Chemistry Research*, 25(2), 339-347.)

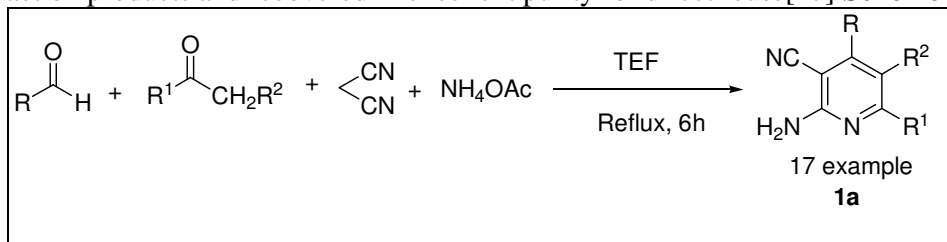
Another study investigated the antifungal activity of ACP against the opportunistic fungal pathogen *Candida albicans*. The study found that ACP was able to inhibit the growth of *C. albicans* in vitro, suggesting its potential as a therapeutic agent for fungal infections (Wang et al., 2018). (Wang, X., Zhang, J., Yan, S., Shen, Q., & Xu, G. (2018). Synthesis and antifungal activity of 2-amino-3-cyanopyridine derivatives. *Journal of Chemistry*, 2018.)

In addition to its antimicrobial and antifungal properties, ACP has also been shown to have anticancer activity. One study investigated the effect of ACP on the proliferation of human lung cancer cells. The study found that ACP was able to inhibit the growth of lung cancer cells in vitro by inducing apoptosis (programmed cell death) (Ma et al., 2015). (Ma, Y., Cui, Y., Du, J., & Zhu, Q. (2015). 2-Amino-3-cyanopyridine induces apoptosis and G2/M arrest in human lung cancer A549 cells. *Journal of Cancer Research and Therapeutics*, 11(2), 376.)

Overall, these studies suggest that ACP has potential as a therapeutic agent for a range of infectious diseases and cancers. However, further studies are needed to fully elucidate its mechanisms of action and potential clinical applications. In this review, we summarize the various synthetic methods reported in the literature for the preparation of 2-Amino-3-cyanopyridine. This review article is mainly focused on some important methods and different catalytic materials in the synthesis of 2-amino-3-cyanopyridine derivatives.

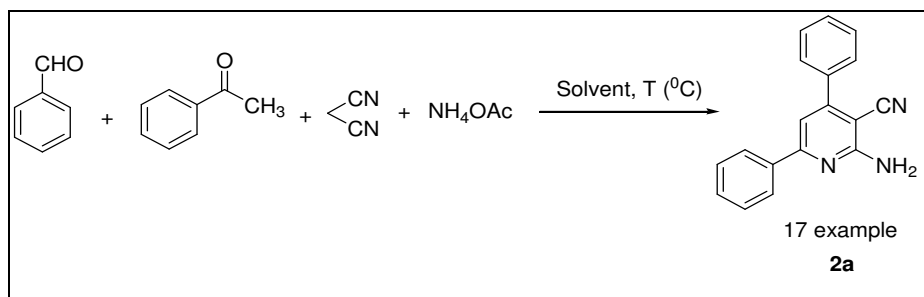
Synthesis of 2-amino-3-cyanopyridine

There are several methods of synthesis of 2-amino-3-cyanopyridine. The 2-amino-3-cyanopyridine **1a** synthesized by various method such as aldehydes, ketones, malononitrile and ammonium acetate in presence of 2,2,2-trifluoroethanol (TFE) as solvent in refluxed condition with 80-95 % yields for 6 h. In this method TFE act as solvent as well as catalyst for the reaction. In this reaction of TFE act as Bronsted acid, the reaction mechanism enamine formed from ketone and ammonium acetate. They are activated by TEF. The alkylidene and malononitrile to give intermediate by cycloaddition, further isomerization and aromatization gives the final product. The merit of this method is the solvent (TEF) can be readily separated from reaction products and recovered in excellent purity for direct reuse [27] **Scheme 1**.



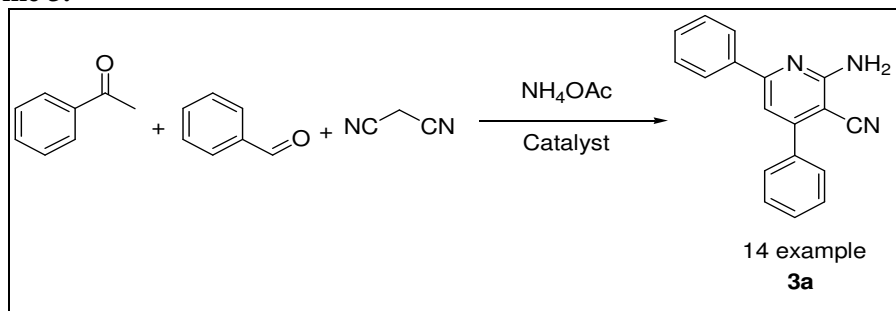
Scheme 1

Four component synthesis of 2-amino-3-cyanopyridine reaction **2a** between ketone, aldehyde, malononitrile, and ammonium acetate in the presence of 2 mol% copper nanoparticle on charcoal (Cu/C) catalyst. Then refluxed in acetonitrile gives 83-94 % yields within the 6-8 h. In this method catalyst can be synthesized in two steps. The activated carbon was refluxed with a nitric acid solution for 6 h, washed with deionized water until pH 6-7. Then dried in an oven at 110 °C overnight under vacuum. The oxidized activated carbon was refluxed with a solution of CuI under N₂ atmosphere in absolute ethanol for 4 h. It is then washed with ethanol, and finally dried under vacuum in an oven overnight at 110 °C to form Cu/C nanocatalyst. This method is applicable to large-scale operation without any problem. The catalyst can be reused at least eight times with almost consistent activity [28] **Scheme 2**. The multicomponent synthesis of 2-aminocynopyridines offers a highly efficient, environmentally friendly, and versatile synthetic approach to prepare complex molecules with a high degree of diversity.



Scheme 2

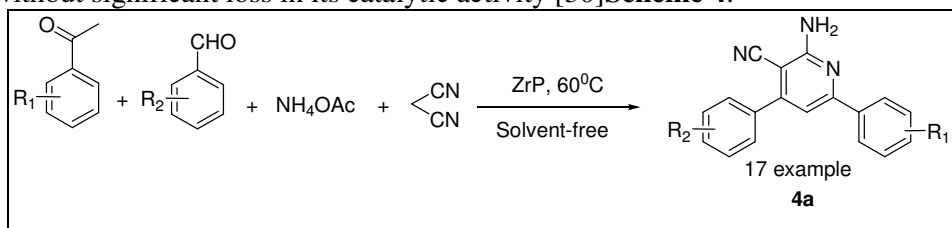
Furthermore the synthesis of 2-amino-3-cyanopyridine derivatives **3a** were done via reaction of aromatic aldehyde, acetophenone derivatives, malononitrile and ammonium acetate in the presence of Cu(OAc)₂ under reflux in ethanol 85-97 % yields for 2-4 h. Mirjalilet *al* shows compound 2-amino-6-(4-chlorophenyl)-4-phenylnicotinonitrile had the best antimicrobial efficacy toward *C. albicans*, *E. Faecalis*, *P. aeruginosa* and *E. coli*. In final conclusion, comparing the structure and activity, this compounds with the presence of Cl residue at para-position of phenyl ring improve the antimicrobial and antifungal activity. In these methods the presence of Cu(OAc)₂ as a highly effective heterogenous acid catalyst [29] **Scheme 3**.



Scheme 3

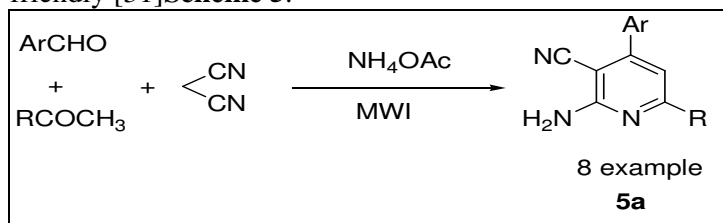
Hirbod *et al* described one-pot synthesis of 2-amino-3-cyanopyridine **4a** for aldehyde, ketone, malononitrile, ammonium acetate solvent-free in presence of α -zirconium phosphate (ZrP) nanoparticles catalyst at 60°C room temperature with 80-95 % yields for 20-90 min. ZrP nanoparticle was synthesized by using 2% solution of PEG-200 prepared by dissolving PEG in deionized water. By adding HCl, the pH value was adjusted. About 3.50 mL of a 1 M solution of ZrOCl₂.8H₂O added dropwise to precursor solution. It is then heated at 50°C for 1

h with constant stirring using a magnetic stirrer. To the resulting homogenous solution, dropwise addition of 50 mL of a 2 M H₃PO₄ solution at 50-60 °C for 1 h. The resulting mixture under ultrasonication kept for 30 min, and dried in an oven at 80 °C overnight. Finally it was calcined at 600 °C for 3h to decompose the organic matrix. The obtained product is pure α-hexagonal zirconium phosphate (ZrP) nanoparticle. The catalyst was characterized by several physicochemical technique such as ICP-OES, XRD, TPD-NH₃, pyridine-FTIR, BET, FTIR, TGA, SEM. The catalyst was recovered and reused at least eight times without significant loss in its catalytic activity [30] **Scheme 4**.



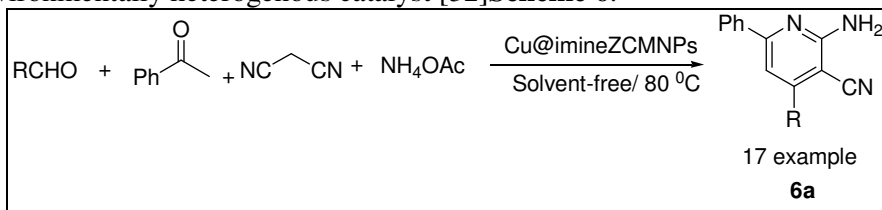
Scheme 4

A series of 2-amino-3-cyanopyridine **5a** derivatives have been prepared by one-pot condensation from malononitrile, aromatic aldehyde, methyl ketone and ammonium acetate under microwave irradiation without solvent with 72-86 % yields for 7-9 min. The main advantages of in this reaction is short routine, good yields, convenient workup and being environmentally friendly [31] **Scheme 5**.



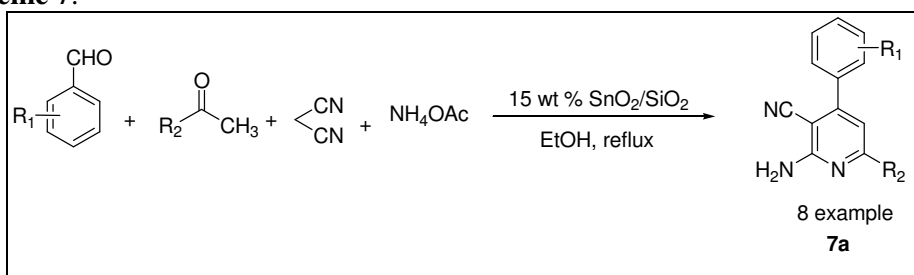
Scheme 5

Further synthesis of 2-amino-3-cyanopyridine derivatives **6a** one-pot four-component reaction of various types of aldehydes, acetophenone, malononitrile, and ammonium acetate solvent-free in the presence of 10 mg Cu@imineZCMNPs catalyst with 85-96 % yields for 12-25 min. The synthesis of Cu@imineZCMNPs catalyst by using two grams of imineZCMNPs was suspended in 20 mL of CH₂Cl₂. Thereafter, CuCl₂ (0.25 mmol) was added to CH₂Cl₂ (10 mL), and the reaction mixture was stirred for 24 h under argon atmosphere. After 24 h, the resultant precipitate formed was separated by filtration, and the product was washed with water to remove unreacted metal precursors to give Cu@imineZCMNPs catalyst. These catalytic systems were characterized by FT-IR, EDS, TGA, XRD, TEM, SEM and VSM. Due to the magnetic nature of catalyst, it can be easily recovered by an external magnetic field and comfortable reused Cu@imineZCMNPs as a novel, environmentally heterogenous catalyst [32] **Scheme 6**.



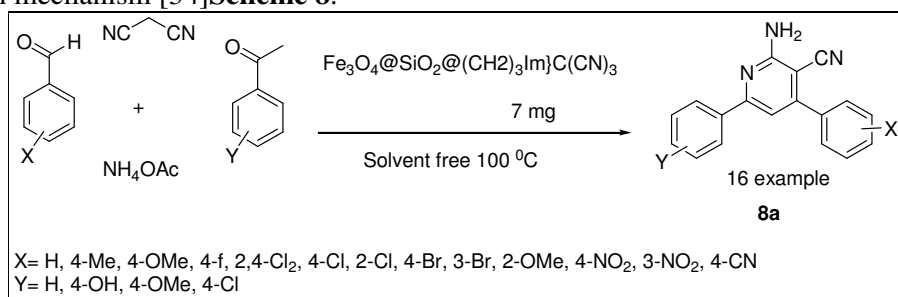
Scheme 6

Another method gives an efficient and rapid protocol for the synthesis of 2-amino-3-cyanopyridine **7a** by the cyclocondensation reaction of aromatic aldehyde, methyl ketones, malononitrile and ammonium acetate catalyzed by SnO₂/SiO₂ nanocomposite materials at refluxed condition in ethanol 82-91 % yields for 4-5 h. Here the SnO₂/SiO₂ nanocomposite synthesized by Sol-gel method by using 0.846.g.of Tin(IV) chloride dissolved in 20 mL double-distilled water and tetraethyl orthosilicate solution (2.408 g) was added drop-wise in an autoclave bottle. The drop-wise addition of 1% cetyltrimethylammonium bromide (CTAB) in 20 mL ethanol with constant stirring. The pH 10 was maintained by adding aqueous ammonia. Mixture was then hydrothermally treated at 60 °C for 12 h in an autoclavable bottle. It was then filtered, washed with DW and dried 110 °C for 7 h in an oven. The obtained powder was calcined at 400 °C for 2h to form SnO₂/SiO₂ nanocomposite materials. These nanocomposite materials were characterized by using XRD, TEM, SEM, EDS, FT-IR, BET and NH₃-TPD. Advantages of the present method includes a simple work-up procedure, high yields of the products and catalyst can be reused at least three-time [33] **Scheme 7**.



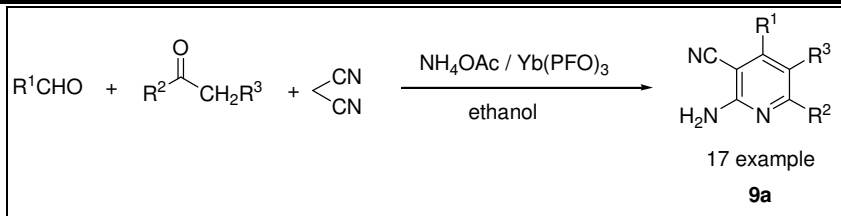
Scheme 7

Zolfigol *et al* can be explained the synthesis of 2-amino-4,6-diphenylnicotinonitrile by using Fe₃O₄@SiO₂@(CH₂)₃Im}C(CN)₃ as a nanostructured catalyst with an ionic liquid tag under solvent free and benign conditions. Aromatic aldehydes were condensed with acetophenone derivatives, malononitrile and ammonium acetate to afford their corresponding products in short reaction times 25-60 min. and good to high 80-90 % yields. In this reaction ionic liquid Fe₃O₄@SiO₂@(CH₂)₃Im}C(CN)₃ was added as a heterogenous core-shell catalyst. This material was preserved after nine runs without any loss of its initial activity in the yield and the reaction time. 2-amino-3-cyanopyridine mechanism and theoretical studied confirmed that the final step of the synthetic pathway is proceeded via an anomeric based oxidation mechanism [34] **Scheme 8**.



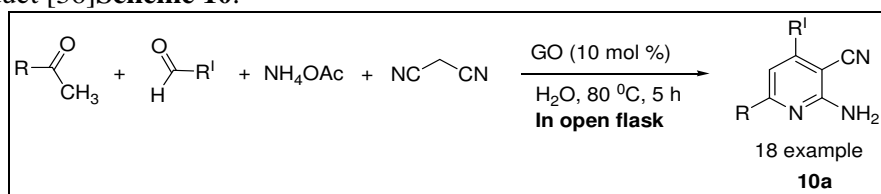
Scheme 8

2-amino-3-cyanopyridines **9a** are synthesized from aldehydes, ketones, malononitrile, and ammonium acetate in ethanol at refluxing temperature for 4 h *via* one-pot reaction catalyzed by ytterbium perfluorooctanoate [Yb(PFO)₃]. In this reaction shows the seventeen derivatives. The two derivatives formation is trace amount and fifteen derivatives up to the 60-95 % yields of final product. This method tolerates most of the substrates. The catalyst can be recycled and reused at least three times without significant loss of activity [35] **Scheme 9**.



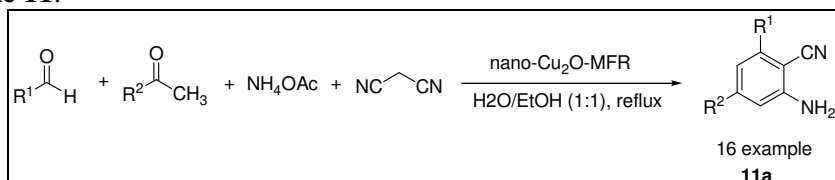
Scheme 9

A one-pot synthesis of 2-amino-3-cyanopyridine **10a** derivatives has been demonstrated through the multicomponent reaction of aldehydes, ketone, malononitrile and ammonium acetate using graphene oxide as a heterogenous catalyst in water as a green medium in open flask with 75-97 % yields for 5 h. Graphene oxide (GO) was synthesized by the oxidation of graphite powder using modified Hummers methods, followed by exfoliation in an aqueous solution. The prepared GO was characterized using XRD, TGA, FT-IR, UV/Vis, Raman spectroscopy and AFM study. In this reaction total eighteen derivatives of final product [36] **Scheme 10**.



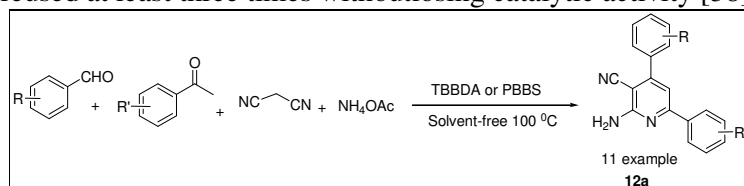
Scheme 10

Four-component synthesis of 2-amino-3-cyanopyridine **11a** derivatives of different aldehydes, ketones, malononitrile, and ammonium acetate in refluxing H₂O/EtOH (1:1) in the presence of doped nano-sized Cu₂O-MFR as a highly efficient heterogenous catalyst to form final product. In this reaction shows sixteen different derivatives with 74-94 % yields for 1-2 h. Melamine-formaldehyde resin (MFR) has a unique chemical structure which makes it a suitable and useful solid support for absorbing metal salts like nano-sized Cu₂O on melamine-formaldehyde resin (nano-Cu₂O-MFR) as a novel and highly efficient heterogenous catalyst they can be reused at least seven times without loss of catalytic activity [37] **Scheme 11**.



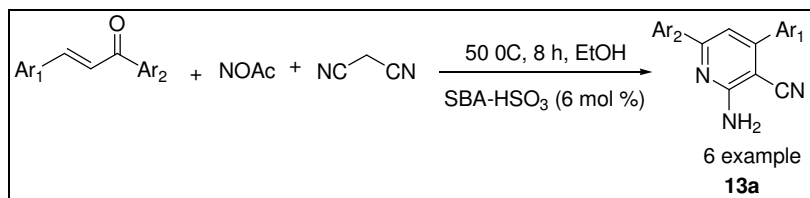
Scheme 11

A series of 2-amino-3-cyanopyridines were obtained from aryl aldehydes, substituted acetophenones, malononitrile and ammonium acetate and utilizing N,N'-NO, NO-tetrabromobenzene-1,3-disulfonamide [TBBDA] and poly(N-bromo-N-ethylbenzene-1,3-disulfonamide) [PBBS] as catalysts to form desired product under solvent free condition. In this reaction eleven derivatives with 85-94 % yields for the 5-40 min were synthesized. The catalyst can be reused at least three times without losing catalytic activity [38] **Scheme 12**.



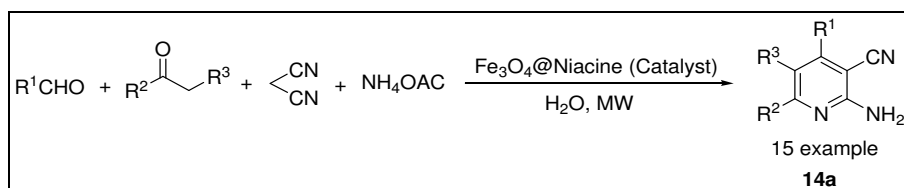
Scheme 12

Condensation reaction of chalcones with malononitrile and ammonium acetate, ethanol as a solvent in the presence of green nano-modified SBA-15 affords the corresponding 2-amino-3-cyanopyridine **13a** in six derivatives with 86-91% yields for 8 h. In a typical synthesis of nano-modified SBA-15 first prepared in mesoporous silica materials. Then add 1 g produced SBA-15 with chlorodiphenylphosphine and 1,4-butane sultone in dry toluene refluxed for 36 h. The obtained solid was treated with 0.5 mL of H₂SO₄ and CH₂Cl₂ for 24 h. After evaporation of solvent, solid nano acid catalyst SBA-HSO₃ was obtained. These prepared catalytic materials were characterized by using FT-IR, XRD, SEM and TEM advantages such as excellent yields and cleaner reaction [39] **Scheme 13**.



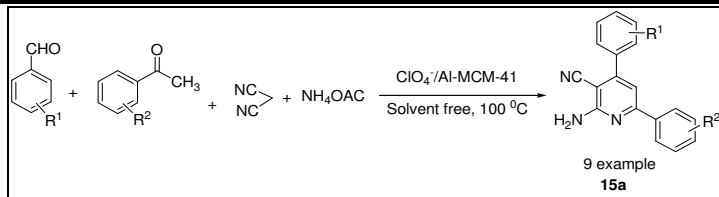
Scheme 13

Superparamagnetic nanoparticles of modified vitamin B₃ (Fe₃O₄@Niacin) represent a new efficient for the one-pot synthesis of 2-amino-3-cyanopyridine derivatives **14a** via four component condensation reaction between aldehyde, ketones, malononitrile and ammonium acetate under microwave irradiation in water with 85-95% yields for 7-10 min. Here nanoparticle was synthesized by using co-precipitation method. In the first, Fe₃O₄ nanoparticle synthesized in (FeCl₃.6H₂O.4H₂O) precursor in ammonia medium and then nicotinic acid coated on magnetic nanoparticles to form (Fe₃O₄@Niacin) green biocatalyst. The prepared catalyst was fully characterized FT-IR, XRD, SEM, VSM, UV-Vis, DLS and EDS. The recovered catalyst was reused for six consecutive cycles without any significant loss in catalytic activity. The main advantages is short reaction times, excellent yields, green methodology, which makes it more economic than the other conventional method [40] **Scheme 14**.



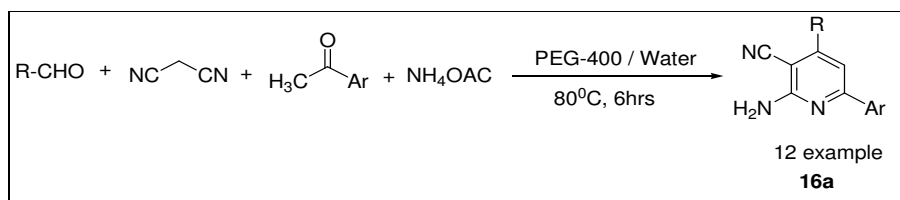
Scheme 14

A one-pot four component reaction of substituted aldehydes, acetophenone, malononitrile, and ammonium acetate in presence of perchlorated Al-MCM-41 (ClO₄⁻/Al-MCM-41) nanoparticles for the synthesis of 2-amino-3-cyanopyridines **15a** solvent-free with 72-82% yields for 15-30 min. This catalytic material was synthesized by using sol-gel method. Firstly, prepared Al-MCM-41 catalyst for ratio of Si/Al source then add perchloric acid and dried to form (ClO₄⁻/Al-MCM-41) nanoparticles. This material was calcined 250, 300, 350 and 400 °C in different temperature. The best catalytic activity was found in 300 °C for the synthesis of 2-amino-3-cyanopyridine. The catalyst were characterized by using SEM, TEM, XRD and FT-IR potentiometric titration, pyridine adsorption and nitrogen adsorption-desorption. Advantages in this reaction catalyst can be reused four time, high yields, non-toxic, short reaction time [41] **Scheme 15**.



Scheme 15

A series of 2-amino-3-cyanopyridines **16a** are synthesized by condensation reaction of benzaldehyde, malononitrile, acetophenone and ammonium acetate were dissolved in 30% polyethylene glycol in water for 6 h with 75-85% yields. The merit of this method is green protocols such as multicomponent reaction with high yields and mild reaction condition. PEG-400 as a phase transfer catalyst they can be reused at least four times without loss in catalytic activity [42]**Scheme 16**.



Scheme 16

Conclusions

In conclusion, the synthesis of 2-Amino-3-cyanopyridine has been demonstrated using various synthetic methods, with the multicomponent reaction being the most efficient and versatile method for the preparation of this compound. Microwave-assisted synthesis has also been shown to be an effective method for the preparation of 2-Amino-3-cyanopyridine with high yields and shorter reaction times. Recent advances in metal-catalyzed reactions have also provided access to a wide range of derivatives of this important heterocyclic compound. Continued research in this area is warranted, as the synthesis of 2-Amino-3-cyanopyridine has important implications for the development of new drugs and agrochemicals.

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INTRA-REGULAR Γ -SEMIHYPERRINGS

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Abstract.

In this paper we introduced the notion of intra-regular Γ -Semihyperring we give several characterizations of intra-regular Γ -Semihyperring with the help of ideals, bi-ideals and quasi-ideals of Γ -Semihyperrings.

Keywords: Quasi-ideal, Bi-ideal, Regular Γ -Semihyperring.

1 Introduction

The notion of hypergroup was introduced by Marty [2] in 1934. After that, many authors studied algebraic hyperstructure which are generalization of classical algebraic structure. In classical algebraic structure, the composition of two elements is an element, while in an algebraic hyperstructure composition of two elements is a set. In 2003, Corsini and Leoreanu [1] have given application of theory of hyperstructures in various subjects like: geometry, cryptography, artificial intelligence, relation algebras, automata, median algebras, relation algebras, fuzzy sets and codes. If we let H be a non-empty set. Then, the map $\circ : H \times H \rightarrow P^*(H)$ is called a hyperoperation, where $P^*(H)$ is the family of all non-empty subsets of H and the couple (H, \circ) is called a hypergroupoid. Moreover, the couple (H, \circ) is called a semihypergroup if for every $a, b, c \in H$ we have, $(aob)\circ c = ac(boc)$.

As theory of hyperstructure has vast application in various fields of sciences so it is essential to study the concepts of classical algebraic structure in hyperstructure theory. In [3] Jagatap and Pawar introduced intra-regular Γ -Semiring and made its characterizations with the help of ideals, bi-ideals and quasi-ideals of Γ -Semirings. Here we have introduced the concept of intra-regular Γ -Semihyperring and made its characterizations with the help of ideals, bi-ideals and quasi-ideals of Γ -Semihyperrings analogues to Jagatap and Pawar cite[3].

Here are some useful definitions and the readers are requested to refer [7].

Definition 1.1: Let R be a commutative semihypergroup and Γ be a commutative group. Then, R is called a Γ -semihyperring if there is a map $R \times \Gamma \times R \rightarrow P^*(R)$ (images to be denoted by $a\alpha b$, for all $a, b \in R$ and $\alpha \in \Gamma$) and $P^*(R)$ is the set of all non-empty subsets of R satisfying the following conditions:

- (1) $a\alpha(b + c) = a\alpha b + a\alpha c$.
- (2) $(a + b)\alpha c = a\alpha c + b\alpha c$.
- (3) $a(\alpha + \beta)c = a\alpha c + a\beta c$.
- (4) $a\alpha(b\beta c) = (a\alpha b)\beta c$, for all $a, b, c \in R$ and for all $\alpha, \beta \in \Gamma$.

Definition 1.2: A Γ -semihyperring R is said to be commutative if $a\alpha b = b\alpha a$ for all $a, b \in R$ and $\alpha \in \Gamma$.

Definition 1.3: A Γ -semihyperring R is said to be with zero, if there exists $0 \in R$ such that $a \in a + 0$ and $0 \in 0\alpha a, 0 \in a\alpha 0$ for all $a \in R$ and $\alpha \in \Gamma$.

Let A and B be two non-empty subsets of a Γ -semihyperring R and $x \in R$, then

$$A + B = \{x | x \in a + b, a \in A, b \in B\}$$

$$A\Gamma B = \{x | x \in a\alpha b, a \in A, b \in B, \alpha \in \Gamma\}$$

Definition 1.4: A non-empty subset R_1 of Γ -semihyperring R is called a Γ -subsemihyperring if it is closed with respect to the multiplication and addition, that is, $R_1 + R_1 \subseteq R_1$ and $R_1\Gamma R_1 \subseteq R_1$.

Definition 1.5: A right (left) ideal I of a Γ -semihyperring R is an additive sub semihypergroup of $(R, +)$ such that $I\Gamma R \subseteq I$ ($R\Gamma I \subseteq I$). If I is both right and left ideal of R , then we say that I is a two sided ideal or simply an ideal of R .

Definition 1.6[5]: A non-empty set B of Γ -semihyperring R is a bi-ideal of R if B is a Γ -subsemihyperring of R and $B\Gamma R\Gamma B \subseteq B$.

Definition 1.7[4]: A subsemihypergroup Q of $(R, +)$ is said to be a quasi-ideal of Γ -semihyperring R if $(R\Gamma Q) \cap (Q\Gamma R) \subseteq Q$.

Definition 1.7[6]: An element e of Γ -semihyperring R is said to be a left (right) identity of R if $r \in e\alpha r$ ($r \in r\alpha e$) for all, $r \in R$ and $\alpha \in \Gamma$.

An element e of Γ -semihyperring R is said to be a two sided identity or simply an identity if e is both left and right identity, that is $r \in e\alpha r \cap r\alpha e$ for all $r \in R$ and $\alpha \in \Gamma$

Theorem 1.8[5]: Every quasi-ideal of a Γ -Semihyperring R is a bi-ideal of R .

Theorem 1.9[5]: Every one sided (two sided) ideal of a Γ -Semihyperring R is a bi-ideal of R .

Theorem 1.10[4]: Every one sided (two sided) ideal of a Γ -Semihyperring R is a quasi-ideal of R .

2 Intra-regular Γ -Semihyperring

In this section we introduced the concept of intra-regular Γ -Semihyperring and made it's characterization with the help of ideals, bi-ideals and quasi-ideals of Γ -Semihyperring on the line of Jagatap and Pawar[3].

Definition 2.1: A Γ -Semihyperring S is said to be an intra-regular Γ -Semihyperring if for any $x \in S$, $x \in S\Gamma x\Gamma x\Gamma S$.

Theorem 2.2: Let S be a Γ -Semihyperring with an identity element. Then S is intra-regular if and only if each right ideal R left ideal L of S satisfies $R \cap L \subseteq L\Gamma R$.

Proof. Let S be an intra-regular Γ -Semihyperring with an identity element and $a \in R \cap L$. As S is an intra-regular, $a \in S\Gamma a\Gamma a\Gamma S$. Now, $S\Gamma a\Gamma a\Gamma S = (S\Gamma a)\Gamma(a\Gamma S) \subseteq (S\Gamma L)\Gamma(R\Gamma S) \subseteq L\Gamma R$. Therefore $R \cap L \subseteq L\Gamma R$.

Conversely, for any $a \in S$ we have $S\Gamma a$ is left ideal containing a and $a\Gamma S$ is right ideal containing a . By assumption $a \in a\Gamma S \cap S\Gamma a \subseteq S\Gamma a\Gamma a\Gamma S$. Therefore S is an intra-regular Γ -Semihyperring.

Theorem 2.3: In Γ -Semihyperring S with an identity element following statements are equivalent.

1. S is an intra-regular.
2. For bi-ideals B_1 and B_2 of S , $B_1 \cap B_2 \subseteq S\Gamma B_1\Gamma B_2\Gamma S$.

3. For every bi-ideal B and a quasi-ideal Q of S , $B \cap Q \subseteq (S\Gamma Q\Gamma B\Gamma S) \cap (S\Gamma B\Gamma Q\Gamma S)$.
4. For every quasi-ideal Q_1 and Q_2 of S , $Q_1 \cap Q_2 \subseteq S\Gamma Q_1\Gamma Q_2\Gamma S$.

Proof. (1) \Rightarrow (2) Suppose that S is an intra-regular Γ -Semihyperring. Let B_1 and B_2 be bi-ideals of S . Let $a \in B_1 \cap B_2$. As S is an intra-regular, $a \in S\Gamma a\Gamma a\Gamma S \subseteq S\Gamma B_1\Gamma B_2\Gamma S$. Therefore $B_1 \cap B_2 \subseteq S\Gamma B_1\Gamma B_2\Gamma S$.

(2) \Rightarrow (3), (3) \Rightarrow (4) Implication follow as every quasi-ideal is a bi-ideal By **Theorem 1.8**.

(4) \Rightarrow (1) Let L be a left ideal and R be a right ideal of S . Then R and L both are quasi-ideals of S By **Theorem 1.10**. By (4), $R \cap L \subseteq S\Gamma L\Gamma R\Gamma S = (S\Gamma L)\Gamma(R\Gamma S) \subseteq L\Gamma R$. Therefore we get, $R \cap L \subseteq L\Gamma R$. Thus By **Theorem 2.2**, S is an intra-regular.

Theorem 2.4: In Γ -Semihyperring S with an identity element following statements are equivalent.

1. S is an intra-regular.
2. For a left ideal L and bi-ideals B of S , $L \cap B \subseteq L\Gamma B\Gamma S$.
3. For a left ideal L and quasi-ideal Q of S , $L \cap Q \subseteq L\Gamma Q\Gamma S$.
4. For a right ideal R and bi-ideal B of S , $R \cap B \subseteq S\Gamma B\Gamma R$.
5. For a right ideal R and quasi-ideal Q of S , $R \cap Q \subseteq S\Gamma Q\Gamma R$.

Proof. (1) \Rightarrow (2) Suppose that S is an intra-regular. Let L be a left ideal and B be a bi-ideal of S . Let $a \in B \cap L$. As S is an intra-regular, $a \in S\Gamma a\Gamma a\Gamma S \subseteq S\Gamma L\Gamma B\Gamma S \subseteq L\Gamma B\Gamma S$. Hence $B \cap L \subseteq L\Gamma B\Gamma S$.

(2) \Rightarrow (3), (4) \Rightarrow (5) Implication follow as every quasi-ideal is a bi-ideal By **Theorem 1.8**.

(1) \Rightarrow (4) Suppose that S is an intra-regular. Let R be a right ideal and B be a bi-ideal of S . Let $a \in B \cap R$. As S is an intra-regular, $a \in S\Gamma a\Gamma a\Gamma S \subseteq S\Gamma B\Gamma R\Gamma S \subseteq S\Gamma B\Gamma R$. Hence $B \cap R \subseteq S\Gamma B\Gamma R$.

(5) \rightarrow (1) Let L be a left ideal and R be a right ideal of S . Then L both is a quasi-ideals of S by **Theorem 10.10**. By (5), $R \cap L \subseteq S\Gamma L\Gamma R \subseteq L\Gamma R$. Therefore we get, $R \cap L \subseteq L\Gamma R$. Thus by **Theorem 2.2**, S is an intra-regular.

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GREEN SYNTHESIS , CHARACTERIZATION AND ANTIMICROBIAL ACTIVITY OF COPPER NANOPARTICLES USING SYZYGIUM CUMINI PLANT LEAF EXTRACT

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Abstract:

In the present work, copper nanoparticles have been synthesized by green method, using *Syzygium cumini* plant leaf extract as reducing agent. The biosynthesized CuNPs were characterized using UV-Vis analysis, X-ray diffraction analysis (XRD) and Transmission Electron Microscopy (TEM) analysis. TEM image shows that the synthesized CuNPs were spherical in shape with a mean diameter of 4.68 nm. The electrochemical activity of copper nanoparticles was studied by cyclic voltammetry. The CuNPs showed excellent catalytic activity in the reductive degradation of indigo carmine and methyl red dye. These biologically synthesized copper nanoparticles were tested for antimicrobial activity against human pathogens viz. *Bacillus subtilis* and *E-coli*. These biologically synthesized copper nanoparticles were found to be effective in controlling growth of human pathogens viz., *Bacillus subtilis* and *E-coli*.

Keywords: Green Synthesis, Nanoparticles, *Syzygium cumini*, SEM, XRD, EDAX, FTIR, UV-Vis, *Bacillus subtilis* and *E-coli*.

1. Introduction:

Nanotechnology is one of the powerful technologies and it is being applied in all fields, because of their small size (10^{-9} nm) and large surface area. Nanoparticles offer a larger surface-to-volume ratio than the corresponding bulk materials. The unique physical and chemical properties of nanoparticles as compared to that of bulk material [1] are due to a strong interplay between elastic, geometric, and electronic parameters. Nanoparticles are prepared in many ways such as physical, chemical and green method. Green synthesis method was found to be the best method when compared to the other methods such as chemical reduction, photochemical reduction, electrochemical reduction, heat evaporation etc.[2]. Biological synthesis is one of the bottom up approach for synthesis of metal nanoparticles. In this approach the microorganism, plants and animal source are used as reducing agent [3-6]. The advantages of green synthesis over other methods are low cost, simplicity, use of less temperature, the usage of less toxic materials, moreover it is compatible for medical and food applications [7]. Many researchers used green synthesis methods for different metal nanoparticles due to their growing need of eco-friendly processes. Copper nanoparticle is one of the commonly used material for their electrical, optical, catalytic, biomedical and antibacterial applications among various metal particles such as gold, silver, iron, palladium, zinc and quantum dots[8]. It can give more yields in mild reaction conditions when compared to other traditional catalysts.

Green chemistry focuses on the production of desired products without generation of hazardous intermediate byproducts in chemical reaction processes. Integrating green chemistry principles into nanotechnology has led to the identification of environmentally

friendly reagents that are multifunctional, in that they can serve as a reducing agent as well as a capping agent [9]. Synthesis of nanoparticles (NPs) can be performed using a number of routinely used chemical and physical methods. Plants and their related materials for production of nanomaterials are not only ecofriendly alternatives, but they are also cost effective. Synthesis of copper oxide (CuO) nanoparticles has been performed using extracts of soybeans, gum karaya, bark extract, leaf extract, fruit, tea and coffee powder, peel extract and flower extract [10].

Development in large-scale production for both metallic and nonmetallic nanoparticles has introduced risk to the environment and human health. Improper disposal of nanomaterial waste by labs as well as industry is an alarming threat to the ecosystem as well as aquatic life. With this perspective, researchers are focusing on the green synthesis of nanomaterials. The aim is to protect the environment and human health from toxic impacts of nanomaterials and their derived complex compounds and at the same time safely utilize nanomaterials. Environmental and biological risks for copper nanoparticles have been investigated by many researchers. However, the toxicity of nanosized and bulk CuO metal oxide nanoparticles to bacteria [11], yeast, green algae, crustaceans *Daphnia magna* and *Thamnocephalus platyurus* and isopods are well documented. Researchers have also found toxic and inhibiting growth impacts to terrestrial plants caused by CuO metal oxide nanoparticles [12]. The lethal effect of CuO nanoparticles on aquatic organisms has been verified by several studies, which include zebrafish (*Danio rerio*), sea anemones (*Exaiptasia pallida*), fresh water shredders, blue mussels (*Mytilus edulis*) and goldfish [13]. Cytotoxicity and genotoxicity of CuO nanoparticles have been investigated in humans as well as in animals. Finally, CuO nanoparticles have been determined more toxic to human cells with their ability to damage DNA than bulk micrometer particles [14].

Green synthesis of CuNPs using nontoxic and inexpensive materials like curd, milk, and herbal extracts such as tamarind and lemon juice as capping agents was reported by Sastry et al., [15]. CuNPs have attracted much attention of researchers due to its application in wound dressings and biocidal properties [16]. Due to these properties CuNPs are used in processes such as gas sensors, catalytic process, high temperature superconductors and solar cells [17]. In this study CuNPs have been synthesized using leaves extract of *Syzygium cumini* as a reducing agent.

2. Experimental Methods:

2.1 Materials:

In the present work all the chemicals used are of analytical grade and were obtained from E-Merck chemicals. Whatman no.1 filter papers are used for filtration purpose. Double distilled water was used for dilution purpose. All glassware were washed well, rinsed with double distilled water and dried in hot air oven before starting the experiment.

2.2 Preparation of *Syzygium cumini* Leaves Extract:

The leaves of *Syzygium cumini* was collected and the fresh leaves were washed well with double distilled water and cut into small pieces. About 5 grams of cut leaves were weighed and transferred into 250 mL beaker containing 100 mL of water. This was boiled for about 20 minutes and the extract was filtered through whatman filter paper. The filtrate was collected and stored in refrigerator for further purpose.

2.3 Biosynthesis of Copper Nanoparticle:

The 5 mL of *Syzygium cumini* leaves extract and 10 mL of 1 mM CuSO₄ solution were taken in a 100 mL beaker and the total volume was made upto 25 mL using double distilled water. The solution was kept in a heating magnetic stirrer heated at 70 °C for 20

minutes. After 20 minutes the colour changed from light colour to dark brown colour which indicated the formation of CuNPs.

2.4 Characterization:

The UV-Vis spectral studies of CuNPs was monitored on a JASCO V-600 spectrophotometer. TEM analysis was performed by using a PHILIPS CM 200 instrument operated at operating voltages 200 kV, resolution 2.4 Å. Shimadzu (IR Tracer-100) instrument was used for recording FT-IR spectra. Electro-catalytic activity was studied in the electrochemical analyzer, CH Instruments, Electrochemical workstation model 660C.

3. Results and Discussion:

3.1 UV-Vis Spectra:

UV-Vis spectrum of CuNPs is shown in Fig. 1. The peak observed at 301 nm indicates the formation of CuNPs [18, 19]. The peak is also intense which shows that the particles are small in size and are easily dispersed in the solvent.

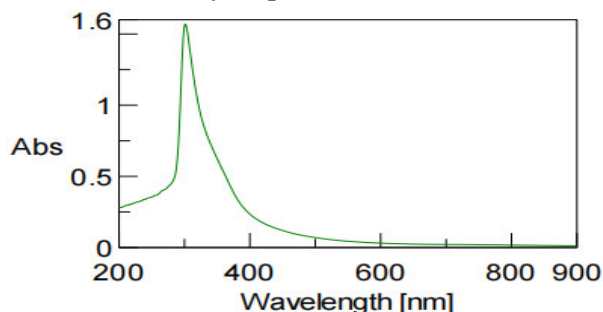


Fig. 1 UV-Vis spectra of CuNPs synthesized from the extract of *Syzygium cumini* leaves

3.2 FTIR Analysis:

Fourier transform infrared spectroscopy gives data of functional groups present in compounds in the extract that interact with metal ions. The FTIR spectrum of CuNPs synthesized using *Syzygium cumini* leaves extract is shown in Fig. 2. Peak 3410, 3481 cm^{-1} corresponds to O-H or NH stretching. The peak at 1633 cm^{-1} is due to presence of C=O stretching [20]. The peak at 1166 cm^{-1} shows C-O stretching of phenol and alcoholic compounds. The peak at 810 cm^{-1} is due to aromatic C-H bending the peak at 721 cm^{-1} is due to O-H out of plane deformation in aromatic phenol. The peak at 663 cm^{-1} is due to aromatic C-H bending. The peak at 489 cm^{-1} is due to metal- carbon stretch. The FTIR analysis suggests that the CuNPs might be surrounded by organic molecules such as polyphenols, alkaloids and terpenoids, as already reported [21]. The phenolic constituents present in plant leaves extract are responsible for the reduction of copper ions to copper nanoparticle.

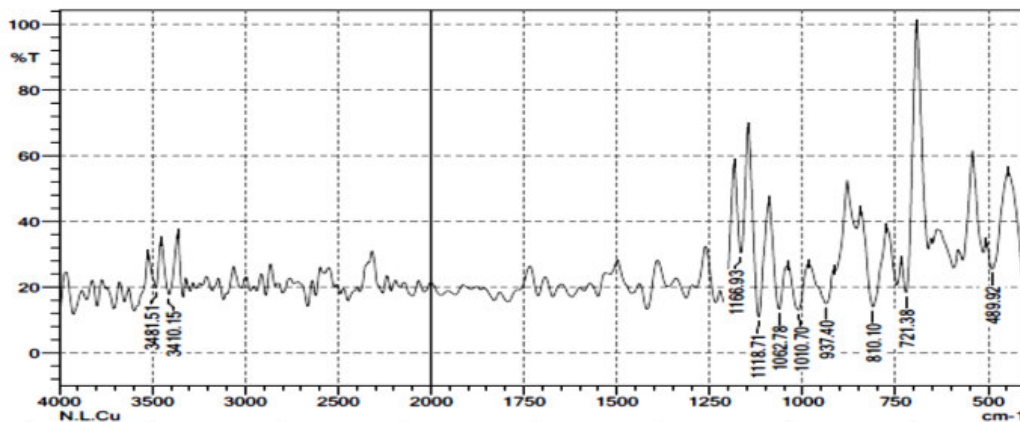


Fig. 2 FTIR spectrum of CuNPs synthesized using Syzygium cumini leaves extract

3.3 Transmission Electron Microscopy Analysis:

TEM image of copper nanoparticles synthesized using Syzygium cumini leaves at different magnifications are shown in Fig. 3. The CuNPs are spherical in shape with particles in size range 2.75 – 6.58 nm with a mean diameter of 4.68 nm. A faint thin layer around the surface of copper nanoparticles may be due to the presence of polyphenolic compounds from Syzygium cumini leaves extract, which act as capping agent.

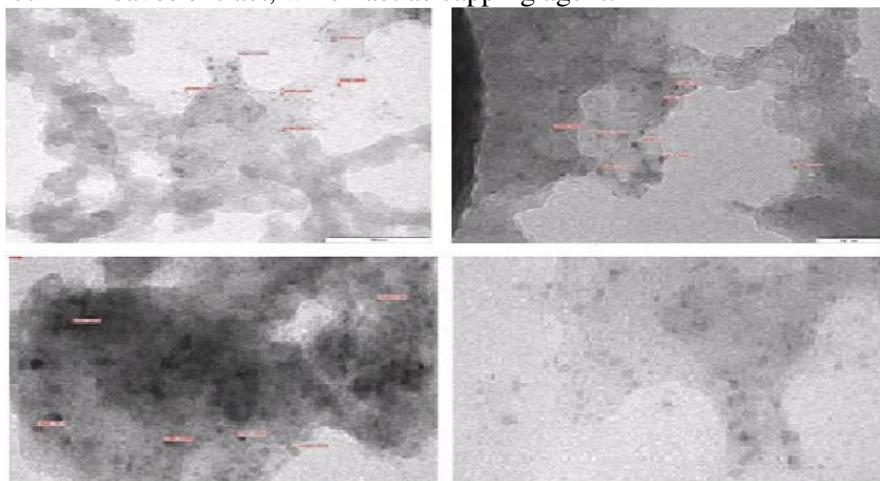


Fig. 3 TEM images of CuNPs synthesized using Syzygium cumini leaves

3.4 Cyclic Voltammetry:

The cyclic voltammogram was run between the potential range of -1.0 and 1.0 V at the scan rate 75 mVs⁻¹ to study the electrochemical behaviour of CuNPs on Glassy Carbon Electrode. The cyclic voltammogram of CuNPs at pH 1 is shown in Fig. 4. Anodic peaks at -0.15 V, 0.45 V and a cathodic peak at -0.35 V shows there is oxidation and reduction, and the reaction is found to be reversible. The high value suggests that the CuNPs can be used as a redox catalyst.

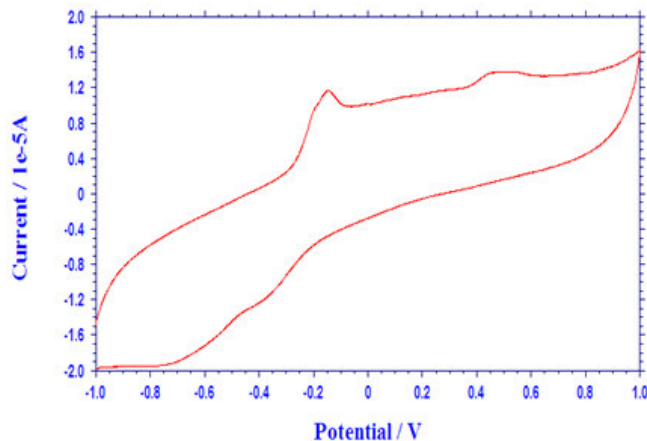


Fig. 4 Cyclic Voltammogram of CuNPs synthesized using Syzygium cumini leaves extract

3.5 XRD Analysis:

XRD pattern of synthesized copper nanoparticle using the leaf extract is shown in the Fig. 5. The copper nanoparticle show high crystalline nature which corresponds the diffraction angle at 18° , 28° , and 32° . The average size of Cu Nps was calculated using Debye -Scherrer equation.

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

Where D is the Crystalline size of Nanoparticles, k is the Scherrer's constant ranges from 0.9. The size of the Cu NP in the extract was found to be 11 nm.

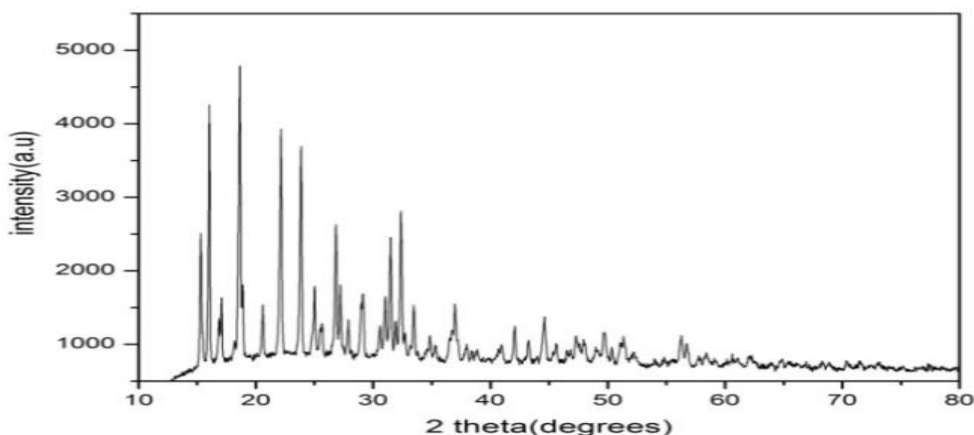


Fig. 6 XRD analysis of copper nanoparticle

4 Applications:

4.1 Degradation of Indigo Carmine:

The catalytic activity of synthesized CuNPs was monitored by using Indigo Carmine (IC) dye as a test compound. The progression of the catalytic degradation of indigo carmine dye can easily be examined by decrease in optical density at 610 nm, as shown in Fig. 6a UV-Vis spectra of IC (100 μ M) and NaBH₄ (10 mM) mixtures in the absence of CuNPs showed only a small increase of degradation with time, as shown in Fig. 6a. The degradation of dyes by other metal nanoparticles have also been reported in literature [22]. However, the reductive degradation observed after addition of CuNPs catalyst in the same sample solutions were highly enhanced. The process of degradation of IC dyes as shown in Fig. 6b. It was also

observed that the reaction rate of IC degradation with CuNPs enhanced the degradation efficiency when compared with the results of the control test.

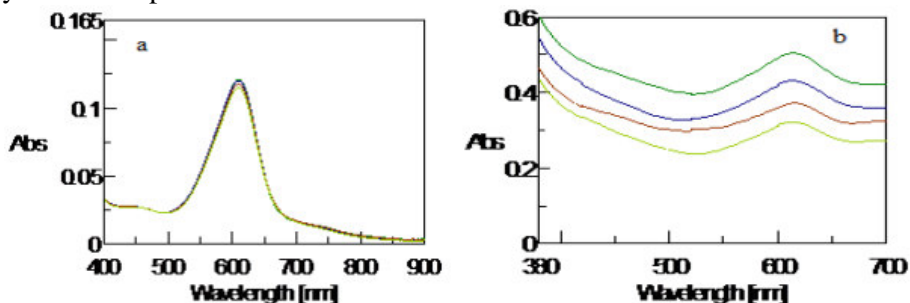


Fig. 6 UV spectra for IC degradation a) in absence and b) in presence of CuNPs

4.2 Degradation of Methyl Red:

The catalytic degradation of Methyl Red (MR) dye can easily be examined by decrease in absorbance at 520 nm, as shown in Fig. 7. UV-Vis spectra of methyl red (100 μ M) and NaBH₄ (10 mM) mixtures in the absence of CuNPs showed only a small increase of reductive degradation with time, as shown in Fig. 7a. However, the reductive degradation after addition of CuNPs in the same sample solutions was complete within 3 mins, as shown in Fig. 7b. It was also observed that the reaction rate of MR degradation with CuNPs enhanced the degradation efficiency when compared with the results of the control.

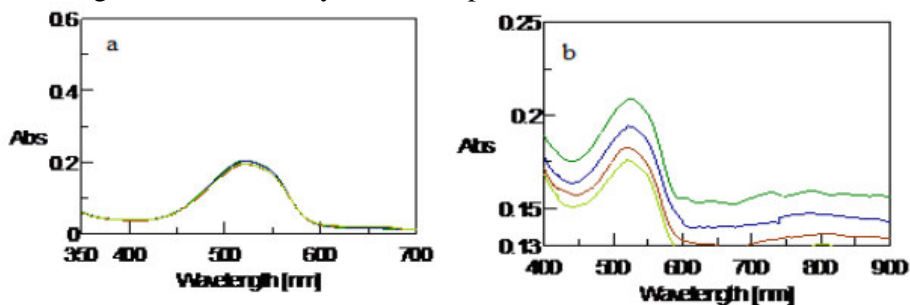


Fig. 7 UV spectra for MR degradation a) in absence and b) in presence of CuNPs

5. Antimicrobial activity:

The antimicrobial activity of pathogens was established using well diffusion method. The bactericidal effect of copper nanoparticles has been attributed to their high surface to volume ratio and small size which allows them to interact very closely with microbial membranes. The antimicrobial study of CuNPs was carried out using two pathogenic bacteria such as *E. coli* and *Bacillus subtilis*. To cultivate the bacteria, nutrient agar was used. About 20 mL of sterile molten agar was poured into the sterile Petri dishes. After solidification of medium, the Petri dishes were placed on the solidified medium. Then copper nanoparticles with 600 μ L concentration was prepared. 40 μ L concentration were added into the one of the well of Petri dishes. Petri dishes were incubated for 24 h at 37 $^{\circ}$ C. Antibacterial capacity of the copper nanoparticles was measured by standard zone of inhibition assay [23] Fig.8.

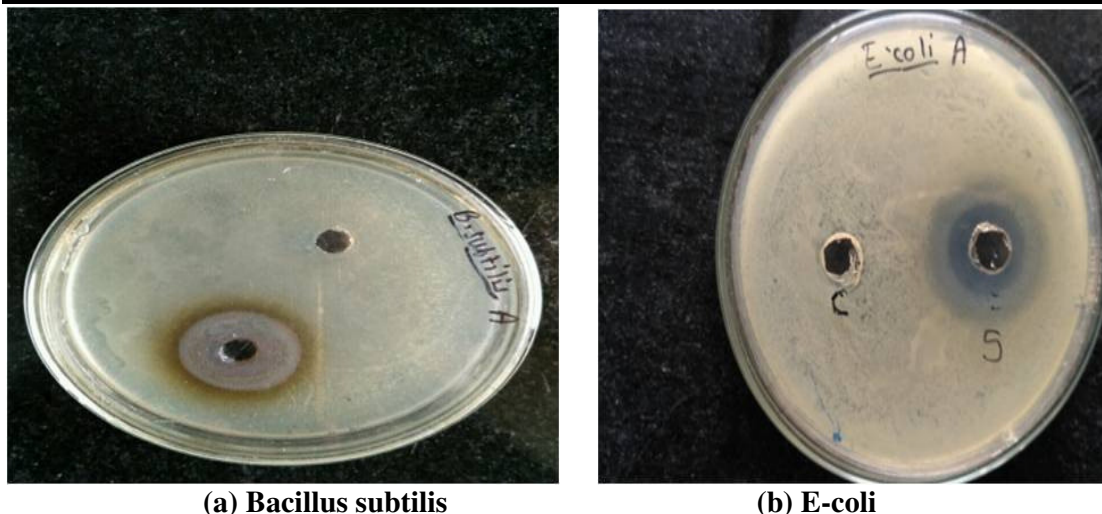


Fig.8. Antimicrobial activity of CuNPs

6. Conclusion:

The copper nanoparticles were successfully synthesized by using *Syzygium cumini* leaves extract as reducing agent which provides cost effective method for synthesis of CuNPs. The copper nanoparticles were characterized using UV-spectrophotometer, FTIR, TEM and CV. From the FTIR analysis the functional groups in the leaf extract which are responsible for the reduction of copper ions into metallic CuNPs were identified. The synthesized CuNPs were spherical in shape as seen in TEM images. From CV, the redox property of CuNPs was proved. The catalytic activity of synthesized CuNPs was studied by degradation of indigo carmine and methyl red dye.

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SYNTHESIS AND CHARACTERIZATION OF MIXED LIGAND VANADIUM METAL COMPLEXES USING 2, 2'-BIPYRIDINE AND L-AMINO ACIDS AS LIGANDS

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Abstract:

Four new mixed ligand complexes of vanadium metal were synthesized using 2, 2'-bipyridine as primary ligand and some L-amino acids such as L-Phenyl Alanine, L-serine L-glycine and L-aspartic acid as secondary ligands respectively. The synthesized complexes were characterized by using IR spectra, elemental analysis, molar conductance and magnetic susceptibility measurement. All the synthesized complexes are proposed to have square pyramidal geometry based on the results obtained from IR spectra, molar conductance, elemental analysis and magnetic study of complexes.

Keywords: Mixed ligand complex, L-Amino acids, 2,2'-Bipyridine, Molar conductance and Magnetic property etc.

Introduction:

Now a day's number of researchers has been focused on to synthesis of mixed ligand complexes of transition metals. Mixed ligand complexes are exhibited better biological activities as compare to simple complexes. This is due to more than one type of ligands coordinated to central metal atom [1, 2]. The literature survey about mixed ligand oxovanadium(IV) complexes which show modulating activities of various enzymes [3, 4]. Vanadium compounds with vanadyl ion having oxidation state +4 and +5 exist in the environment and in biological systems. These complexes also have biological activities such as antibacterial, antifungal, antiviral, and anticancer drugs [5–7]. The mixed ligand transition metal complexes with benzoheterocyclic rings and some L-amino acids have been the focus of a considerable number of investigations for their good coordination ability with metal atoms [8]. A large number of mixed-ligand complexes involving heterocyclic bases such as pyridine, 2,2'-bipyridine, o-phenanthroline, etc. were reported by many researchers due to their biological applications and thermal stability [9].

In this article we have reported the synthesis of four mixed ligand complexes of vanadium metal with 2, 2'-bipyridine and L-Phenyl Alanine, L-serine L-glycine and L-aspartic acid ligands respectively. All the synthesized complexes were characterized by using IR spectra, elemental analysis, molar conductance and magnetic susceptibility measurement. On the basis of spectroscopic results obtained, all the synthesized complexes were exhibited square pyramidal geometry.

Experimental Section:

Materials:

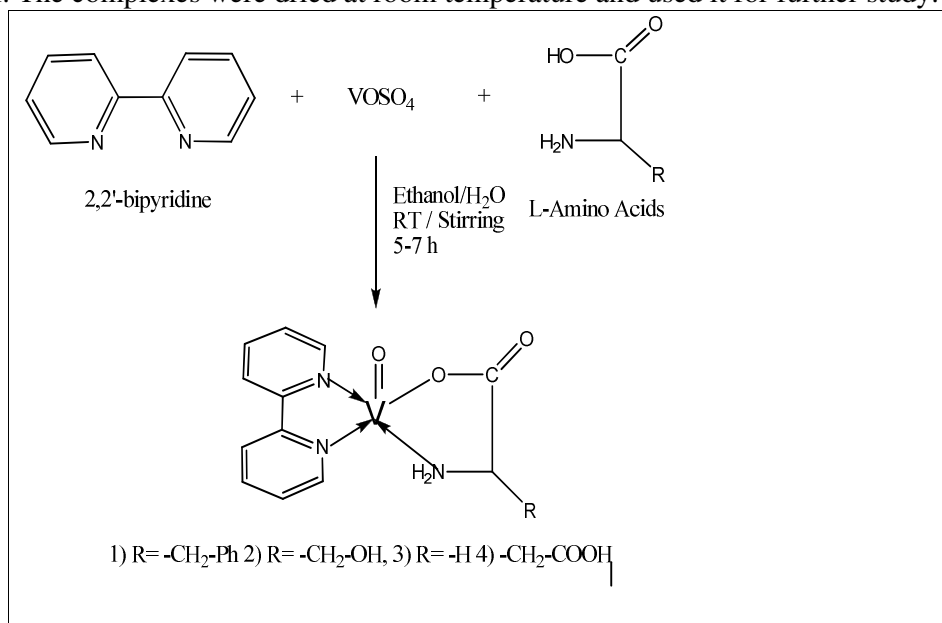
All amino acids were purchased from S.D. fine chemicals, Mumbai, second ligand 2, 2' bipyridine and vanadylsulphate (VO_2SO_4) were purchased from Babaji traders Parbhani. All the chemicals used were of AR grade. All the solvents were used after purified by the recommended method (Vogel,1989. Textbook of Practical Organic Chemistry, 5th ed. Longman,London [10]).

Melting points or decomposition temperatures of all the synthesized compounds were measured using a simple capillary tube method and are uncorrected. Molar conductance values of all the synthesized complexes were measured by preparing 10^{-3} M solutions in DMF solvent using Equiptronics conductivity meter with an inbuilt magnetic stirrer (Model:Eq-664) at room temperature. Magnetic susceptibilities were determined on the SES Instrument's magnetic susceptibility Gouy's balance (Model: EMU-50) at room temperature using copper (II) sulphate as a standard. IR spectra of complexes were recorded as KBr pellets in the region of $4000-400\text{ cm}^{-1}$ on a SHIMADZU Spectrophotometer.

Synthesis of Mixed ligand complexes:

General procedure:

To take aqueous solution (20 ml) of vanadylsulphate (1.63 gm 0.01 Mole), add ethanolic solution (20 ml) of 2,2'-bipyridine (1.56 gm 0.01Mole) was added drop wise with constant stirring. The mixer was stirred for 1 hrs at room temperature. To this reaction mixer add aqueous solution (20 ml) of amino acids (0.01 Mole) drop wise with constant stirring. The reaction mixer was stirred 5-7 hrs at room temperature and then coloured complexes were precipitated. Filter the complex and wash it with cold distilled water followed by ethanol. The complexes were dried at room temperature and used it for further study.



General scheme: synthesis of mixed ligand complexes

Result and Discussion:

Physicochemical data:

The physicochemical characterizations such as percentage yield, colour of complexes, decomposition temperature or melting point were recorded for all the complexes. The melting point of complexes was recorded by simple capillary tube method. All the complexes are found to be decomposed at more than 260°C temperature indicates thermally more stable complexes. The molecular weight and chemical formula are estimated for all the synthesized complexes using 'Chem Draw ultra 11.0' software. The solubility of all the synthesized complexes was checked with available solvents in laboratory. The complexes are insoluble in common organic solvents but purely soluble in DMSO and DMF. All the recorded data of synthesized complexes is represented in Table 1.

Table-1: Colour, Elemental analysis, molar conductance and magnetic moments

Complex	Molecular Weight	Percent Yield (%)	Colour	C, H, N Analyses, found (calculated) (%)		
				C	H	N
Complex- C1	334.21	68	Faint Brown	50.17 (50.19)	4.53 (4.54)	13.50 (13.48)
Complex- C2	352.28	78	Black	45.49 (45.48)	4.11 (4.10)	12.24 (12.20)
Complex- C3	285.33	76	Black	48.52 (48.50)	4.89 (4.87)	11.32 (11.32)
Complex- C4	331.24	75	Faint Green	49.28 (49.26)	4.73 (4.72)	12.31 (12.30)

IR Spectra:

The FT-IR spectra of synthesized complexes were recorded and compared with free ligand molecules. The some major absorption bands are expressed here. The absorption band of the (C=N) group of free bipyridine molecule at 1454 cm⁻¹ [13]. This band was shifted to lower wave number in complexes in the range of 1435-1445 cm⁻¹, indicates bipyridine ligand coordinated to metal atom via the nitrogen atom.

The asymmetric and symmetric (COO-) bands observed in the region 1580-1597 and 1402-1408 cm⁻¹ in free amino acids were observed to be shifted to lower wave numbers region of 1571-1575 and 1373-1377 cm⁻¹ respectively in the spectra of complexes. This indicates bonding of COO- group with metal via oxygen atom of carboxylic group of amino acids. The band observed between 940-950 cm⁻¹ in the spectra of complexes indicates $\nu(\text{V}=\text{O})$ stretching vibrations. Finally the bands observed in the range of 440-450 cm⁻¹ and 620-635 cm⁻¹ indicates $\nu(\text{M}-\text{N})$ and $\nu(\text{M}-\text{O})$ bonding in complexes respectively.

Molar conductance:

Molar conductance values for all the synthesized complexes were recorded by preparing 10⁻³ M solutions in DMSO solvent. The observed molar conductance values in the range (18-28 ohm⁻¹ cm² mol⁻¹) for complexes indicated towards their non-electrolytic nature of complexes.

Magnetic properties:

Magnetic susceptibility values for all the synthesized mixed ligand complexes were recorded at room temperature using copper (II) sulphate as an internal standard. These were then converted into magnetic moment values using spin only formula. The Magnetic moment value of all four complexes in the range of 1.87 to 1.92 BM. It indicates oxidation state of vanadium in complexes is +4 correspond to the presence of one unpaired electron present in all these complexes [14]. Thus all the four complexes exhibited square planar geometry around the vanadium metal atom.

Conclusion:

The mixed ligand complexes of vanadium with bipyridine and L-amino acids as ligands have been prepared at room temperature. The elemental analysis data reveals that 1:1:1 (M:L:L) proportion in complexes. The decomposition temperature values of complexes were recorded and found to be more than 260 °C it indicates that, complexes are thermally more stable. The molar conductance, IR spectra and Magnetic moment values of complexes are reveals that vanadium metal having +4 oxidation state with one unpaired electron present in all these complexes with square pyramidal structural arrangement around vanadium metal atom.

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ULTRASOUND PROMOTED ONE-POT SYNTHESIS OF SUBSTITUTED PYRAZOLES

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ABSTRACT

Synthesis of substituted pyrazoles by one pot condensation reaction of substituted cinnamaldehydes and tosylhydrazine in the presence of glyoxylic acid under solvent free condition. The methodology highlights the use of ultrasonic irradiation as non conventional sources. The catalyst used is readily available and cost effective which makes the method more green and efficient.

Key words: 3-Substituted pyrazole, Glyoxylic acid, Ultrasound irradiation.

INTRODUCTION

Pyrazoles and its derivatives are usually used in medicinal chemistry as they have large range of biological and pharmacological activities such as anti-inflammatory, analgesic, antibacterial, antidiabetic, antipyretic, antiviral, uricosuric, hypoglycemic, antineoplastic antiarthritic, and antiphlogistic properties¹⁻⁴. Due to various important features of pyrazoles various synthetic methods are reported for the pyrazole synthesis. Condensation of hydrazonyl halides with b-dicarbonyl compounds and 1,3-dipolar cycloaddition of diazo compounds with alkynes⁵⁻⁷ are found to yield pyrazoles. The most usually used synthetic protocol for obtaining polysubstituted pyrazoles is by condensation of 1,3-dicarbonyl compounds with hydrazines using acid catalysts like sulphuric acid⁸, polystyrene sulphonic acid⁹, ionic liquid¹⁰ and hydrochloric acid¹¹.

Here we are interested to use glyoxylic acid as it is a strong acid with excessive large applications such as Diels Alder reaction¹², deportation of oximes¹³ and for the synthesis of imidazoles¹⁴.

MATERIALS AND METHODS

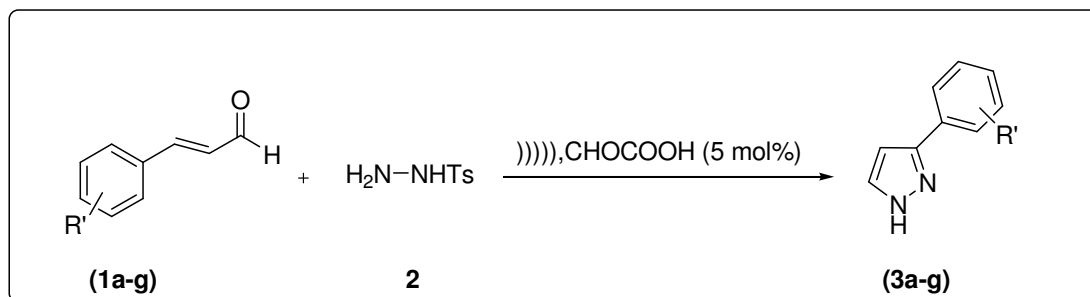
General procedure for the synthesis of Pyrazoles

Cinnamaldehyde (**1**) (1.00 mmol) and tosylhydrazine (**2**) (1.00 mmol) was taken in RBF to that glyoxylic acid (5 mol%) was added and then after the RBF was kept into the ultrasonic water bath, and was irradiated at 40% of the power of the ultrasonic bath at rt. By using TLC the progress of the reaction was monitored. After complete conversion the reaction mass was poured on crushed ice. The obtained solids were filtered, washed with water and dried. The crude compounds were crystallized using (1:1) DMF-Ethanol.

Spectral data for representative compound 3a.

white solid, FTIR cm^{-1} : 3165 (N-H str.), 1536 (C=N str., Pyrazolyl), 1048 (C-O str.); ¹H-NMR (400 MHz, DMSO): δ 3.77 (s, 3H, -OCH₃), 6.65 (d, 1H, Ar-H, J = 8 Hz), 7.28 (t, 1H, Ar-H, J = 8 Hz), 7.37 (d, 1H, Ar-H, J = 8 Hz), 7.44 (s, 1H, Ar-H), 7.66 (s, 2H, Pyrazolyl), and 14.02 (s, 1H, N-H) ppm; ¹³C-NMR (100 MHz, DMSO): δ 159.58, 133.87,

129.59, 117.65, 112.90, 110.50, 101.98, 54.81 ppm; MS (ESI, m/z): calcd for C₁₀H₁₀N₂O (M + H⁺) 174.0793; found: 175.1162.



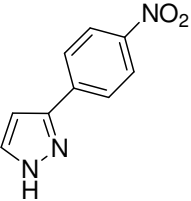
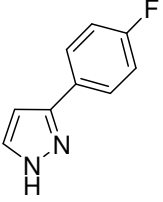
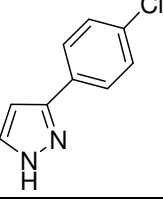
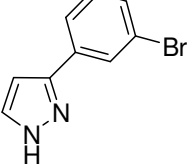
Scheme: Synthesis of substituted pyrazoles (3a-g) using glyoxylic acid under ultrasound irradiated.

RESULTS AND DISCUSSION

The synthesis of pyrazole using readily available starting materials such as cinnamaldehyde (1a-g) and p-toluenesulfonyl hydrazide (TsNHNH₂) (2). The use of glyoxylic acid as a catalyst and media for the synthesis makes the method more cost effective. Here, we have noted that the conversion takes place in less time with respect to cinnamaldehyde as the donating group increasing and as we have noticed that if there is any strong withdrawing group present than the conversion is less (Table 1, 3d). The reactions were carried out at room temperature for 30 min. The progress of the reaction was monitored by TLC. Various cinnamaldehydes (1a-g) could give target pyrazoles through the same action (3a-g). And the use of ultrasound irradiation as a non-conventional source has played a key role in the synthesis as compared to other conventional methods.

Table 1: Glyoxylic acid catalyzed synthesis of pyrazoles^a.

Entry	R'	Product	Yield	M. P. (°C)
3a	m-OMe		93	91-92
3b	-H		86	77-81
3c	p-Me		90	75-77

3d	p-NO ₂		65	195-196
3e	p-F		75	102-104
3f	p-Cl		88	100-104
3g	m-Br		85	74-76

CONCLUSION

In conclusion, we have investigated a simple, highly efficient, and environmentally friendly method for the synthesis of substituted pyrazoles. Here, the use of glyoxalic acid works as an excellent catalyst. The use of ultrasound irradiation as a non-conventional source has played a key role in the synthesis. And the further use of the methodology for the synthesis of other useful heterocycles is going on our laboratory.

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DIMINISHING BIODIVERSITY-A CHALLENGE TO THE FRAGILE ECOSYSTEM OF OUR UNIVERSE.

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Introduction:

Biodiversity is a scientific term describing the variability of life on Earth (wild and cultivated). So, it is about sheer numbers of different species, genetic variation between and within species, and the extent and variety of natural habitats and ecosystems. We are losing this diversity and abundance at increasing and alarming rates (now around 1000 times higher than natural background rates). To understand why biodiversity loss matters for development it is important to understand what biodiversity does. Nature produces and delivers a wide range of goods and services on which humans depend from breathable air, to fertile soil to food. And biodiversity underpins nature's ability to deliver those goods and services over the long term. Species do not exist in isolation, but interact with each other and with their environment. A large and diverse mix of species, and the interactions between them, is critical to ensuring nature continues to deliver its goods and services. Over the past 25 years, evidence from thousands of experiments and observations in a range of ecosystems shows that these goods and services are produced more efficiently and with more stability where the diversity of microbes, plants, fungi, herbivores and predators is higher.

Biodiversity loss and the risk to development gains It is because of biodiversity's importance in maintaining (and enhancing) stable, productive and resilient natural ecosystems and the resources and services they provide that biodiversity loss is an important development issue. Biodiversity is not just about the wealth of nature but also about the health of nature. Loss of biodiversity undermines ecosystems' abilities to function effectively and efficiently and thus undermines nature's ability to provide us with a healthy environment. This is particularly important in a changing climate where loss of biodiversity reduces nature's resilience to change. While some loss of species is perfectly normal – extinction is a normal part of the evolutionary process the current rate is estimated to be about 1000 times higher than natural background rates. This loss is largely human-caused (anthropogenic), driven by conversion of forests and other ecosystems for agriculture, infrastructure and urban development, as well as over-exploitation through hunting and fishing. It is also, and increasingly, linked to climate change, because changing climatic conditions is altering species' distributions and the extent and quality of ecosystems. Box. Exploring the evidence that diversity matters Biodiversity has a significant impact on ecosystems' productivity and stability, and on the services they generate. The crop genetic diversity has increase in the capacity of yield of commercial crops of agriculture. tree species diversity enhances and/or stabilises wood production in plantations; plant species diversity produces more fodder in grasslands; fish species diversity is associated with more stable catches. There is also evidence that biodiversity's impacts on productivity and stability are more significant than either climatic or nutrient influences. Furthermore, biodiversity makes ecosystem productivity more resilient to climate extremes.

Beyond productivity impacts, plant biodiversity also: increases a system’s resistance to invasion by exotic plants and reduces the prevalence of plant pathogens; increases above-ground carbon sequestration; and increases nutrient mineralisation and soil organic matter. Overall there is a substantive body of evidence which shows that diversity confers both social and ecological resilience and adaptive capacity particularly under a changing climate. Of course, biodiversity is not the only factor: a report for The Economics of Ecosystems and Biodiversity (TEEB) initiative correctly notes that “the economic importance of wild nature does not rely solely on variability”. Indeed, and particularly from a development and poverty reduction perspective, many of the benefits people get from nature rely as much on the amount (eg the abundance of particular species) as on diversity. How well ecosystems provide people with developmental benefits also depends on their condition and extent, and on the specific functions certain species, groups of species or ecosystems perform as sources of food, absorbers of air pollution, natural barriers against sea storms and so on. But, crucially, diversity underpins the abundance, extent and condition of nature, natural resources and ecosystems and secures the flow of benefits to people in the future, particularly in the face of changing environmental conditions. IIED Issue paper www.iied.org Eleven Biodiversity loss is often measured in terms of losses of particular species. But it is also about loss of ecosystems however living places that matter to people, and loss of genes which determine for example, the varieties of agricultural crops that we eat. Mangrove forests are highly productive ecosystems on which millions of coastal communities depend, and they are being lost at a rate of 1 percent per year, which is double that of terrestrial forests. Mangrove restoration that doesn’t pay due attention to species diversity, is proving to be an inadequate solution to coastal degradation. And at the other end of the spectrum, loss of genetic diversity within our global food system has huge implications for its future sustainability. Out of the millions of species and varieties that people have described and recorded, only crops provide 95 percent of human food energy needs, and just four of them – rice, wheat, maize and potatoes provide more than 60 percent. This homogenisation of agricultural production has resulted in significant genetic erosion as farmers worldwide have replaced multiple local varieties and landraces with genetically uniform, high-yielding varieties. Any loss, degradation or relocation of biodiversity can impinge on human wellbeing, but it can have a particular impact on poor and marginalised people who often a) depend more directly on natural resources and the services nature provides to meet their immediate livelihood needs, and b) cannot afford substitutes for previously freely-available natural resources and services. There is a lot we don’t know about the impacts of biodiversity loss but the evidence we do have suggests that biodiversity loss will challenge our ability to achieve many development priorities from health to food security to disaster risk reduction. These development challenges are summarised and discussed in more detail below.

Who is, and will be, hardest hit by biodiversity loss? The highest rates of biodiversity loss are currently in the tropics although historically there has been extensive biodiversity loss in temperate zones, as Figure 2 illustrates. More recently, however, the 2018 Living Planet Report finds that declines in vertebrate populations since the 1970s are greatest in Latin America and the Caribbean, where abundance has declined by 89 percent between 1970 and 2014.⁴ Comparable figures from other regions⁴ are a 64 percent decline in the Indo-Pacific region, and 56 percent in Sub-Saharan Africa, 31 percent in the ‘Palaearctic’ realm (Europe, Middle East, North Africa, Central Asia) and 21 percent in North America. Tropical forests are one of the most diverse types of ecosystem on the planet but include major hotspots for biodiversity loss.

biodiversity loss? It is clear that continued biodiversity loss will be a challenge to development, especially in the context of a changing climate. The poorest will be hit not just the hardest and but hit doubly hard due to these interconnected challenges. To date, progress in economic development has been measured as if nature has no value, yet the annual revenue from nature based resources has been estimated as worth 125 trillion US. Fourat the same time, much conservation has proceeded without taking local needs and knowledge into account. Yet it is local communities who are the primary stewards of most of Earth’s biodiversity. As a result, efforts to protect biodiversity are failing: since the 1970s, there has been a 660 percent increase in protected area coverage yet a 60 percent decline in the global populations of most major animal groups.⁶⁵ Key reasons for the biodiversity conservation development disconnect include.

Conclusion: The goal of future efforts to address biodiversity must not be merely the compilation of lists of species. Though one must be sympathetic to intensive efforts to find out how much species diversity exists, there is no substitute for learning how systems work, the implications of their characteristic diversity, and the role individual species play. That is, I see our task not as species inventory, but more as ecological discovery. the aim of efforts to different diversity is not completed with the list of species we have to increase the efforts to save diversity. Ecological diversity maintained this is important mark which we have to follow. it is to be taken into consideration that species are an important and integral part of ecosystem and they should be protected. the description of species is not sufficient. Rather, we need to identify the species that are important contributors to ecosystem processes.



A COMPARATIVE QUALITY EVALUATION OF HONEY MADE BY *A. DORSATA* AND *A. CERENA INDICA* FROM THE MELGHAT REGION OF MAHARASHTRA.

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In this investigation, the physicochemical characteristics of the honey samples were examined. The honey samples of squeezed honey from *A. dorsata* and *A. cerena indica* were collected from experimental beehives planted in various sites across Melghat. Some physicochemical factors are examined. *A. dorsata* honey has typical values of 0.70 mS/cm electrical conductivity, 1.37 specific gravity, 5.9 PH, 69% glucose-fructose ratio, 1.3 % sucrose, 0.9% total protein content, 18% moisture content, 0.27 free acidity (formic acid), 0.37% ash content, 6.1 mg/100 gm HMF value, and 0.3% minerals. *A. cerena indica* honey shows average values of 0.79 mS/cm electrical conductivity, 1.22 specific gravity, 5.3 PH, 65% glucose-fructose ratio, 2.1 % sucrose, 0.6 % total protein content, 20 % moisture content, 0.23 free acidity (formic acid), 0.27% ash content, 7 mg/100 gm HMF value, and 0.2% minerals. When compared to *A. cerena indica* honey, *A. dorsata* honey has a greater protein content and glucose-fructose ratio. *A. cerena* honey has greater electrical conductivity, etc. According to the results, the physicochemical characteristics of the honey samples are comparable to those estimated by the Food Safety and Standard Authority of India (FSSAI). The information gathered from the study of the two samples of honey suggests that some physicochemical properties of *A. dorsata* has higher value than *A. cerena indica*. And may differ depending on the location of the comb, floral sources, water accessibility, environmental factors, or weather, and they may also alter with time.

Keywords: Honey, Physico-chemical properties, *Apis dorsata*, *Apis cerena indica* Melghat,

REDUCED POTENTIAL CURVES FOR THE DIATOMIC MERCURY HALIDES

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Abstract:

The reduced potential curves (RPC) of the ground electronic states of HgCl, HgBr and HgI are constructed. These curves obey the rules of RPC scheme and also show similarity to respective RKR curves.

Key words: Potential energy curves, Reduced potential functions for diatomic molecules

1. Introduction

Diatomic mercury halides HgX (X = Cl, Br and I) are used in laser. The experiment on photodissociation [1] of HgX₂ vapour and electron-beam excitation [2] of a mixture of Hg, Ar and halogen-bearing hydrocarbons have shown that strong lasing action in the bound-state transitions B ²Σ⁺ - X ²Σ⁺ may be used in high –power lasers. Recently dissociation energies of HgCl, HgBr and HgI from potential energy curves reported by Bhartiya et al [3].

The potential energy curves are important in the studies of dissociation energies, Franck-Condon factors, chemical physics, laser physics etc. The potential functions can be drawn using RKR [4-6] method, which is based on an experimental data. Recently Jenc and Brandt [7] have developed a method of calculating potential energy curves, which is known as RPC. In the present study this method has been employed to construct the RPC's for the ground states of HgCl, HgBr and HgI.

2. The reduced potential energy curves

The method suggested by Jenc and Brandt [7] uses the RKR data. The reduced potential energy curves are drawn between two parameters namely ρ on X axis and u + 1 on Y axis

$$u = U/D_e \text{ where } U = \sum C_i (v + \frac{1}{2})^i \quad \dots (1)$$

C_i are vibrational constants like C₁ = ω_e, C₂ = -ω_ex_e, C₃ = ω_ey_e etc. D_e is dissociation energy.

$$\dots (2) \quad \rho = \frac{r - [1 - \exp(-r / \rho_{ij})] \rho_{ij}}{r_e - [1 - \exp(-r / \rho_{ij})] \rho_{ij}}$$

Where r_e is equilibrium internuclear separation and ρ_{ij} can be calculated as follows,

$$\rho_{ij} = \frac{r_e - [(3.96) D_e / \kappa_e]^{1/2}}{1 - \exp(-r_e / \rho_{ij})} \quad \dots (3)$$

Where κ_e is a force constant.

The reduced quantities fulfill following conditions.

- i) $\rho \geq 0$
- ii) $\rho = 0$ for $r = 0$
- iii) $\rho = 1$ for $r = r_e$
- iv) $\rho \rightarrow \infty$ for $r \rightarrow \infty$
- v) $u \leq 0$ for $U \leq 0$
- vi) $u = 0$ for $U = 0$
- vii) $u \rightarrow \infty$ for $U \rightarrow \infty$
- viii) $u = -1$ for $U = -De$

3. Properties of RPC

- 1) The RPC's of different molecules never intersect.
- 2) The RPC's of diatomic molecules slightly differing in both atomic numbers coincide.
- 3) While keeping one atomic number constant a considerable change in the values of other effect than a relatively small change in the values of both atomic numbers. This fact is clear in the RPC's of heavy hydrides.
- 4) In general the shape of RPC turns slowly to the right around the minimum while becoming broader.
- 5) Rare gas molecules does not follow the rule number 2, 3 and 4. The RPC's of rare gas molecules coincide approximately to each other and form a right hand boundary of the admissible RPC region.
- 6) All RPC's including excited state lie in RPC region.
- 7) The approximate coincidence mentioned in rule 2 and 5 is very accurate in repulsive limb.

It was found that deviations from the above rule in the RPC's of the diatomic molecules might appear suggesting the possible existence of perturbation in the state or because of erroneous extrapolation of the RKR potential.

4. Molecular Constants

The latest spectroscopic constants are used to construct RKR and RPC curves. All these constants are summarized in Table 1. along with references [3,8,9,10]. The ρ_{ij} are calculated using expression (3). For the calculation of RKR curves, the vibrational as well as rotational constants are also needed which are listed in Table 1.

5. Verification of RPC

The individual RKR and RPC of HgCl, HgBr and HgI are shown in Figs 1 (a,b,c and a', b', c') respectively. RKR and RPCs of respective molecules have similarity. Secondly the combined RPCs of HgCl, HgBr and HgI which are shown in Fig. 2, the RPC of lighter molecule HgCl is in side where as the RPC of heavier molecule HgI is outside which is as expected.

The applications of RPC could be as follows:

- i) It can detect the errors in the construction of RKR.
- ii) It can be used to detect errors in molecular constants.
- iii) It can detect the errors in analysis of a spectrum due to perturbations or otherwise.

It is shown that the behavior of this group of chemically related molecules is fully in accord with the overall regularities observed for many other groups of diatomic molecules [11].

6. Conclusion: The RPC scheme is verified for the ground states ($X^2\Sigma$) of HgCl, HgBr and HgI molecules. The RPC scheme seems to lead to a picture that might be called “a periodic system of diatomic molecules.”

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STUDIES OF MEDICINAL PLANTS FROM MARATHWADA EFFECTIVELY USED AS ANTIDOTE

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ABSTRACT

Snakebite is a severe medical, social, and economic problem in India. It is a common problem of death of many people particularly in rural areas. It is a common problem in Marathwada also. There are many medicinal plants are used as antidotes for snakebites, used either singly or in combination with other agents. The present study makes an effort to assemble information on medicinal plants from Marathwadathat are used for snakebite treatment. From a range of literature sources, data have been compiled with emphasis on the plants, family, parts used, etc., depending on the availability of information. This paper enumerates **10** plant species belonging to **09** families that act as antidotes against snakebites. The present study is focused on the medicinal plants from Marathwada region which are effectively used to as Antidote on snakebite.

Keywords: India, Marathwada, Medicinal plants, Antodote, Snakebite.

Introduction

Historically, humans have depended on nature to provide for their fundamental needs, namely food, clothing, medicines, and natural healing remedies. Medicinal herbs have been traditionally a resource for the treatment of many diseases and health related problems (Zarei GA, *et al*, 2015; Baharvand-Ahmadi, B., *et al*, 2015, Mahmoudi GA, *et al*, 2016, Rezvanirad A, *et al*, 2016, Bahmani, M., *et al*, 2016). (Peter A. Akah and Alphonsus I. Nwambie, 1994). Snakebite is a severe medical, social, and economic problem in India. It is a common problem of death of many people particularly in rural areas. It is a common problem in Marathwada also. There are many medicinal plants are used as antidotes for snakebites, used either singly or in combination with other agents. The present study makes an effort to assemble information on medicinal plants from Marathwadathat are used for snakebite treatment. From a range of literature sources, data have been compiled with emphasis on the plants, family, parts used, etc., depending on the availability of information. This paper enumerates **10** plant species belonging to **09** families that act as antidotes against snakebites.

The present study is focused on the medicinal plants from Marathwada region which are effectively used as antidotes on snakebite. Marathwada (70° 5' - 78° 5' E Longitude and 17° 5' - 20° 5' N Latitude) a geographical region of the [Indian state of Maharashtra](#). Marathwada has total area of 64590 km². Districts of Marathwada region are ChatrapatiSambhajinagar, Nanded, Latur, Parbhani, Jalna, Beed, Dharashiv, Hingoli. Marathwada. There are more than 1650 species of Angiospermic plants in Marathwada of which more than 500 species are medicinally useful (Naik, 1998). It is found that **10** species of flowering plants which are useful as antidote on snakebite.

Methodology

The present study is based on survey of flowering plants used as antidote on snakebite in Marathwada during 2021-2023. The plants were identified with the help of Flora of Marathwada- V. N. Naik (1998). The medicinal value of plants was verified with the knowledge of local people, aged rural folks, traditional ayurvedic practitioners, local herbal drug sellers and referring literature of Naik (1998), Trivedi (2003-2008), Gambhire (2008), Mali and Bhadane (2011), MohmmadNafees Iqbal and Suradkar (2011), Lal and Singh (2012), Bhogaonkar and Ahmad (2012), Nag and Hasan (2013), Muley and Sharma (2013), Biradar (2013).

RESULTS AND DISCUSSION

Study revealed that there are **10** species of flowering plants from Marathwada which are useful as antidote on snakebite. The results are tabulated in the form of botanical name, family, local name and parts used as antidote on snakebite.

Sr. No.	Botanical name	Family	Local/Vernacular name	Parts used
01.	Adhatodazeylanica	Acanthaceae	Adulsa	Leaves and Root
02.	Albizialebeck	Mimosaceae	Shirish	Seeds
03.	Aristolochiaindica	Aristolochiaceae	Sapsan	Leaves, Roots, Seeds
04.	Cordiadichotoma	Boraginaceae	Bhokar	Bark
05.	Curcuma longa	Zingiberaceae	Halad	Rhizome
06.	Euphorbia nerifolia	Euphorbiaceae	VaiNivdung	Root, leaves and Latex
07.	Gymnemasylvestre	Asclepiadaceae	Bedki	Root
08.	Pergulariadaemia	Asclepiadaceae	Utran	Leaves
09.	Strychnospotatorum	Longaniaceae	Nvli/Nirmali	Seeds
10.	Vitexnegundo	Verbenaceae	Nirgudi	Leaves

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REVIEW ON SYNTHESIS OF ISOQUINOLINES AND ITS BIOLOGICAL ACTIVITY

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ABSTRACT:-

Isoquinolines constitute a significant class of natural alkaloids that demonstrate a broad range of biological activities. Thus, development of new methods for efficient synthesis of isoquinoline and its derivatives has concerned considerable awareness of chemists and pharmacologists over recent years. Isoquinoline ring has been found to have wide range of biological and pharmacological activities like anti-HIV, antimalarial, insect growth retarding antitumor, antileukmic antibacterial, antimicrobial, and Parkinson's disease activity and is a scaffold for chiral ligands. Isoquinoline is a significant source of leads for drug discovery. To find out this chemical gap numerous established protocols for the synthesis of Isoquinoline ring such as the Bischler-Napieralski Pictet Spengler and Pomeranz-Fritsch reactions which all centre on the electrophilic aromatic substitution so are controlled to electron-rich carbocycles. The article aims at importance these very recent advancements in the synthesis of the isoquinoline ring by the use of different starting material and catalyst.

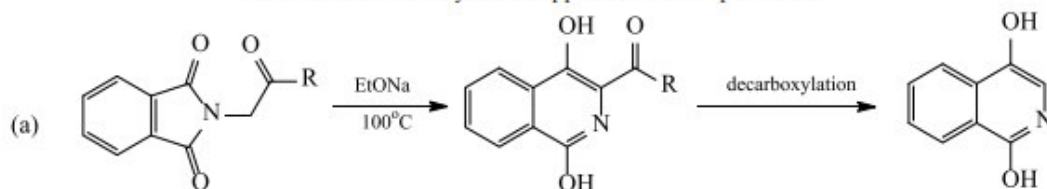
INTRODUCTION:-

Isoquinolines is a promising nucleus which occurs in numerous natural compounds and are pharmacologically active substances displaying a wide range of biological activity like antimalarial, anti-HIV, insect growth retarding, antitumor, antimicrobial, antileukmic, antibacterial [1]. A number of well-known protocols are there for the synthesis of isoquinoline ring, which can be well modified to prepare a number of differently substituted quinolines. New methods to isoquinolines are still highly popular, particularly ones with the ability to directly access the isoquinoline moiety in a range of oxidation levels and which do not require highly-focused starting materials [2]. The Pomeranz–Fritsch reaction provides an efficient scheme for the synthesis of isoquinoline. This reaction uses a benzaldehyde and aminoacetoaldehyde diethyl acetal, which in an acid medium react to form isoquinoline [3]. Discovery and various sites of application of natural isoquinoline alkaloids [4–9] and synthesis of isoquinoline derivatives is a hot topic in organic and medicinal chemistry that desires development of new strategies [10, 11].

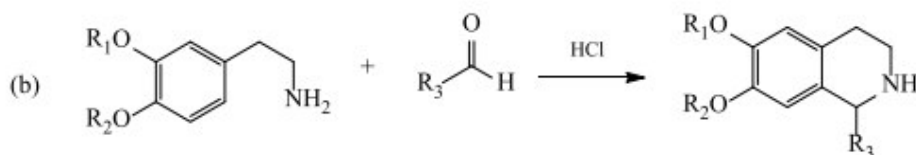
SYNTHESIS:-

(a) In 1900, Gabriel and Colman proposed the technique that involved phthalimide as the raw material and proceeded via rearrangement upon strong alkaline conditions leading to isoquinoline derivatives, and following decarboxylation of those gave 1,4-dihydroxy isoquinoline (Scheme 1a) [12].

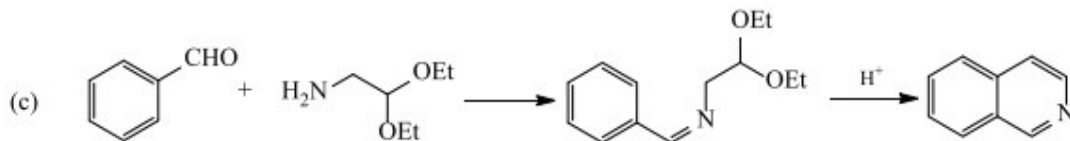
Scheme 1. Various synthetic approaches to isoquinolines.



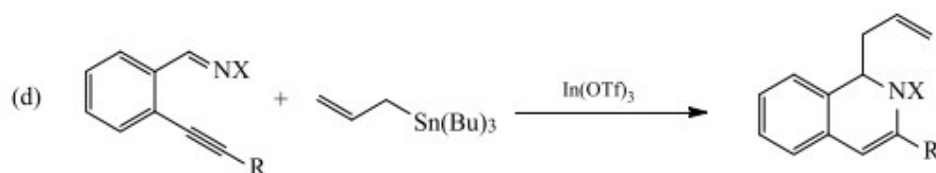
(b) In 1911, Swiss chemists Ame Pictet and Theodor Spengler reported the method in which tetrahydroisoquinoline was obtained from beta-aryl ethylamine and carbonyl compounds by cyclization and condensation in the presence of hydrogen chloride. Such approach is still considered to be the most efficient approach to tetrahydroisoquinoline, isoquinoline alkaloids and related drugs (Scheme 1b) [13].



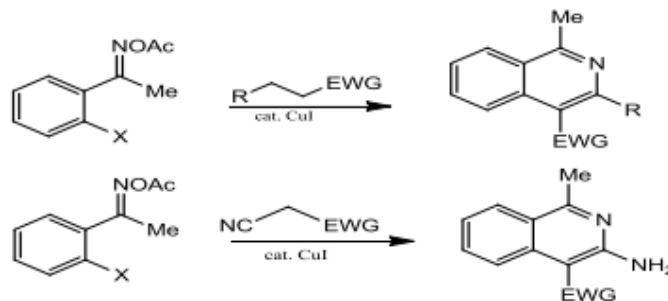
(c) In 1970 was proposed the Pomeranz-Fritsch method that used aromatic aldehydes and aminoacetal as initial compounds in producing isoquinolines by cyclization under acidic conditions (Scheme 1c) [14].



(d) Takemoto pioneered synthesis of isoquinoline via the tandem nucleophilic addition and cyclization of ortho-alkynylarylaldimines in the presence of a metal catalyst (Scheme 1d) [15].



(e) Huanfeng J et al. [16] synthesized a series of isoquinoline derivatives, with high chemo- and regioselectivities, via the copper-catalyzed cascade reaction of 2-haloaryloxime acetates with β -diketones, β -keto esters, and β -keto nitriles. This tandem annulations process features inexpensive catalysts, no need for additional ligands, and excellent functional group tolerance, which makes it have potential synthetic applications.



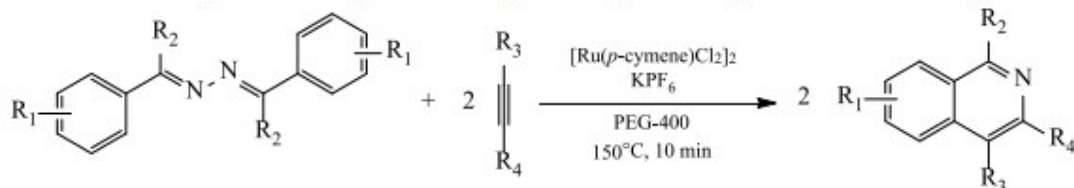
Scheme 2- metal catalyzed synthesis of isoquinoline and its derivatives:-

Among various catalytic reactions, transition-metal catalyzed domino processes have proven to be efficient in conversion of simple starting molecules into those of complex structures in a stepwise manner [17–19]. Over recent years, transition metal catalysts have been widely used due to their vacant d-orbital's and acting as electrophiles, and also ability to donate lone pairs of d-electrons and acting as nucleophiles.

2. Ruthenium-Catalyzed Synthesis of Isoquinoline Derivatives:-

Direct activation of the C–H bond by ruthenium has become a powerful tool in organic synthesis. B.M. Bhanage and co-workers [20] pioneered ruthenium catalysis of C–H/N–N in the synthesis of isoquinoline derivatives from dibenzoylhydrazine (Scheme 2). The developed method was environmentally friendly because of shortened time of purification and no external oxidants or transition metals involved.

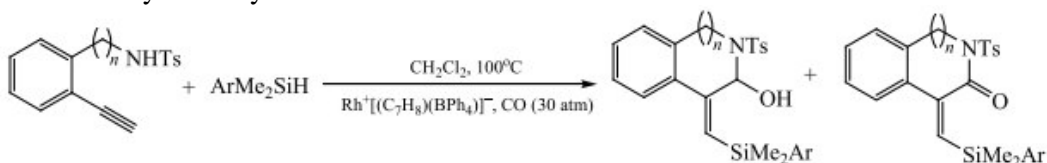
Scheme 2. Synthesis of isoquinolines using the homogeneous recyclable ruthenium catalyst.



3. Rhodium-Catalyzed Synthesis of Isoquinoline:-

Derivatives Rhodium-catalyzed cyclization has become one of the most important strategies for producing heterocyclic structures. Aronica and his colleagues, silylated tosylindolinols, and tosyltetrahydroisoquinolinols were successfully synthesized by carbocyclization reactions of N-(2-ethynylphenyl)- and N-(2-ethynylbenzyl)- tosylamides (Scheme 3) [21].

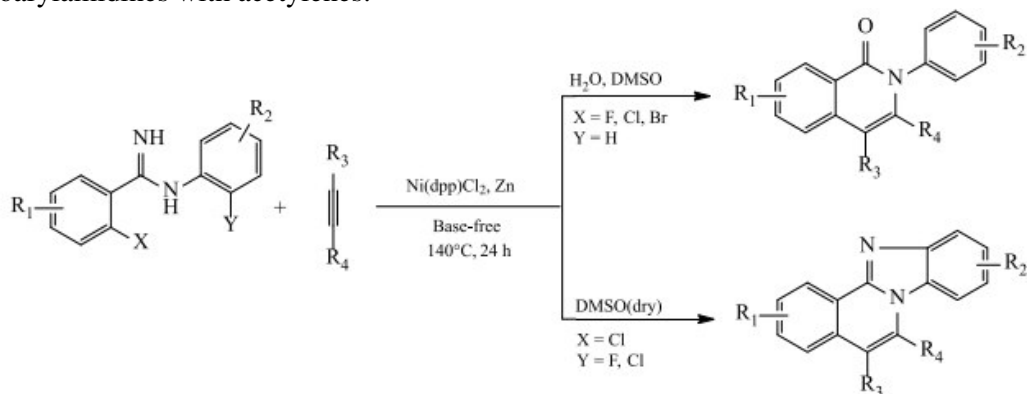
Scheme 3. Synthesis of silylindole and tetrahydroisoquinoline derivatives by silylation of toluidine with aryldimethylsilane.



4. Nickel-Catalyzed Synthesis of Isoquinoline Derivatives:-

Nickel has been used traditionally as a catalyst in reduction reactions. Its catalytic activity in cyclization reactions also has been studied. Deng and co-workers [22] introduced an efficient approach to substituted 1(2H)-isoquinolone derivatives by nickel-catalyzed cyclization of substituted alkynes with o-haloarylamidines in the presence of water (Scheme- 4)

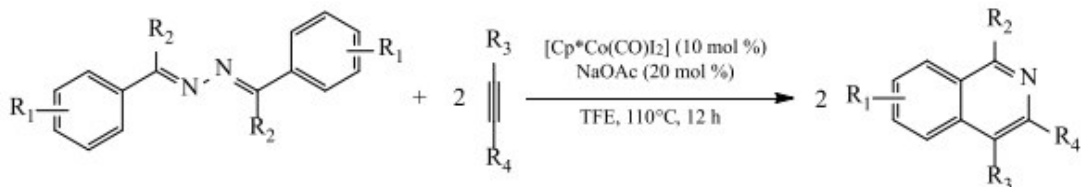
Scheme 4. Syntheses of isoquinoline one and its derivatives via cyclization of o-haloarylamidines with acetylenes.



5. Cobalt-Catalyzed Synthesis of Isoquinoline:-

Derivatives Cobalt is known as a catalyst which can coordinate with other ligands forming catalysts even of higher activity. Activation of C–H/N–N bonds of azo compounds by a cobalt catalyst was used in the synthesis of isoquinoline bicyclic derivatives (Scheme 5) [23].

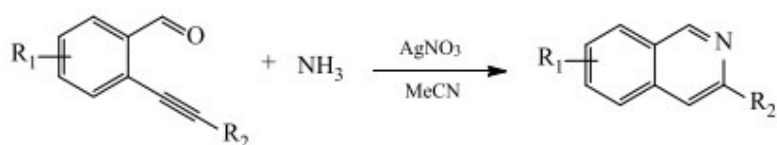
Scheme 5. Syntheses of isoquinolines via Co(III)-catalyzed annulations of azines by C–H/N–N bond activation.



6. Silver-Catalyzed Synthesis of Isoquinoline Derivatives:-

Silver exhibited significant activity in synthesis of isoquinoline derivatives due to its efficient activation of the triple bond. Zhao and co-workers [31] developed a convenient and efficient tandem reaction of o-alkynylaldehyde with ammonium bicarbonate via Ag-catalyzed 6-endo-dig closed-loop process which led to various substituted isoquinoline derivatives in moderate to excellent yields (Scheme 10) [31]. The method was characterized by the use of NH₄HCO₃ as a silver nitrate-catalyzed ammonia source in the absence of external metals.

Scheme-6. Synthesis of isoquinolines by silver-catalyzed continuous imination/annulations of 2-alkynyl aldehyde with ammonium bicarbonate.



Biological properties:

1. Anti-proliferative/anti-cancer activity:-

Although some lamellar in alkaloids, which act mainly as Top1 inhibitors, possess noticeable antiproliferative activity against a number of diverse cancer cell lines, they suffer from some limitations, such as small duration of action, high toxicity and poor solubility. Recently, Kakhki *et al.* synthesized a new class of compounds as ligands of estrogen receptors (ER) in breast cancer cell lines. These molecules were planned by merging the structure of the DHPIQ cytotoxic molecules and with the pharmacophore of the selective ER modulator tamoxifen (25)

2. Anti-platelet aggregation:-

Platelets are blood cells that play an essential role in haemostasis, but some pathological conditions including thrombosis and inflammation are attributed to these cells. These pathological conditions lead to cardiovascular disease. Hence, targeting platelets is an efficient approach for prevention and treatment of some cardiovascular diseases. Although current anti-platelet aggregation (PA) drugs show serious side effects including dangerous bleeding, finding new drugs in this field is still essential.(26) Interestingly, some *Corydalis* species have traditionally been used for the treatment of thromboembolism and can be used for finding PA inhibitors.(27).

3. Anti-inflammatory properties:-

Many natural products, particularly alkaloids and terpenes, possessed anti-inflammatory properties. Isoquinoline alkaloids were the most studied chemical structures.(28) The first report on anti-inflammatory alkaloids from *Corydalis* species dates back to 1994, a study of anti-inflammatory activities of methanolic extract and alkaloids from *C. turtschaninovii*.(29)

4. Antiviral activities

In 2006, Orhan *et al.* studied antiviral activity of 33 isoquinoline alkaloids belonging to *Fumaria* and *Corydalis* on Herpes simplex(HSV) and Parainfluenza (PI-3) viruses. Recently, Zeng *et al.* evaluated anti-HBV virus activity of dehydrocheilanthifoline (18). After six days of treatment, Dehydrocheilanthifoline (18) showed an inhibitory effect on HBsAg and HBeAg secretion from Hep G 2.2.15 cell line with IC₅₀ values of 15.84 and 17.12 mM, respectively.

5. Antibacterial and antifungal activities:-

Isoquinoline alkaloids show good antibacterial and antifungal activities. A high content of berberine (161) is established in the well-known Chinese drug (Huangliansu) taken to treat intestinal infections caused by *Bacillus dysenteriae*, *Escherichia coli* and other microorganisms. Berberine also effectively protected mice infected with *Salmonella typhimurium*.(30). The easy isoquinoline alkaloid carnegine (4) showed antibacterial activity with MIC ranging from 564 to 2259 μ M against various strains.

CONCLUSION:-

As presented above, according to the reaction conditions, the synthetic approaches to isoquinoline and its derivatives have been designed and developed by a multiplicity of methods, involving the use of transition metals or non-metals as catalysts. The transition metal catalysts show good low consumption, catalytic activity, and some of those can be

recycled. The non-metal catalysts are more environmentally friendly, and the corresponding reaction conditions are relatively mild, even can be used directly as region selective reactants, due to which might lead to further transformations. Isoquinoline ring has been found to have broad range of biological and pharmacological activities. Application in dyes industry, research in synthesis of chiral isoquinoline derivatives and isoquinolinium salts.

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“AN EFFICIENT SYNTHESIS OF SOME NOVEL BIO ACTIVE 5-OXO-IMIDAZOLINE DERIVATIVES COMPRISING QUINOLINEBENZOFURAN AND PYRAZOLE MOIETY”

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ABSTRACT

In the present work we have reported synthesis of novel 5-oxo-imidazoline (**5a-e**) derivatives containing benzofuran, pyrazole, quinoline ether moieties. It comprises preparation of intermediate 4-((2-(*p*-tolylloxy)-substituted quinolin-3-yl) methylene)-2-phenyloxazol-5(4*H*)-one (**3a-e**) from benzoyl glycine and substituted 2-(*p*-tolylloxy)-substituted quinoline-3-carbaldehyde (**2a-e**) in presence anhydrous sodium acetate and acetic anhydride. These oxazolinone derivatives (**3a-e**) is further treated with 5-(benzofuran-2-yl)-1-phenyl-1*H*-pyrazole-3-carbohydrazide (**4**) in acetic acid to afford the target derivatives 4-((2-(*p*-tolylloxy)-substitutedquinolin-3-yl)methylene)-4,5-dihydro-5-oxo-2-phenylimidazol-1-yl)-5-(benzofuran-2-yl)-1-phenyl-1*H*-pyrazole-3-carboxamide (**5a-e**). The characterization of newly synthesized compound (**3a-e**) and (**5a-e**) was made by, FTIR, ¹HNMR, ¹³CNMR, elemental analysis and further supported by Mass spectra. All synthesized compounds were screened for their *in-vitro* antimicrobial activity at different concentration against a panel of pathogenic microorganism including *S. aureus* as Gram positivewhile *E.coli*, *P.vulgaris*, *S.typhi* as Gram negative bacterial strains. The result of bioassay is compared with Chloramphenicol as standard drug.

Keywords: Carbohydrazide, 5-oxo-imidazoline, Phenyl oxazole, (*p*-tolylloxy)quinoline-3-carbaldehyde, Antimicrobial activity.

INTRODUCTION

The Nitrogen containing heterocyclic compounds such as imidazolinone have grown enormous importance due to biologically accepted pharmacophores owing to wide range of biological activities as well as their various pharmacological actions. Consequently over the year's 5-oxo-imidazoline related drugs have fascinated the attention of the scientific community to synthesize a large number of imidazolinone derivatives as novel chemotherapeutic medicines. Numerous drugs contain imidazole ring, such as antifungal drugs like Ketoconazole, Miconazole, Clotrimoxazole and Nitroimidazole. The significance

of imidazolinone with quinoline heterocyclic nucleus in the field of medicinal chemistry research is worth mentioning. 5-oxo-imidazole have been reported to exhibit a wide range of diverse bioactivities such as antimicrobial¹⁻⁷, non-purine xanthine oxidase inhibitors⁸, anticancer⁹⁻¹¹, antihistaminic¹², antioxidant agents¹³, antifungal^{14,15}, antipyretic and wound healing¹⁶, anticonvulsant^{17,18}, biological¹⁹⁻²², anthelmintic²³, photochemical probe agents²⁴, anti-hyperglycaemic agents²⁵, CNS depressant²⁶, herbicidal²⁷, anti-HIV²⁸, multi-domain peptide²⁹. Besides this Imidazole nucleus is also present in natural products such as, alkaloids³⁰, they are utilized as valuable synthetic templates for the preparation of innovative compounds with specific biological, pharmaceutical and material properties.

All of these above facts inspired us to synthesize some novel series of 5-(benzofuran-2-yl)-*N*-4,5-dihydro-5-oxo-4-((2-phenoxyquinolin-3-yl)methylene)-2-phenylimidazol-1-yl)-1-methyl-1*H*-pyrazole-3-carboxamide **5a-e** derivatives and screen them against some pathogenic bacterial strains with a assumed that combination of imidazolinone ring with quinoline moiety may enhance their pharmacological activities as in the area of medicinal chemistry the synthesis of these types of derivatives is always a crucial factor.

MATERIAL & METHODS

Chemicals used for the synthesis were of AR grade of Merck, S.D. Fine and Aldrich. The reactions were monitored by E. Merck TLC aluminum sheet silica gel₆₀F₂₅₄ and visualizing the spot in UV Cabinet and iodine chamber. The melting points were recorded in open capillary in paraffin bath and are uncorrected. ¹H NMR spectra are recorded on a Bruker AM 400 instrument (400 MHz) using tetramethylsilane (TMS) as an internal reference and DMSO-*d*₆ as solvent. Chemical Shifts are given in parts per million (ppm). Positive-ion Electro Spray Ionization (ESI) mass spectra were obtained with a Waters Micromass Q-TOF Micro, Mass Spectrophotometer. IR spectra were recorded on a Shimadzu IR Spectrophotometer (KBr, ν_{\max} in cm^{-1}). The compounds are purified by using column chromatography on silica gel (60-120 mesh). Elemental (CHN) analysis was done using Thermo Scientific (Flash-2000), the compounds were analysed for carbon, hydrogen and nitrogen and the results obtained are in good agreement with the calculated values.

Procedure for the synthesis of 4-((2-(*p*-tolylxy)-substituted quinolin-3-yl) methylene)-2-phenyloxazol-5(4*H*)-one(3a-e): In a 250mL conical flask mixture of (2.73g , 0.015mol) of benzoyl glycine³¹(**1**) and (4.15g , 0.015mol) of 2-(*p*-tolylxy)-8-methylquinoline-3-carbaldehyde³² (**2a**) was taken to that (2.12mL, 0.045mol) acetic anhydride and (1.23g , 0.015mol) anhydrous sodium acetate were added. Reaction content was heated on electric hot plate with constant shaking until the mixture liquefies completely, then it was refluxed on water bath for 2h then 10mL of ethanol was added to the content of the flask and the mixture was allowed to stand overnight. The crystalline precipitate formed was filtered, washed, dried and recrystallized using benzene to afford compound **3a**. Correspondingly, other (4)-4-((2-(*p*-tolylxy)-substituted quinolin-3-yl) methylene)-2-phenyloxazol-5(4*H*)-ones **3b-e** were synthesized from compound **1** and **2b-e** by following the same procedure for **3a** 4-((2-(*P*-Tolyloxy)-8-methyl quinoline) methylene)-2-phenyloxazol-5(4*H*)-one(**3a**): yellow amorphous solid, mp 198°C; yield, 85%; (from benzene); M.F; C₂₇H₂₀N₂O₃. IR(KBr, ν_{\max} in cm^{-1}): 3063, 3035(C-H str., arom.), 2952, (C-H asym. str., aliph.), 2919(C-H sym. str., aliph.), 1469, 1451 (C-H asym.def., aliph.), 1369(C-H sym.def., aliph.), 1602, 1553 (C=C str., arom.), 1075 (C-H i.p.def., arom.), 884, 759(C-H o.o.p.def., arom.), 1251(C-O-C asym. str., ether), 1053, 1022 (C-O-C sym. str., ether), 1656, 1602 (C=N str., oxazolone ring), 1221(C-N str.), 1765, 1796(CO str. in oxazolone ring). ¹H NMR (DMSO-*d*₆) δ ppm; 2.34(s, 3H, -CH₃ attached to aromatic ring), 2.37(s, 3H, -CH₃ attached to quinoline ring), 7.10-8.29(m, 14H, aromatic & quinoline ring protons).

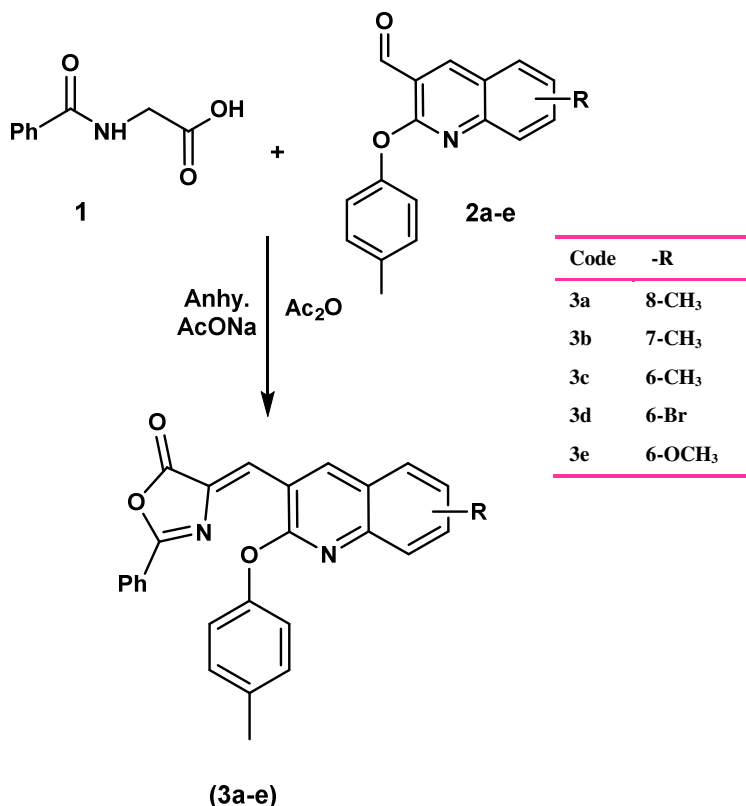
4-((2-(*P*-Tolyloxy)-7-methylquinolin-3-yl)methylene)-2-phenyloxazol-5(4*H*)-one(3b):

yellow amorphous solid, mp 203°C; yield, 83%; (from benzene); M.F; C₂₇H₂₀N₂O₃. IR(KBr, ν_{max} in cm⁻¹): 3061, 3032(C-H str., arom.), 2954, (C-H asym. str., aliph.), 2916(C-H sym. str., aliph.), 1455, 1470(C-H asym.def., aliph.), 1366(C-H sym.def., aliph.), 1608, 1556(C=C str., arom.), 1072(C-H i.p.def., arom.), 886,756(C-H o.o.p.def., arom.), 1253(C-O-C asym. str., ether), 1051,1024 (C-O-C sym. str., ether), 1652, 1606(C=N str., oxazolone ring), 1226(C-N str.), 1763,1793(CO str. in oxazolone ring). ¹H NMR (DMSO-d₆) δppm;2.35(s, 3H, -CH₃ attached to aromatic ring), 2.34(s, 3H, -CH₃ attached to quinoline ring), 7.10-8.50(m, 14H, aromatic & quinoline ring protons).

4-((2-(*P*-Tolyloxy)-6-methylquinolin-3-yl)methylene)-2-phenyloxazol-5(4*H*)-one (3c):

yellow amorphous solid, mp 196°C; yield, 88%; (from benzene); M.F C₂₇H₂₀N₂O₃. IR(KBr, ν_{max} in cm⁻¹):3064, 3037(C-H str., arom.), 2956(C-H asym. str., aliph.), 2921(C-H sym. str., aliph.), 1453, 1473(C-H asym.def., aliph.), 1363(C-H sym.def., aliph.), 1609,1558 (C=C str., arom.), 1071(C-H i.p.def., arom.), 881,761(C-H o.o.p.def., arom.), 1253(C-O-C asym. str., ether), 1056,1027 (C-O-C sym. str., ether), 1659,1609(C=N str., oxazolone ring), 1230(C-N str.), 1767,1791(CO str. in oxazolone ring). ¹H NMR (DMSO-d₆) δppm;2.34(s, 3H, -CH₃ attached to aromatic ring), 2.35(s,3H, -CH₃ attached to quinoline ring), 6.90-8.44(m,14H, aromatic & quinoline ring protons).

Reaction scheme – I



4-((2-(*P*-Tolyloxy)-6-bromoquinolin-3-yl)methylene)-2-phenyloxazol-5(4*H*)-one (3d):

yellow amorphous solid, mp 201°C; yield, 86 %; (from benzene); M.F C₂₆H₁₇BrN₂O₃.IR(KBr, ν_{max} in cm⁻¹): 3066, 3038(C-H str., arom.), 2951 (C-H asym. str., aliph.), 2922(C-H sym. str., aliph.), 1453, 1476(C-H asym.def., aliph.), 1366(C-H sym.def., aliph.), 1605,1550(C=C str., arom.), 1078(C-H i.p.def., arom.), 884, 754(C-H o.o.p.def., arom.), 1254(C-O-C asym. str., ether), 1050,1020(C-O-C sym. str., ether), 1658,1605 (C=N

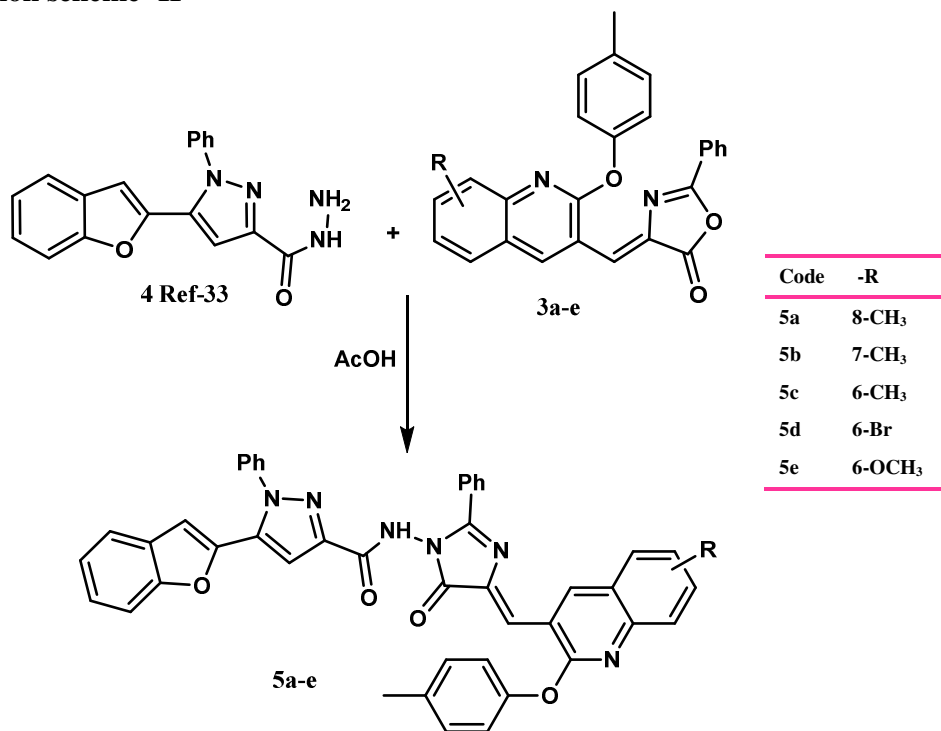
str., oxazolone ring), 1221(C-N str.), 1765,1796(CO str. in oxazolone ring). ¹H NMR (DMSO-d₆) δppm;2.36(s, 3H, -CH₃ attached to aromatic ring), 6.89-8.48(m, 14H, aromatic & quinoline ring protons).

4-((2-(p-tolyloxy)-6-methoxyquinolin-3-yl)methylene)-2-phenyloxazol-5(4H)-one(3e)::

Yellow amorphous solid, mp 204°C; yield, 84 %; (from benzene); M.F C₂₇H₂₀N₂O₄. IR(KBr, ν_{max} in cm⁻¹): 3060,3033(C-H str., arom.), 2956(C-H asym. str., aliph.), 2924(C-H sym. str., aliph.), 1456,1462(C-H asym.def., aliph.), 1365(C-H sym.def., aliph.), 1604, 1556(C=C str., arom.), 1077 (C-H i.p.def., arom.), 882,763(C-H o.o.p.def., arom.), 1257(C-O-C asym. str., ether), 1053,1029 (C-O-C sym. str., ether), 1651,1604(C=N str., oxazolone ring), 1229(C-N str.), 1766, 1794(CO str. in oxazolone ring).

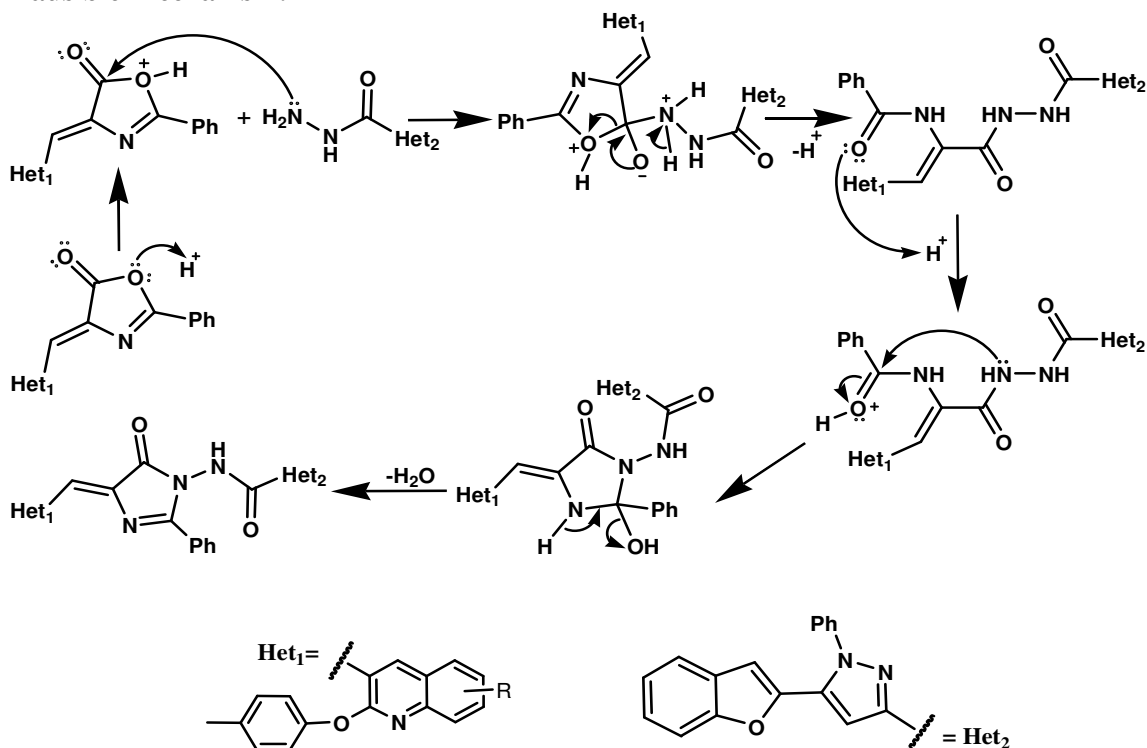
Procedure for the Synthesis of 5-(Benzofuran-2-yl)-N-(5-oxo-2-phenyl-4-((2-(p-tolyloxy)-substituted-quinolin-3-yl)methylene)-4,5-dihydroimidazol-1-yl)-1-phenyl-1H-pyrazole-3-carboxamide (5a-e): In100 mL. B flask mixture of(2.18g, 0.005mol) of 4-((2-(P-Tolyloxy)-8-methyl quinoline) methylene)-2-phenyloxazol-5(4H)-one(**3a**) and (1.59 g, 0.005mol) of 5-(benzofuran-2-yl)-1-phenyl-1H-pyrazole-3-carbohydrazide (**4**)³³ was taken and 20mL of acetic acid was added, contents was refluxed for 8h. Resulting mass was poured into crushed ice, filtered and the product wasrecrystallized from ethanol to afford (**5a**).

Reaction scheme -II



Correspondingly, other 4-((2-(p-tolyloxy)-substitutedquinolin-3-yl)methylene)-4,5-dihydro-5-oxo-2-phenylimidazol-1-yl)-5-(benzofuran-2-yl)-1-phenyl-1H-pyrazole-3-carboxamide**5b-** were also synthesized from compound **4**and **3a-i** by following the similar procedure for **5a**.

Plausible Mechanism:



4-((2-(*P*-Tolyloxy)-8-methylquinolin-3-yl)methylene)-4,5-dihydro-5-oxo-2-phenylimidazol-1-yl)-5-(benzo furan-2-yl)-1-phenyl-1*H*-pyrazole-3-carboxamide (5a): IR(KBr, ν_{\max} in cm^{-1}): 3408, 3198(N-H str., -CONH-), 3063(C-H str., arom.), 2955(C-H asym. str., aliph.), 2841(C-H sym. str., aliph.), 1454(C-H asym.def., aliph.), 1370(C-H sym.def., aliph.), 1506, 1453(C=C str., arom.), 1075, 1023,1006(C-H i.p.def., arom.), 836(C-H o.o.p.def., arom.), 1258, 1235(C-O-C asym. str., ether), 1075, 1023(C-O-C sym. str., ether), 1525(C=N str., pyrazole ,imidazole and quinoline nucleus), 1659(C=O str., 5-oxo-imidazolines ring), 1619(C=O str., amide group), 1166(C-N-C str.), 1075(C-N str.). ^1H NMR (DMSO- d_6 , 400 MHz): δ (ppm)2.40(s, 3H, - CH_3 attached to aromatic ring), 2.38(s, 3H, - CH_3 attached to quinoline ring), 12.22(s,1H, -CONH- linkage), 6.57-8.90(m,25H, aryl ,pyrazole, quinoline ring and ethylenic protons), ^{13}C NMR (DMSO- d_6): δ (ppm)23(- CH_3), 20(- CH_3 attached to quinoline ring), 106.51, 110, 119, 120, 123, 125, 126, 127, 129 ,130, 132, 133, 135, 139, 140, 144(s,1C, C_3 of pyrazole ring), 154(s,1C, C_9 of Benzofuran ring), 155 (s,1C, C_6 of quinoline),161(s, 1C,amide linkage), 166(s, 1C, C_5 of 5-oxo-imidazoline ring), 172(s, 1C, C_2 of quinoline ring to which phenyloxy group attached)GC-MS (m/z):720 [M],Elemental Anal.Calcd for $\text{C}_{45}\text{H}_{32}\text{N}_6\text{O}_4$ calculated;C, 74.99; H, 4.47; N, 11.66; Found C, 74.79; H,4.33; N,11.34.

5-(Benzofuran-2-yl)-*N*-(4-((7-methyl-2-(*p*-tolylloxy)quinolin-3-yl)methylene)-5-oxo-2-phenyl-4,5-dihydroimidazol-1-yl)-1-phenyl-1*H*-pyrazole-3-carboxamide(5b):IR(KBr, ν_{\max} in cm^{-1}): 3405, 3193(N-H str., -CONH-), 3058(C-H str., arom.), 2953(C-H asym. str.,aliph.), 2844(C-H sym. str., aliph.), 1452(C-H asym.def., aliph.), 1367(C-H sym.def., aliph.), 1506, 1451(C=C str., arom.), 1074, 1032,1006(C-H i.p.def., arom.), 832(C-H o.o.p.def., arom.), 1255, 1232(C-O-C asym. str., ether), 1074,1032(C-O-C sym. str., ether), 1526(C=N str., Pyrazole ,imidazole and quinoline nucleus), 1656(C=O str., 5-oxo-imidazolines ring), 1617(C=O str., amide group) , 1161(C-N-C str.), 1074(C-N str.). ^1H NMR

(DMSO-d₆, 400 MHz): δ (ppm)2.43(s, 3H, -CH₃ attached to aromatic ring), 2.35(s, 3H, -CH₃ attached to quinoline ring), 12.16(s,1H, -CONH- linkage), 6.8-8.90(m,25H, aryl ,pyrazole, quinoline ring and ethylenic protons),¹³C NMR (DMSO-d₆): δ (ppm)24(-CH₃), 20(-CH₃ attached to quinoline ring), 106, 114, 118, 121, 122, 125, 126, 127, 129, 130, 132, 134, 135, 139, 140, 140(s,1C, C₃ of pyrazole ring), 155(s,1C, C₉ of Benzofuran ring), 154 (s,1C,C₆ of quinoline),160(s, 1C,amide linkage), 167(s, 1C, C₅ of 5-oxo-imidazoline ring), 170(s, 1C, C₂ of quinoline ring to which phenyloxy group attached)GC-MS (*m/z*):720 [M],Elemental Anal. Calcd forC₄₅H₃₂N₆O₄calculated;C, 74.99; H, 4.47; N, 11.66; found C, 74.70; H, 4.38; N, 11.24.

5-(Benzofuran-2-yl)-N-(4-((6-methyl-2-(*p*-tolylloxy)quinolin-3-yl)methylene)-5-oxo-2-phenyl-4,5-dihydro imidazol-1-yl)-1-phenyl-1*H*-pyrazole-3-carboxamide (5c):IR(KBr, ν_{\max} in cm⁻¹): 3407, 3199(N-H str., -CONH-), 3064(C-H str., arom.), 2956(C-H asym. str., aliph.), 2846(C-H sym. str., aliph.), 1455(C-H asym.def., aliph.), 1364(C-H sym.def., aliph.), 1500, 1457(C=C str., arom.), 1073, 1023, 1006(C-H i.p.def., arom.), 835(C-H o.o.p.def., arom.), 1251, 1234(C-O-C asym. str., ether), 1073, 1023(C-O-C sym. str., ether), 1528(C=N str., pyrazole, imidazole and quinoline nucleus), 1658(C=O str., 5-oxo-imidazolines ring), 1615(C=O str., amide group), 1168(C-N-C str.), 1073(C-N str.). ¹H NMR (DMSO-d₆, 400 MHz): δ (ppm)2.40(s, 3H, -CH₃ attached to aromatic ring), 2.37(s, 3H, -CH₃ attached to quinoline ring), 12.20(s,1H, -CONH- linkage), 6.57-8.90(m,25H, aryl ,pyrazole, quinoline ring and ethylenic protons),¹³C NMR (DMSO-d₆): δ (ppm)23(-CH₃), 21(-CH₃ attached to quinoline ring), 105, 111, 119, 121, 123, 124, 126, 127, 129, 130, 132, 133, 135, 139, 140, 142(s,1C, C₃ of pyrazole ring), 156(s,1C, C₉ of Benzofuran ring), 153(s,1C,C₆ of quinoline),161(s, 1C,amide linkage), 165(s, 1C, C₅ of 5-oxo-imidazoline ring), 172(s, 1C, C₂ of quinoline ring to which phenyloxy group attached)GC-MS (*m/z*):719.70 [M], Elemental Anal.Calcd forC₄₅H₃₂N₆O₄ calculated;C, 74.99; H, 4.47; N, 11.66; found C, 74.80; H, 4.30; N, 11.40.

5-(Benzofuran-2-yl)-N-(4-((6-bromo-2-(*p*-tolylloxy)quinolin-3-yl)methylene)-5-oxo-2-phenyl-4,5-dihydro imidazol-1-yl)-1-phenyl-1*H*-pyrazole-3-carboxamide (5d): IR(KBr, ν_{\max} in cm⁻¹): 3403, 3193(N-H str., -CONH-), 3066(C-H str., arom.), 2950(C-H asym. str., aliph.), 2848(C-H sym. str., aliph.), 1457(C-H asym.def., aliph.), 1373(C-H sym.def., aliph.), 1506, 1459(C=C str., arom.), 1072, 1023, 1006(C-H i.p.def., arom.), 833(C-H o.o.p.def., arom.), 1254, 1238(C-O-C asym. str., ether), 1072, 1023(C-O-C sym. str., ether), 1529(C=N str., pyrazole ,imidazole and quinoline nucleus), 1652(C=O str., 5-oxo-imidazolines ring), 1623(C=O str., amide group), 1166(C-N-C str.), 1072(C-N str.). ¹H NMR (DMSO-d₆, 400 MHz): δ (ppm)2.41(s, 3H, -CH₃ attached to aromatic ring), 12.16(s,1H, -CONH- linkage), 6.61-8.00(m,25H, aryl ,pyrazole, quinoline ring and ethylenic protons), ¹³C NMR (DMSO-d₆): δ (ppm)24(-CH₃), 109, 116, 117, 121, 122, 125, 126, 127, 129, 130, 132, 133, 135, 139, 140, 145(s,1C, C₃ of pyrazole ring), 155(s,1C, C₉ of Benzofuran ring), 153 (s,1C,C₆ of quinoline),160(s, 1C,amide linkage), 168(s, 1C, C₅ of 5-oxo-imidazoline ring), 171(s, 1C, C₂ of quinoline ring to which phenyloxy group attached)GC-MS (*m/z*):784 [M], Elemental Anal.Calcd forC₄₄H₂₉BrN₆O₄ calculatedC, 67.27; H, 3.72; N, 10.70; found C, 67.10; H, 3.56; N, 10.10.

5-(benzofuran-2-yl)-N-(4-((6-methoxy-2-(*p*-tolylloxy)quinolin-3-yl)methylene)-5-oxo-2-phenyl-4,5-dihydro imidazol-1-yl)-1-phenyl-1*H*-pyrazole-3-carboxamide (5e):IR(KBr, ν_{\max} in cm⁻¹): 3400, 3196 (N-H str., -CONH-), 3061(C-H str., arom.), 2952(C-H asym. str., aliph.), 2843(C-H sym. str., aliph.), 1450(C-H asym.def., aliph.), 1369(C-H sym.def., aliph.), 1504, 1450(C=C str., arom.), 1072, 1029, 1003 (C-H i.p.def., arom.), 830(C-H o.o.p.def., arom.), 1256, 1237(C-O-C asym. str., ether), 1072, 1029(C-O-C sym. str., ether), 1523(C=N str., Pyrazole, imidazole and quinoline nucleus), 1656(C=O str.,5-oxo-imidazolines ring),

1616(C=O str., amide group) , 1164(C-N-C str.), 1072 (C-N str.). ¹H NMR (DMSO-d₆, 400 MHz):δ (ppm) 2.41(s, 3H, -CH₃ attached to aromatic ring), 3.82(s,3H, -OCH₃ attached to quinoline ring), 12.20(b,1H, -CONH- linkage), 6.57-8.90(m,25H, aryl ,pyrazole, quinoline ring and ethylenic protons) ¹³C NMR (DMSO-d₆): δ (ppm) 21(-CH₃), 55(-OCH₃), 106.51, 111, 119, 122, 123, 125, 126, 127, 128 ,129, 132, 133, 135, 139, 140, 144(s,1C, C3 of pyrazole ring), 153(s,1C, C9 of Benzofuran ring), 155 (s,1C,C6 of quinoline),158,161(s, 1C,amide linkage), 168(s, 1C, C5 of 5-oxo-imidazoline ring), 172(s, 1C, C2 of quinoline ring to which phenyloxy group attached) GC-MS (m/z): 736 [M], Elemental Anal. Calcd for C₄₅H₃₂N₆O₅ calculated; C, 73.36; H, 4.38; N, 11.41; found C, 73.70; H, 4.30; N, 11.24.

General procedure for the determination of zone of inhibition by agar disc-diffusion method: *In vitro* antibacterial activity was determined by using Mueller Hinton Agar obtained from Hi media Ltd., Mumbai. Petri plates were prepared by pouring 10mL of Mueller Hinton Agar for bacteria containing microbial culture was allowed to solidify. Test solutions were prepared with known weight of compound in DMSO and half diluted suitably to give the resultant concentration of 31-1000µg/mL. Whatmann no.1 sterile filter paper discs (6 mm) were impregnated with solution and allowed to dry at room temperature. The discs were then applied and the plates were incubated at 37°C for 24h (bacteria) and the inhibition zone was measured as diameter in four directions and expressed as mean. The results of the antimicrobial screening are illustrated in the Table 2 and 3.

Table 1: Physical data of the synthesized compound 5a-e

Entr y	R	Colour	Recry. solvent	M.F	M.pt. °C	% yield	Rf
5a	8-CH ₃	Yellow	Ethanol	C ₄₅ H ₃₂ N ₆ O ₄	210	80	0.75
5b	7-CH ₃	Yellow	Ethanol	C ₄₅ H ₃₂ N ₆ O ₄	209	78	0.68
5c	6-CH ₃	Yellow	Ethanol	C ₄₅ H ₃₂ N ₆ O ₄	214	82	0.67
5d	6-Br	Yellow	Ethanol	C ₄₄ H ₂₉ BrN ₆ O ₄	212	80	0.69
5e	7-Cl	yellow	Ethanol	C ₄₄ H ₂₉ ClN ₆ O ₄	210	79	0.72

Table 2: Antibacterial activity of 5a-e

Compd. Code	Zone of Inhibition (mm)											
	Gram +ve <i>S. aureus</i>						Gram -ve <i>P. vulgaris</i>					
	Conc. (µg/mL)											
	1000	500	250	125	63.5	31	1000	500	250	125	63.5	31
5a	26	24	20	18	16	18	27	24	25	20	19	15
5b	24	24	19	15	17	15	26	22	24	18	17	16
5c	25	21	19	16	15	14	25	23	19	20	15	14
5d	25	23	22	20	16	15	26	25	19	17	16	17
5e	22	24	21	19	18	13	27	23	22	20	18	16
DMSO	-	-	-	-	-	-	-	-	-	-	-	-
Std. Drug Chloramphenicol	25	22	20	19	17	15	26	24	23	21	17	15

Table 3: Antibacterial activity of 5a-e

Compd. Code	Zone of Inhibition (mm)											
	Gram -ve											
	<i>E. coli</i>						<i>S.typhi</i>					
	Conc. (µg/mL)						Conc. (µg/mL)					
	1000	500	250	125	63.5	31	1000	500	250	125	63.5	31
5a	27	23	24	21	16	14	19	16	13	10	10	09
5b	25	22	24	21	18	12	18	17	12	13	09	08
5c	26	23	22	17	16	13	15	14	13	12	08	07
5d	24	25	23	22	17	11	18	13	11	12	10	08
5e	27	23	23	21	14	12	17	15	12	13	09	06
DMSO	-	-	-	-	-	-	-	-	-	-	-	-
Std. Drug Chloramphenicol	26	24	23	21	17	14	17	15	12	11	09	08

RESULTS AND DISCUSSION

The synthesis of the title compound **5a-e** is described in the reaction schemes **1** and **2**. At every stage reaction was monitored with TLC technique. The identities of synthesized compounds have been confirmed using elemental and different spectroscopic techniques such as IR, ¹H NMR and ¹³C NMR and they were also evaluated for their antimicrobial activity. The synthesis of the starting compound 4-((2-(*p*-tolylloxy)-substituted quinolin-3-yl)methylene)-2-phenyloxazol-5(4*H*)-one **3a-e** was achieved in quantitative yields by reacting benzoyl glycine³¹ (**1**) with 2-(*p*-tolylloxy)-substituted quinoline-3-carbaldehyde **2a-e**. IR spectrum of **3a** showed characteristic absorption bands at 1765, 1796 cm⁻¹ due to CO stretch, and another band at 1656 cm⁻¹ is due to C=N stretch in oxazolone ring. Other absorption band was observed at 1053, 1022 cm⁻¹ due to their C-O-C symmetric stretching. ¹H NMR of **3a** showed a singlet at δ 2.34 ppm due to three protons of -CH₃ attached to aromatic ring similarly another singlet observed at δ 2.37 ppm was due to three protons of -CH₃ attached to quinoline ring. Aromatic and quinoline ring proton shows multiplet in the range of δ 6.57-8.90 ppm, thus all above spectral data confirms the formation of compound **3a**.

The reaction of 5-(benzofuran-2-yl)-1-phenyl-1*H*-pyrazole-3-carbohydrazide **4** with 4-((2-(*p*-tolylloxy)-substituted quinolin-3-yl)methylene)-2-phenyloxazol-5(4*H*)-one **3a-i** in acetic acid solvent afforded **5a-e** in good yields. IR spectrum of **5e** showed a distinct absorption band at 3400 cm⁻¹ due to NH stretch band while a band at 1523 cm⁻¹ aroused due to C=N stretch in pyrazole, band at 1164 cm⁻¹ was due to C-N-C stretch. Two characteristic stretching bands due to two carbonyl groups were seen at 1650 cm⁻¹ and 1616 cm⁻¹, hence it is confirmed that 4-((2-(*p*-tolylloxy)-6-methoxy quinolin-3-yl)methylene)-2-phenyloxazol-5(4*H*)-one has been condensed with 5-(benzofuran-2-yl)-1-phenyl-1*H*-pyrazole-3-carbohydrazide (**4**). ¹³C NMR spectra of compound **5e** also showed a singlet at 168 ppm due to the carbon of (-CONH-), another singlet at 172 ppm was observed due to the carbon of carbonyl group (-CO) similarly, a signal at 55.41 ppm was obtained due to the carbon of methoxy group (-OCH₃). Molecular ion peak for compound **5e** [M]⁺ at 736 as obtained in GC-MS spectra and its elemental analysis reveals that % of C, H and N are 73.30, 4.32, 11.39 respectively, is in good agreement with the proposed molecular formula of compound **5e** is C₄₅H₃₂N₆O₅.

Antibacterial activity

The antibacterial activity of the synthesized molecule against bacterial strains of Gram positive and Gram negative express in terms of zone of inhibition result depicted in table no 2 and 3. Antibacterial screening results revealed that most of the synthesised 5-oxo-imidazole derivative **5a-e** exhibit significant antibacterial activity. Test compounds **5a**, **5b**, at a conc. 1000µg/mL and 500µg/mL and **5d** and **5e** at a conc. 31µg/mL and 63.5 µg/mL exhibited excellent activity than the standard drug Chloramphenicol against Gram positive bacteria *S. aureus* and Gram negative bacteria *P. vulgaris*, *E. coli*. Test compounds **5a**, **5b**, at a conc. 31µg/mL and 63.5µg/mL also shows enormous activity against Gram negative bacteria *S.typhi* in compared with reference standard drug at particular concentration. Results also indicated that few of the titled compounds **5c**, **5f** showed moderate to good activity at some concentration while the entire synthesized compound **5c-e** showed poor activity against Gram negative bacteria *S.typhi*. From the consequences it can established that tested compounds showed variable toxicity against selected strains of bacteria. This incongruity in toxicity it may be due to different substitution on *p*-tolyl oxy quinoline which is attached to the basic 5-oxo-imidazole nucleus which enhances the biological activities.

CONCLUSION

we have described the synthesis and antimicrobial screening of series of novel 4-((2-(*P*-Tolyloxy)-substituted quinolin-3-yl)methylene)-4,5-dihydro-5-oxo-2-phenylimidazol-1-yl)-5-(benzofuran-2-yl)-1-phenyl-1*H*-pyrazole-3-carboxamide **5a-e** derivatives through intermediate compound 4-((2-(*P*-Tolyloxy)-substituted quinolin-3-yl) methylene)-2-phenyloxazol-5(4*H*)-one **3a-e** derivatives. Structures of newly synthesised compound **5a-e**, and **3a-e** their purity was checked by physical, analytical and spectral data. The result of bioassay showed that test compounds **5a**, **5b**, **5d** and **5e** at showed remarkable activity against Gram positive bacteria *S. aureus* and Gram negative bacteria *P. vulgaris*, *E. coli* and out of all synthesised only test compounds **5a**, **5b** showed excellent activity against Gram negative bacteria *S.typhi* as compared with standard drug reference drug.

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GREEN METHOD FOR THE SYNTHESIS OF IMIDAZOLE

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Abstract:-

In this study, a Substituted imidazole was synthesized by aromatic aldehydes, Benzil and Ammonium Acetate using commercially available chitosan in 2% acetic acid in aqueous media at 60–65°C. Chitosan (CS) is a natural cationic amino polysaccharide which obtained by alkaline N-deacetylation of chitin. The products were then investigated for antibacterial activity against *A. Niger* and *F. Oxysporum* and antibacterial activity against *S. aureus* and *B. subtilis* using Kirby-Bauer disc diffusion method. Use of a green Catalyst, mild reaction conditions and simple and chromatography free work-up procedure.

Introduction:-

Imidazoles are an important heterocyclic structural motif in functional molecules and are utilized in a diverse range of applications[1] Substituted imidazoles exhibit a variety of valuable pharmacological properties such as antiparasitic, antifungal, and antimicrobial activity[2]. , imidazole is one of the most important N-based heterocyclic aromatic compounds. Recently, imidazole scaffold has captured the attention of many scientists due to having biological activities and different types of industrial applications. It was first synthesized by Debus, in 1858, who isolated the derivatives from the three-component compounds like dicarbonyl, aldehyde, ammonia, or its salts[3] imidazoles have been synthesized by using modest, effectual, clean, globally approachable, and green protocols. Using this key solution for large scale reaction, there is possibility to overcome from pollution problem. For this reason, recently, many protocols have been developed for the synthesis of imidazole derivatives catalyzed by ionic liquids, using a green catalyst, without the catalyst, reaction under microwave irradiation[4]. Chitosan is a linear polysaccharide of glucosamine produced from chitin deacetylation in alkaline media. Chitin is obtained from the exoskeleton of shrimps, crabs, and squids. Therefore, chitosan is environmentally benign and biodegradable Catalyst [5] Chitosan is an abundant, biodegradable, and renewable green material with diverse functionalities. It is a valuable substance used prolifically in numerous applications, such as catalysis, adsorption, delivery of therapeutic agents, and remediation[6]. Chitosan has been attracted much attention due to the unique attributes such as affordability, accessibility, hydrophobicity, biocompatibility, and thermal stability[7]

Chitosan as a sustainable organocatalyst have been used[8] Singh and Rajput prepared a magnetic chitosan/Fe₃O₄ support followed by modification with glutaraldehyde and immobilization of cobalt acetate. Three-component reactions with Benzil, Aromatic aldehydes, and Ammonium acetate afforded 2,4,5-trisubstituted imidazole with medium to high yields[9] Due to such a wide range of applicability, there has been increasing interest in the developments of efficient methodologies for the synthesis of imidazole derivatives,

because large numbers of developments of imidazoles methodologies in heterocyclic syntheses are presented in a concise systematic manner. It is due to their versatility and utility in a number of these areas that expedient methods for the synthesis of imidazole are both highly topical and necessary. The present article is intended to briefly review on recent research progress concerning the synthesis of various imidazole derivatives using Green Catalyst Chitosan methodology, which mainly includes substituted imidazole synthesized. They were synthesized by using the green methodology.

Material and Methods:-

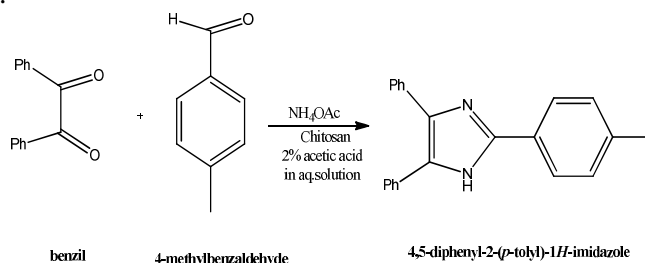
All the chemical of analytical grade. Benzil, 4-methoxybenzaldehyde, Ammonium Acetate (Sigma-Aldrich) were purchased from Sigma-Aldrich and used without further purification. IR Spectra recorded on Perkin Elmer Spectrometer in range 4000-400 cm⁻¹ KBr pellets. Room Temperature magnetic moments by Guoy's method in B.M. Electronic Spectra using DMSO on Varian Carry 5000 Spectrometer. Molar Conductance measurements in dry DMSO having 1×10⁻³ concentration on Systronics conductivity bridge at room temperature. Elemental analysis (C, H, N) were carried out by using perkin Elmer 2400 elemental analyzer.

Antimicrobial Activity:-

2-(4-methoxyphenyl)-4,5-diphenyl-1H-imidazole was evaluated in vitro their antibacterial activity against two Gram-Positive bacteria, viz, B. Subtilis; S. aureus, Two fungal strains A. niger and F. oxysporum by Kirby-Bauer disc diffusion method [19]. The experimental value compare with standard drug value Miconazole for the Antifungal activity and Ciprofloxacin for the antibacterial activity.

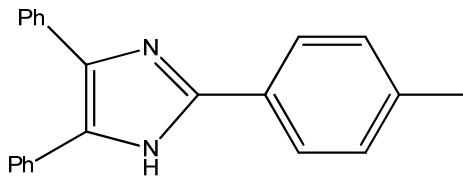
Synthesis of 4,5-diphenyl-2-(p-tolyl)-1H-imidazole:-

4-methylbenzaldehyde (0.24 g, 2 mmol, benzil (0.42 g, 2 mmol) and ammonium acetate (0.32 g, 4.2 mmol) were added in a round-bottom flask with 0.08g of chitosan in 2% aq. acetic acid solution [10]. The reaction mixture was stirred at room temperature for 5 min. Then reaction mixture was heated at 65-70°C for 3 h. The reaction was allowed to cool to room temperature. The resulting precipitate was collected by filtration and washed with cold ethanol to afford the product. The crude product was purified by recrystallization from ethanol (Scheme.1).



Results and Discussion:-

4,5-diphenyl-2-(p-tolyl)-1H-imidazole is prepared (Table.1). Imidazole is stable at room temperature in solid state. The Imidazole is soluble in organic solvent DMSO, DMF, The solid imidazole products, which separated out, were filtered, washed with water and dried. The crude products, thus isolated, were pure (single spot on TLC). After completion of the reactions, solid mass was filtered and the filtrate having chitosan catalyst was reused in the next run as such without any further treatment. Recycled chitosan catalyst was reused for 10 times. Acetic acid was used in this reaction only for homogenizing the chitosan catalyst and itself did not work as catalyst which has already been studied in experiment.



4,5-diphenyl-2-(p-tolyl)-1H-imidazole

Table 1: Table 1: Proposed Structures of Substituted Imidazole

Characterization of 4,5-diphenyl-2-(p-tolyl)-1H-imidazole:-

White Solid; C₂₂H₁₈N₂O, M.P.: 96°C; Yield: 96%; IR (KBr Cm⁻¹): 1216, 1642, 2474, 2878, 3400, 3410; ¹H NMR (400 MHz, DMSO-d₆) δ ppm: δ¹H NMR (CDCl₃/DMSO-d₆, 200 MHz) δ 2.42 (s, 3H), 6.88–6.97 (d, J=8.8 Hz, 2H), 7.27–7.65 (m, 10H), 8.02–8.09 (d, J= 8.8 Hz, 2H), 12.56 (brs, 1H); ¹³C NMR (CDCl₃/DMSO-d₆, 400 MHz) δ 22.1, 112.4, 121.8, 125.5, 127.7, 127.6, 127.7, 133.8, 146.7, 158.4; C₂₂H₁₈N₂: calcd C, 85.13, H, 5.85, N, 9.03; found C, 85.02, H, 5.78, N, 9.01.

IR Spectra of 4,5-diphenyl-2-(p-tolyl)-1H-imidazole show peak at 3410 Cm⁻¹ for imidazole ring nitrogen atom confirms the formation of Imidazole also different peak also suggest at 1216, 1642, 2474, 2878 Cm⁻¹ imidazole compound is formed [11]. ¹H NMR Peak at δ 2.42 for s for 3H of methyl group attached to aromatic ring, Aromatic ring peak observed in between range of δ 6.88–6.97 (d, J=8.8 Hz, 2H). δ 7.27–7.65 is m, for 10H of two phenyl ring proton. δ 12.56 is for 1H attached to nitrogen atom confirms the formation of imidazole. ¹³C-NMR spectra of imidazole show peak at δ 22.1 for methoxy carbon attached to benzene ring, Aromatic carbon attached to methoxy oxygen and imidazole ring carbon show peak in between range δ 112–148 [12]. Mass Spectra of imidazole shows peak at m/z 310.10 [M+H, 100%], which is M+H peak at 100% intensity this peak support to the structure of the ligand. [13]

Antimicrobial Activity:-

The antimicrobial activity in vitro on selected two gram positive bacteria *S. aureus* and *B. Subtilis* two fungi *A. niger* and *F. Oxysporum* was carried out shown in table.2. The substituted imidazole is having good antimicrobial activity [14].

Table 2. Antimicrobial activity of ligand and its Metal Complexes

Compounds	Antibacterial Activity		Antifungal Activity	
	<i>S.aureus</i>	<i>B.subtilis</i>	<i>A.niger</i>	<i>F.oxysporum</i>
	Diameter of inhibition Zone in mm	Diameter of inhibition Zone in mm	Diameter of inhibition Zone in mm	Diameter of inhibition Zone in mm
	500 ppm	500 ppm	500 ppm	500 ppm
S.Imidazole	23	25	27	21
Ciprofloxacin (Standard)	34	33	---	---
Miconazole (Standard)	---	---	31	27

Conclusions:-

The synthesized 4,5-diphenyl-2-(p-tolyl)-1H-imidazole show moderate activity against the tested Bacteria *S.aureus*, *B.subtilis* and Fungi *A.niger*, *F.oxysporum*. So, The present method have several advantageous such as reusability of the catalyst for several times, high-to-excellent yields, mild reaction conditions and simple work up procedure.

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A REVIEW ON SYNTHESIS AND BIOLOGICAL ACTIVITIES OF SOME 1,2,4-TRIAZOLE DERIVATIVES

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Abstract:

Triazole, a heterocyclic five-membered structure with two carbon atoms and three nitrogen atoms, shows a broad range of biological activity. The 1,2,4-triazoles presented in this review include their synthesis, physiochemical characteristics, reactions, and derivatives. Both the Einhorn-Brunner reaction and the Pellizzari reaction can be utilized for creating triazoles from acyl hydrazides. Triazoles are biologically active on an extensive variety of levels. The objective of this review was to summaries all the recent developments in the synthesis and biological applications of triazole derivatives.

KeyWords: Heterocyclic, Triazole, Biological Activities, Chemotherapeutics.

Introduction

The fundamental heterocyclic ring of triazoles, which has five members and the formula $C_2H_3N_3$, has two carbon and three nitrogen atoms. Triazole and its derivatives have an important role in medicinal chemistry, and a variety of heterocyclic compounds containing triazole can be synthesised from them with a number of biological functions. It forms two chemical molecules that are isomers [1].

In order to identify and develop novel potent drugs for treating various diseases or disorders, it also requires investigating metabolism, the mode of action at the molecular level, and the establishment of the structure-activity relationship (SAR) of the active pharmacophore [2]. Although inorganic substances like antacids, mineral supplements, and radiopharmaceuticals still play a significant role in therapy, organic substances with increasingly specialized biological activity obviously predominate [3]. Heterocyclic substances are cyclic substances containing at least two atoms from different elements acting as ring members [4,5].

Due to their potential as chemotherapeutics, triazole and its derivatives have received a lot of interest in recent years [6,7]. A wide range of pharmacological activities, including antimicrobial [8,9], analgesic [10], anti-inflammatory, local anesthetic[11], anticonvulsant [12], antineoplastic [13], antimalarial[14], antiviral [15], antiproliferative [16], and anticancer activities [17] can be seen from the literature that triazole derivatives possess. As medicines, a variety of compounds based on triazoles are available.

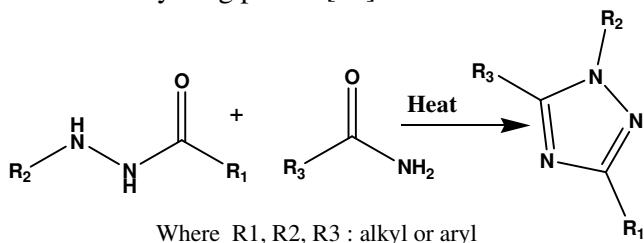
In comparison to the 1,2,3-triazoles, the 1,2,4-triazoles show a significant and diverse range of activity. As a building block for complicated chemical compounds like pharmaceuticals like tazobactam, 1,2,3-triazole is considered to be the most valuable ingredient and is frequently utilized in research [18]. 1,2,4-Triazole and its derivatives possess a wide variety of pharmacological activity.

Methods of Synthesis of 1,2,4 Triazole Derivative:

Pellizzari Reaction:

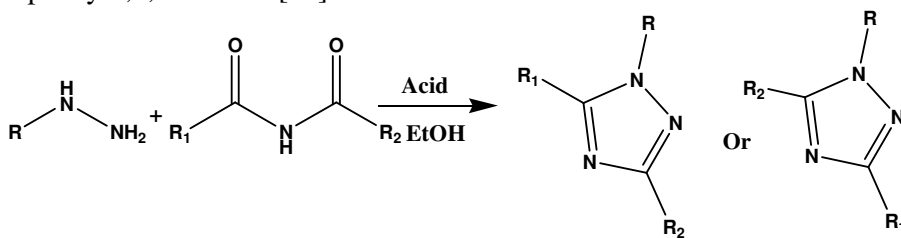
A combination of amide and acyl hydrazide is used in the Pellizzari reaction to create 1,2,4-triazole derivatives. 1,2,4-triazole is produced by heating formamide and hydrazine hydrochloride mixture with potassium hydroxide (KOH); 2,3,5-triphenyl-1,2,4-triazole was

synthesized by using benzamide and benzoyl hydrazide, for example, at high temperature and for a very long period [19].



Einhorn–Brunnerreaction:

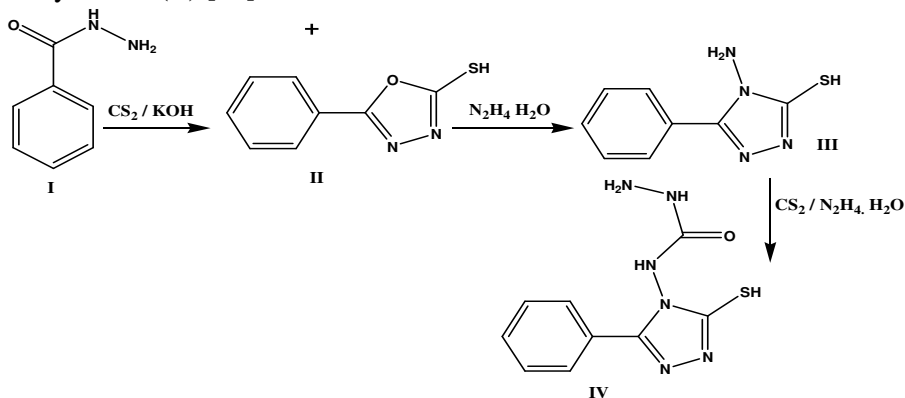
In the Einhorn-Brunner reaction, diacylamines and mono substituted hydrazine are condensed at 140 °C in the presence of a moderate acid to produce 1,2,4-triazoles [20]. With reference to this example: N-formyl benzamide and phenyl hydrazine were used to create 1,5-diphenyl-1,2,4-triazole [21].



R1,R2, R3: alkyl or aryl

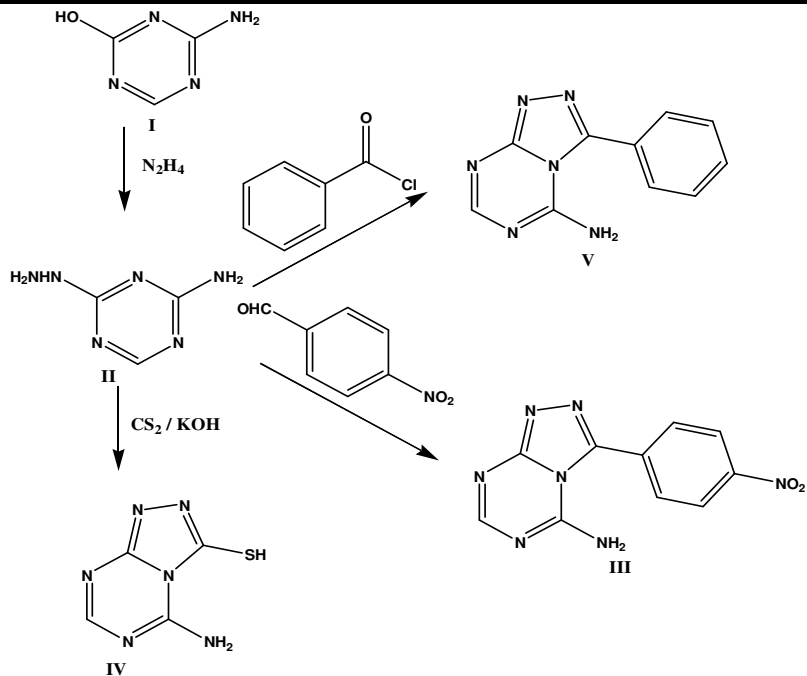
From Carboxylic Acid Hydrazide:

As shown in the Scheme, the 1,2,4-triazole derivative (IV) was synthesized by condensing the 4- amino-5-phenyl-4H-1,2,4-triazole-3-thiol and thiosemi-carbazide (III), both of which were produced by the reaction of hydrazine hydrate and 5-phenyl-1,3,4-oxadiazol-2-ylamine (II) [22].



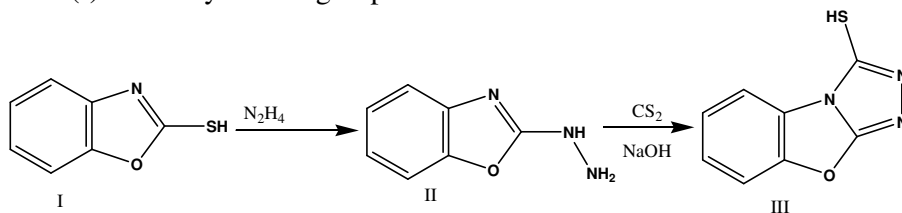
From 1,3,5-Triazine:

1,2,4-triazolo derivative III, IV & V were made from 2-amino-4-hydrazino-1,3,5-triazine (II), which was made by replacing the hydroxy group in the compound with a hydrazine group [23].



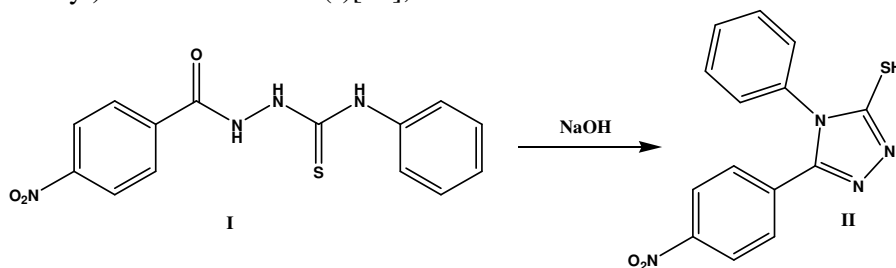
From Oxazole:

As showed in scheme, the reaction of the 2-hydrazino benzoxazole (II) with carbon disulfide and sodium hydroxide formed the 1,2,4-triazole [4,3-b] benzoxazole-1-(2H)thione (III) [24]. This was accomplished by replacing the mercapto group in the 2-mercapto benzoxazole (I) with a hydrazine group.



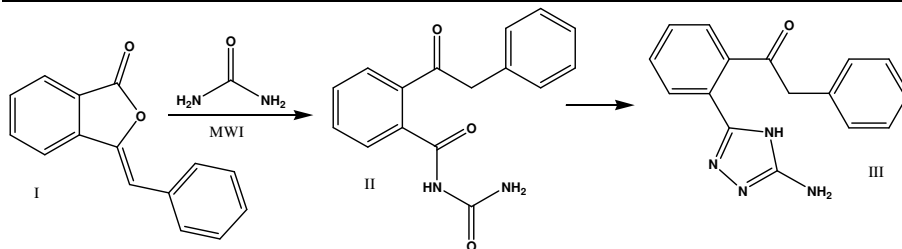
From Thiosemicarbazide:

5-(4-Nitrophenyl)-4-phenyl-4H-1,2,4-triazole-3-thiol(II) were prepared from 1-phenyl-4-(4-nitrobenzoyl)thiosemicarbazide(I)[25], As shown in this scheme.



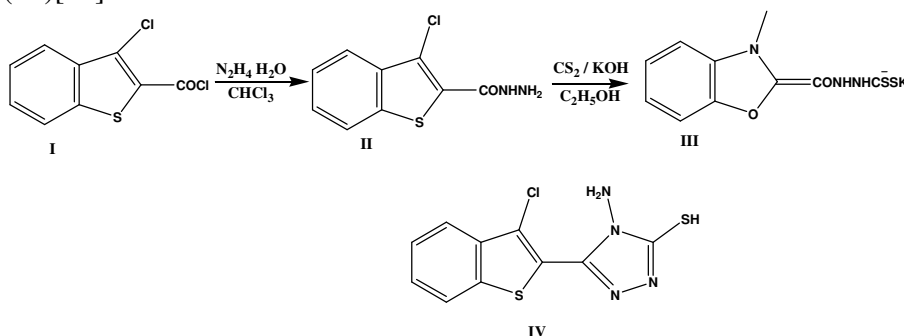
From Urea:

Reaction of 3-benzylidene phthalide (I) with urea under microwave irradiation (MWI) gave 1-(2-(α -phenylacetyl)benzoyl)urea (II) which reacted with hydrazine hydrate to yield 1-(2-(5-amino-4H-1,2,4-triazol-3-yl)phenyl)-2-phenylethanone (III) [26], As shown in below.



From Acid Chloride:

Conventional heating of 3-chloro-2-chlorocarbonylbenzo[b]thiophene (I) with hydrazine hydrate afforded the corresponding hydrazide (II). Potassium dithiocarbazate (III) was cyclized with hydrazine to afford 4-amino-5-(3-chlorobenzo[b]thien-2-yl)-3-mercapto-1,2,4-triazole (IV) [27].

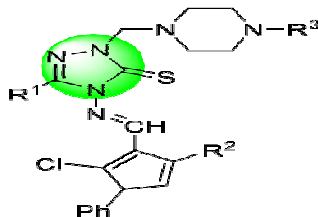


Pharmacological Applications:

The biological and pharmacological characteristics of 1,2,4-triazoles have received major interest in their synthesis and characterization during the past few decades [28]. Different biological activity is shown by 1,2,4-triazole and its derivatives.

Antifungal Activity:

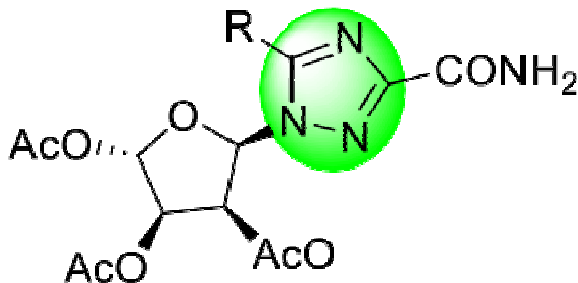
The most common antifungal drugs used to treat aggressive fungal disorders include voriconazole and fluconazole, both of which have received FDA approval [29]. In 2016, Wang et al. synthesised and examined phenyl-pyrazole and piperazine thiones and found that they were effective antifungal agents. The synthesised compounds have been tested against six fungi to compare the percent concentration inhibition of mycelium rate of growth with the positive controls carbendazim, triadimefon, and chlorothalonil [30,31].



Antiviral Activity:

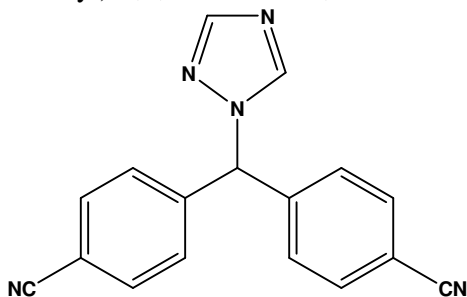
Several antiviral drugs are available for the treatment of viral infections, but they have drawbacks as a result, different antiviral drugs must be created that have a larger antiviral spectrum and are resistant to drug interactions [32]. Chudinov et al. created and examined ribavirin analogues for the first time in order to cure the herpes simplex, hepatitis C, syphilis, and influenza A viruses. At the highest dosage of the synthesised analogues (1250 M), no

harmful effects were noticed. The synthetic counterpart compound had the highest activity, with an EC50 value of 19 M [33].



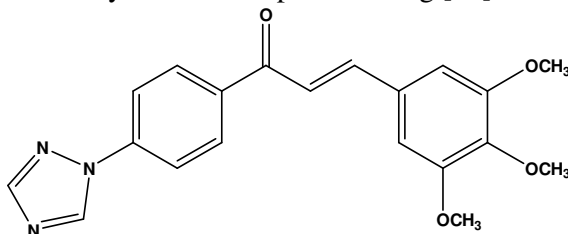
Anticancer Activity:

Various heterocyclic rings with nitrogen atoms can be found in both natural and artificial products, and they show effective anticancer activities against a variety of human cancer cell lines [34]. A triazole building block called letrozole, an aromatase inhibitor, is used to treat cancer. These compounds have significant biological effects such as cyclooxygenase inhibitory and anti-leukemic properties. A number of cancer types are treated with 3,5-bis(pyridin-3-yl)-1,2,4-thiadiazole, an aromatase inhibitor [35].



Antimalarial activity:

Humans suffer a milder form of the disease and rarely die from malaria caused by *Plasmodium vivax*, *Plasmodium ovale*, and *Plasmodium malariae* [36]. In vitro antimalarial activity of new 1,3-diaryl propanone derivatives against the asexual blood stages of the human malaria parasite *Plasmodium falciparum* was described by Mishra et al. The 1,2,4-triazole substituted chalcone from the chloro-series was discovered to be the most efficient at preventing *P. falciparum* development. This is likely the first report of chalcones with azoles showing antiplasmodial activity on the acetophenone ring [37].



Conclusions:

Derivatives of 1,2,4-triazoles show a wide range of biological activities that have been considered to be crucial for the nucleus in regard to pharmacology. Due to their importance in synthetic and biological processes, triazoles and their heterocyclic derivatives have

received a lot of interest in recent years. For instance, multiple ring systems which includes 1,2,4-triazoles have been introduced into a variety of therapeutically promising drug candidates.

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SYNTHESIS OF 1,5-BENZOTHAZEPINES AND ITS DERIVATIVES BY USING MONOSODIUM GLUTAMATE AS AN GREEN CATALYST

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Abstract

One pot multicomponent synthesis of 1-5 benzothiazepines and its derivatives by using monosodium glutamate under solvent free condition has been developed. The present synthetic route is a green protocol offering several advantages such as high yield of products, extremely mild reaction condition compared with previous approaches without using toxic solvent.

Keywords: Substituted Chalcones, 2-aminothiophenil, 1-5 benzothiazepines, Monosodium glutamateosylate.

Introduction

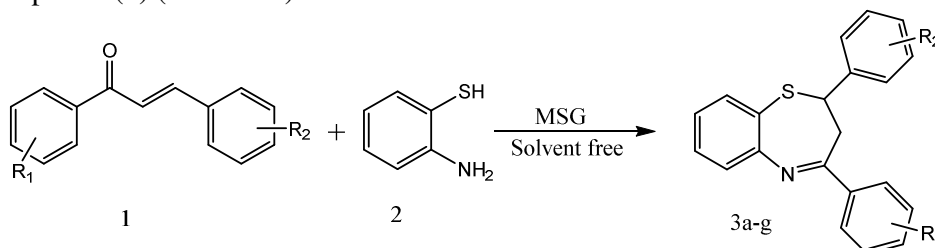
Heterocyclic compound is one which possesses a cyclic structure with at least two different kinds of hetero atoms in ring. Heterocyclic compounds are very widely distributed in nature and are essential to life in various ways.¹ 1,5-Benzothiazepines are the representatives of benzologs of 1,4-thiazepine and one of the three possible benzo-condensed derivatives, namely 1,5-benzothiazepines. The parent 1,5-benzothiazepine, itself, has not hitherto been described in the literature for its pharmacological properties.² 1,5-benzothiazepine moiety is a privileged class of pharmacophore, possess a broad spectrum of biological activities such as vasodilator,³ anticancer,⁴ Ca²⁺ channel antagonist,⁵ antiarrhythmic agents,⁶ V2 arginine vasopressin receptor antagonist,⁷ anticonvulsant,⁸ squalene synthetase inhibitor,⁹ antianginal,¹⁰ antipsychotic,¹¹ antigungal.¹²

Development of new bioactive heterocycles containing nitrogen and sulphur atoms, simple and convenient methods for the transformation of chalcones into 1,5-benzothiazepines. There are many reported methods in the literature for the synthesis of 1,5-benzothiazepines, Among these preferred and widely used route cyclocondensation of 2-aminothiophenols with α , β -unsaturated ketones.¹³ Here we report a convenient synthesis of Considering the pharmacological importance of 1,5-benzothiazepines using monosodium glutamate under solvent free condition. Nowadays the use of harmful, toxic organic solvents has been replaced by various alternatives. Monosodium glutamate is used as green media for organic transformations. Considering this significance we use monosodium glutamate which is rapid significant protocol for condensation of 2-aminothiophenols with α , β -unsaturated ketones which gave 1,5-benzothiazepine and its derivatives. We use monosodium glutamate as an catalyst for synthesis because of its offering green protocol for reaction such as mild reaction condition, high yield of product shorter reaction time, minimizing chemical waste, easy work up procedure and not using heavy metal based catalyst.¹⁴ Monosodium glutamate is most abundant naturally occurring non-essential amino acid,¹⁵ safe for human consumption,¹⁶ as a flavour enhancer and food additive¹⁷ and important neurotransmitters in human brain, playing a key role in learning and memory. Here we tried to cash double benefit of using green protocol with solvent free economic strategy. Here in we wish to report first time Monosodium Glutamate catalysed green tactic for the synthesis of 1,5-benzothiazepines.

Materials and method

General Procedure for the synthesis of 1,5-benzothiazepine and its derivatives:

A model reaction was performed at different reaction conditions, the synthesis of 1,5-benzothiazepines (3a-g) from the condensation of substituted chalcone (1) and 2-aminothiophenol(2) (Scheme 1).



Scheme 1: Synthesis of 1,5-benzothiazepine catalyzed by Monosodium glutamate.

Experimental procedure for the synthesis of 1,5-benzothiazepine and its derivatives

A mixture of chalcone (0.05 mol) and 2-aminothiophenol (0.05 mol), was taken in RBF, to that mixture was dissolved in monosodium glutamate, then RBF was kept into the ultrasonic water bath and was irradiated at 35% of the power of the ultrasonic bath at room temperature. The progress of reaction was monitored by TLC and melting point. After the completion of reaction, the product was extracted by diethyl ether. Then with the vacuum distillation the ether was removed and thus the product was obtained and the product was recrystallized using (1:1) DMF-Ethanol. The recovered MSG was reused for two more cycles of the same reaction.

Result and discussion

Table 1: MSG catalyzed synthesis of 1,5-benzothiazepine and its derivatives

Entry	R ₁	R ₂	Product	Yield %	M.P.	
					Observed	Reported
1	OCH ₃	Cl	3a	83	134-135	133-135
2	OCH ₃	H	3b	72	103-105	105-106
3	H	H	3c	70	111-113	112-113
4	CH ₃	H	3d	68	136-137	135-136
5	NO ₂	H	3e	76	118-119	116-118
6	Cl	OCH ₃	3f	74	109-111	110-112
7	OH	OCH ₃	3g	71	152-154	153-154

Monosodium glutamate is capable to accelerate the reaction by dual interaction with both substituted chalcones (1) and 2-aminothiophenol (2). The reaction scope was shown by reacting 2-aminothiophenol (2) with a series of substituted chalcones (1a-g) generating the corresponding 1,5-benzothiazepine and its derivatives up to 83 % yield (table 1). The reaction was found to be tolerant to a number of electron-withdrawing or electronic donating

substituents such as NO₂, OH, Cl and OCH₃. Heteroaromatic chalcones were also shown to be good substrates for the reaction. The nature of other substituent (either electronic withdrawing or donating) on chalcone has a minor effect on the yield of product.

The scope of 2-aminophenol was investigated by using a substituent on 2-aminophenols bearing an electron-withdrawing or electron-releasing substituent in the reaction with chalcone under the optimized conditions, an excellent result was obtained by using 2-aminophenols bearing an electronic donating group, whereas a lower yield was obtained with 2-aminophenols bearing electron-withdrawing substituents.

Conclusion

Here we describe an eco-friendly strategy for the synthesis of 1,5-benzothiazepine and its derivatives by using MSG as a green catalyst. The present protocol has several advantages of a simple experimental procedure, high yield of product, minimizing chemical waste and clean catalyst. It is an environmentally accepted method and using MSG is a value addition to the reported method.

Acknowledgments

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A REVIEW ON SYNTHETIC METHODS OF BIOACTIVE TETRAHYDROBENZO [C] ACRIDINE DERIVATIVES

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ABSTRACT

Nitrogen containing heterocyclic compounds like 1,4, dihydropyridine, acridine are the building blocks of alkaloids and such natural products which have been found to possess biological and pharmaceutical activity such as anticancer, antibacterial and antitubercular some polycyclic acridine derivatives possess DNA binding activity. Present review focuses on various synthetic methods for tetrahydro benzo[c] acridine derivatives.

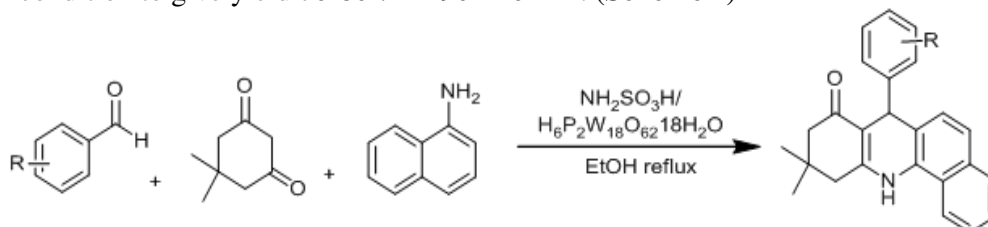
Keywords: one pot synthesis, tetrahydrobenzo[c]acridine, 1-naphthylamine, dimidone, benzaldehyde.

INTRODUCTION

Nowadays, one pot synthesis methods has played significant role in organic synthesis because of its advantages such as, minimum steps, short reaction time, high yield, selectivity, and fewer by products as compared to classical synthetic methods [1]. Nitrogen containing heterocyclic compounds like 1,4, dihydropyridine, acridine are the building blocks of alkaloids and such natural products [2] which have been found to possess biological and pharmaceutical activity such as anticancer, antibacterial and antitubercular [3-5] some polycyclic acridine derivatives possess DNA binding activity [6]. Beside these 5, 6-dihydrobenzo [c] acridine forms electroluminescent complexes with Iridium and these complexes are used to design organic light emitting devices [7]. Therefore, by considering importance of benzo [c] acridine derivatives several methods have been developed using homogenous and heterogeneous catalysts.

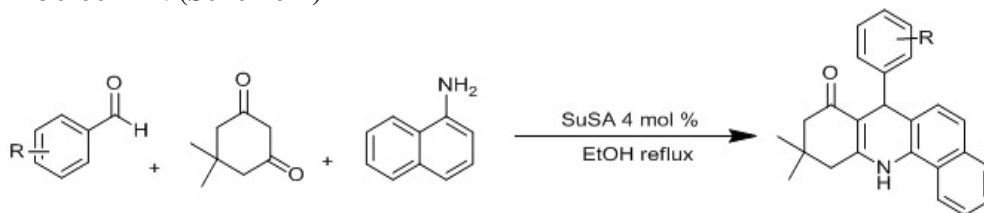
LITERATURE REVIEW ON TETRAHYDROBENZO [C] ACRIDINE DERIVATIVES

M. M. Heravi et al [8], have used heteropolyacid as heterogeneous acid catalyst for one pot synthesis of tetrahydrobenzo [c] acridine derivatives in ethanol as solvent under reflux condition to give yield 70-80 % in 90-110 min. (**Scheme 1**)



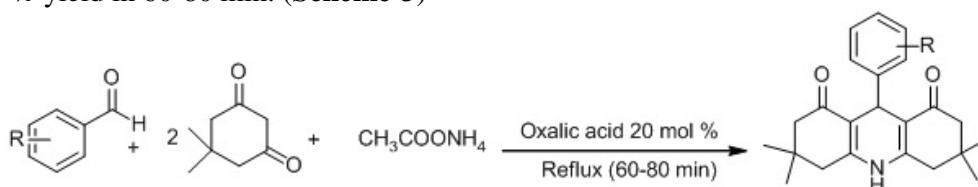
Scheme-1

M. Ghashang et al [9], reported succinimide-N-sulfonic acid (SuSA) as catalyst for one pot synthesis of tetrahydrobenzo [c] acridine derivatives in ethanol under reflux with 80-94% yield in 30-60 min. (**Scheme-2**)



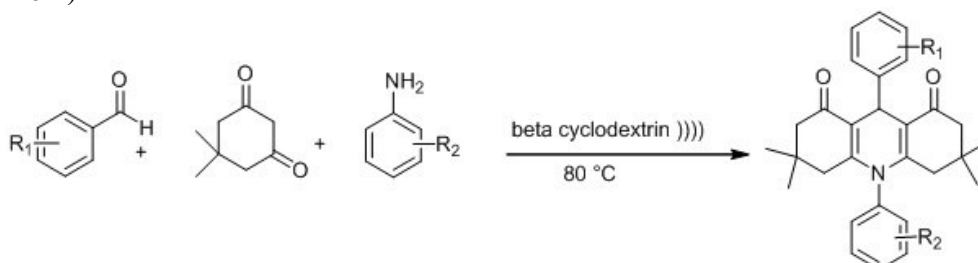
Scheme-2

J. N Sangshetti et al [10], have utilized oxalic acid 20 mol % as catalyst for one pot synthesis of 1, 8-dioxodecahydroacridines derivatives in aqueous medium under reflux condition with 96-97 % yield in 60-80 min. (**Scheme-3**)



Scheme-3

Asha V. Chate [11], have utilized β -cyclodextrin as supra molecular, biodegradable catalyst for one pot synthesis of N-substituted 1,8-dioxodecahydro acridine derivatives in aqueous medium under ultrasound irradiation condition at with 80-93 % yield in 60-90 min. (**Scheme-4**)



Scheme-4

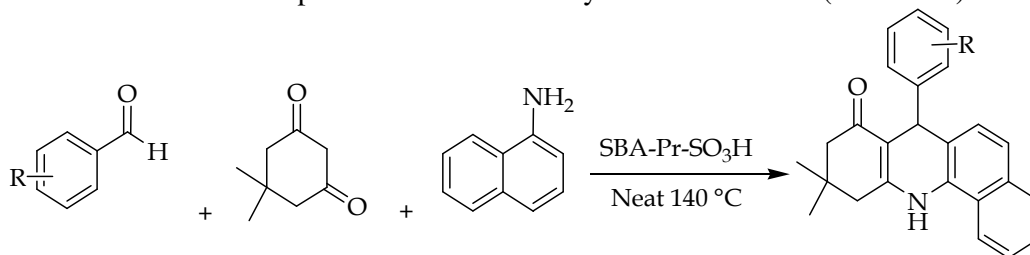
Javad Safaei-Ghomi et al [12], have developed ZnO nanoparticles as efficient heterogeneous catalyst for one pot synthesis of N-substituted 1, 8-dioxodecahydro acridine derivatives under solvent free condition at 90 °C temperature with 90-95 % yield in 5-10 min. (**Scheme-5**)



Scheme-5

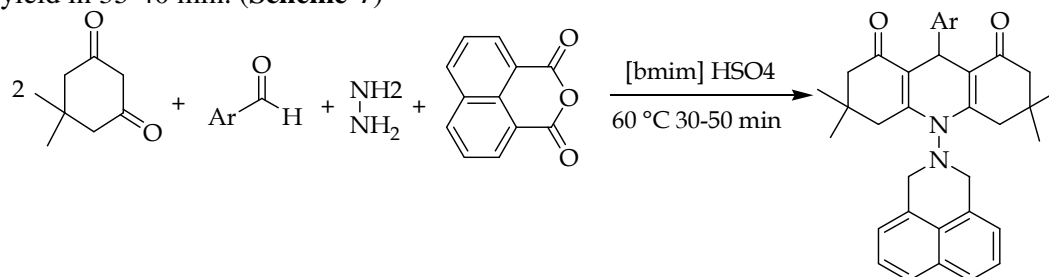
G. M. Ziarani et al [13], have utilized sulphonic acid functionalized SBA-15 as heterogeneous catalyst for one pot synthesis of tetrahydrobenzo [c] acridine derivatives via

cylocondensation of 1-naphthamine, dimedone and aromatic aldehyde under solvent free condition at 140 °C temperature with 90-95 % yield in 10-15 min. (**Scheme-6**)



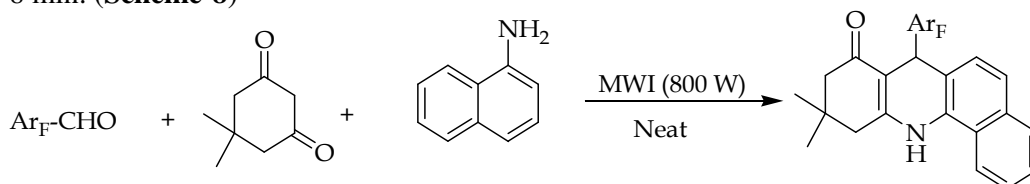
Scheme-6

P. Sagar et al [14], reported ionic liquid promoted one pot synthesis of naphthalimide based acridine-1,8 dione derivatives via one pot cylocondensation of dimedone, aromatic aldehyde, hydrazine hydrate and 1, 8-naphthoic anhydride at 60 °C temperature with 79-93 % yield in 35-40 min. (**Scheme-7**)



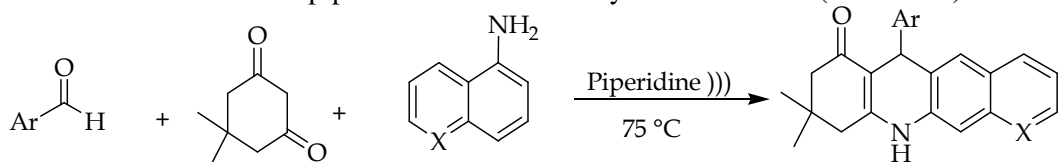
Sche

Jin et al [15], reported one pot synthesis of fluorinated of tetrahydrobenzo [c] acridine derivatives via one pot cylocondensation of dimedone, various fluorine substituted aromatic aldehyde, 1-naphthamine and dimedone under microwave irradiation with 59-81 % yield in 5-8 min. (**Scheme-8**)



Scheme-8

Chung et al [16], reported one pot synthesis of tetrahydroacridinones via one pot cylocondensation of dimedone, aromatic aldehyde, functionalized 1-naphthamine under ultrasound irradiation in piperidine with 59-81 % yield in 5-8 min. (**Scheme-9**)



Although reported methods have good yield in minimum time but, some of them suffered from some problems like acid fictionalization of catalyst, harsh reaction condition, maximum reaction time, low yield, harsh reaction condition, use of non recoverable homogenous catalyst which generates acidic effluent. Some methods required special conditions such as microwave and/or sonication homogenous Nitrogen containing organic bases like piperidine [15] hence in order to overcome these limitations it is necessary to find

sustainable, efficient and ecofriendly protocol for synthesis of tetrahydrobenzo [c] acridine derivatives.

Summary & outlook

Acridine scaffolds are important the building blocks of alkaloids and such natural products which have been found to possess biological and pharmaceutical activity such as anticancer, antibacterial and antitubercular and DNA binding activity. Some Acridine derivatives form electroluminescent complexes with Iridium and Aluminium which can be used to design organic light emitting devices (OLED).

Although reported methods have good yield in minimum time but, some of them suffered from some problems like acid fictionalization of catalyst, harsh reaction condition, maximum reaction time, low yield, harsh reaction condition, use of non recoverable homogenous catalyst which generates acidic effluent. Some methods required special conditions such as microwave and/or sonication homogenous Nitrogen containing organic bases like piperidine hence in order to overcome these limitations it is necessary to find sustainable, efficient and ecofriendly protocol for synthesis of tetrahydrobenzo [c] acridine derivatives

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A MINI REVIEW ON APPLICATIONS OF ZINC COMPLEXES CONTAINING NITROGEN AS A DONOR LIGAND

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Abstract:

Zinc derivatives could not be excluded while exploring the metal base anticancer drug alternatives to the platinum derivatives, because of the importance of this metal for the proper functioning of the human body. Zinc can be considered as the second most abundant trace element in the human body, and is also one of the most significant micro-elements important for human physiology. In particular, its nonexistence of redox activity and its capability to support different coordination geometries and to encourage fast ligands interchange. Analogously to other trace elements, the impairment of its homeostasis can clue to numerous diseases and in some cases can be also related to cancer development. On the other hand, in addition to its physiological role, zinc can have beneficial preventive and therapeutic effects on infectious diseases. Compared to other metal-based drugs, Zn(II) complexes commonly employ lower toxicity and offer few side effects. Zinc derivatives have been recommended as antitumor mediators and, among the great number of zinc coordination complexes which have been designated so far, this review emphasizes on the design, synthesis as well as the biological studies of zinc complexes including N-donor ligands and that have been reported. Zinc has many applications in the field of biology, industries, medicine and agriculture. Zinc has some antioxidant properties which may protect the body muscles and skin from aging. Zinc complexes with a variety of nitrogen donor ligands have many applications in different areas of chemistry such as solution, surface and redox chemistry

Introduction:

Metal ions existing in complexes quicken the drug action and the effectiveness of the organic therapeutic agents. Pharmacological productivities of the metal complexes depend on the nature of the metal ions as well as the ligands. The study of transition metal carboxylates has got major attention due to their, DNA binding, biological and catalytic properties. The lipophilic nature of the carboxylate ligand plays an imperative role in insertion into the cell through cell membrane having lipid layer [2]. Transition metal carboxylate complexes with aromatic ligands such as 2,2'-bipyridine, 1,10-phenanthroline increase the biological activity. Transition metals form complexes with carboxylate anions. Carboxylate ligand implements several types of bonding with transition metal such as monodentate and bidentate [3]. Monodentate coordination is found in lithium and cobalt acetate while examples of bidentate coordination are Zn(II) and Hg(II) complexes of 3-[(4-chlorophenylamido)]propenoic acid. The lipophilic nature of the carboxylate ligand plays an important role in insertion into the cell through cell membrane having lipid layer [4].

What are metal Complexes?

Metal complexes consists of a central atom (or) ion (metal) attached with anions (ligands). Compounds containing a coordination complex are called coordination compounds. Metals are Lewis acid because they possess positive charge, if dissolved in water they successively form hydrated compounds. One of the most interesting areas of research is the coordination chemistry of nitrogen and oxygen donor ligands [5]. One of the general interest as models for bioinorganic processes are complexes of substituted hydrazine such as hydrazides, hydrazones and diacylhydrazines. It is reported that these compounds possessing two amide moieties which have strong ability to form metal complexes. This ligand structure shows keto-enol sort of tautomerism and may act as mononegative tridentate or mononegative bidentate. Applications of metal complexes in terms of therapeutic approach has been a hot topic for advance research. Enzymes comprising zinc are considered a preferred target for therapy of drug [6]. Their inhibitors are added in the modern medicinal research against diseases and disorders like cancer, neurological, cardiovascular, infectious diseases and metabolic diseases. The significance of zinc in biological classifications is conclusively connected to its unique chemical features: Zn^{2+} is redox inactive, is a strong Lewis acid, has a d^{10} configuration, is diamagnetic, can support an adaptable coordination geometry and is inclined to to a fast exchange of ligands. The electron affinity of Zn resembles that of copper or nickel, but the absence of redox activity of divalent zinc ion, contrarily from copper or iron, eradicates any chances of free fundamental reactions and creates it critical for the body's antioxidant protection system [7].

Zinc Complexes:

Zn has a d^{10} configuration. Can support a variable coordination geometry. It is diamagnetic, and is inclined to a fast exchange of ligands [8]. Its electron affinity bear a resemblance to that of copper or nickel, but the absence of redox activity of divalent zinc ion, differently from copper or iron, eradicates any probabilities of free radical reactions as well as makes it crucial for the human body's antioxidant defense system [9]. A huge variability of zinc complexes comprising ligands of diverse hapticity with primarily O, N and S as donor atoms, demonstrating dissimilar geometries and coordination numbers consistently giving rise to dimeric or polymeric species have been informed [10]. In the biological systems, zinc may be penta-, tetra-, or hexacoordinated to Oxygen, Nitrogen or Sulphur donor atoms included in histidine, glutamate/aspartate, and cysteine residues. The determination of the present review article is to designate the improvement in the synthesis, design, and biological studies of zinc complexes of N-donor ligands as therapeutic agents [11]. The supplementary classes of zinc complexes containing Nitrogen as a donor ligand will be conveyed in a resulting article. Possible structure-activity relationships (SARs) for each type of ligands termed and, by a serious analysis of the reported data, to designate the new directions of the investigation for scientists operational in this field. Recently, the medicinal application of metal complexes has been a subject of great interest [12]. Zinc-containing enzymes are considered an attractive target for drug therapy and their inhibitors are included in the armamentarium of modern medicine against human diseases such as cardiovascular, neurological, infectious and metabolic diseases as well as cancer [13].

Nitrogen as donor ligands in Zn complexes:

Consequently, N-donor ligands are one of the most demonstrative category. Homoleptic and mixed-ligand complexes have been informed and, because of the diversity of reachable arrangements, a great assortment of frameworks (from mono- to hexadentate chelates) have been employed [14]. Apart from the vast accomplishment of platinum constructed drugs, some other metal compounds such as ruthenium and titanium complexes ensure certain potential for chemotherapy. The toxicity of metallo-drugs is challenging; consequently, it is suggested that drugs constructed on essential metals may be less toxic. Zinc ions possess some anti-bacterial effects and one research direction for inorganic anti-bacterial agents is to enhance the anti-bacterial

Ability of Zn(II) ions through adding additives. Zinc carboxylates are of prodigious attention owing to their part in biochemical systems, material chemistry and catalysis, this can be attributed to the adaptability of the RCOO^- moiety and the extensive assortment of coordination modes that it can implement [15].

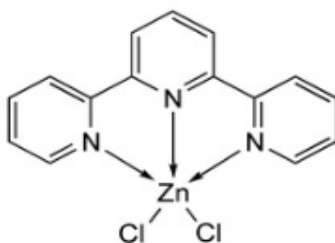


Figure 1
penta-coordinated terpyridine

A penta-coordinated terpyridine (Figure 1) has been informed and its cytotoxic activity was evaluated, resulting significantly cytotoxic on MDA-MB-231 after 72 h ($\text{IC}_{50} = 23 \mu\text{M}$), and on HCT-116 after 24 h ($\text{IC}_{50} = 10 \mu\text{M}$). Its activity can be correlated both with its square-pyramidal structure, less susceptible to changes in coordination geometry in solution with respect to a tetrahedral structure [16].

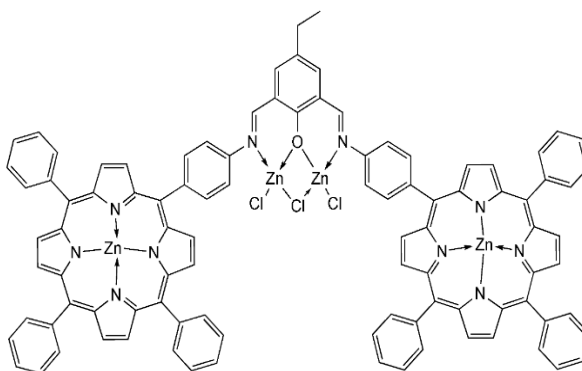


Figure 2
porphyrin-Schiff base ligand and its Zn(II) complex

A new porphyrin-Schiff base ligand as well as the Zn(II) complex were synthesized by Tümer and co-workers. Superoxide dismutase activities of the figure 2 complex was investigated in contrast with comparable Cu(II), Fe(III), Mn(III) and Pt(II) complexes. Furthermore, the DNA binding of the complex was completed by UV-vis spectroscopy ($K_b = 1.3 \times 10^6$). Modest studies with ethidium bromide ($K_b = 1.23 \pm 0.07 \times 10^5$) showed that the compounds interact efficiently with DNA through an intercalating way [17].

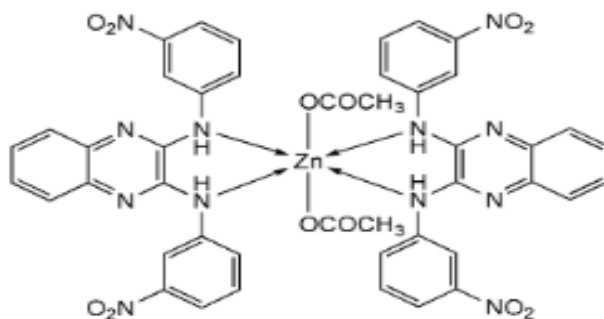


Figure 3

The octahedral complex including the ligand N^2,N^3 -bis(3-nitrophenyl)quinoxaline-2,3-diamine (L_{43}) was tested against HeLa cell line together with analogous Co, Ni and Cu derivatives. Complex exhibited the highest activity ($IC_{50} = 35.29 \mu M$, in comparison to the free ligand ($IC_{50} > 100 \mu M$) and to the other metal complexes (IC_{50} 132.50, 65.09 and 65.62 μM for Co, Ni and Cu derivative correspondingly). Molecular docking study against human papilloma virus (HPV) receptor molecule and the ATP binding site of telomerase demonstrated that is more effective against HPV receptor [18].

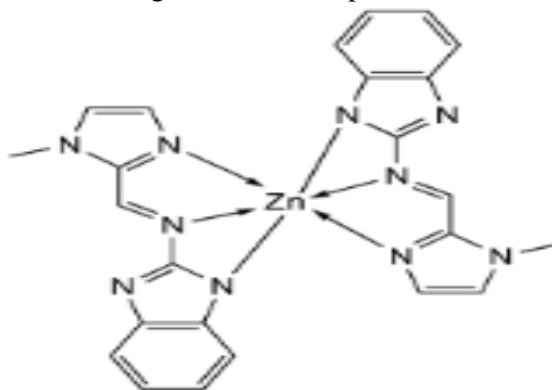


Figure 4

A zinc (II) complex with two benzimidazole-derived ligands has been created and its interaction with the human serum albumin and DNA was examined, screening substantial binding propensity can be observed in figure 4. The nuclease activity of the figure 4 complex was analyzed for pBR322 DNA, sanctioning its potential to cleave DNA.

Furthermore, the cytotoxicity of ligand and the zinc(II) complex was examined on a panel of certain human cancer cells (HepG2, SK-MEL-1, HT018, HeLa and MDA-MB-231), exhibiting IC_{50} values greater than the standard drug cisplatin and then the interrelated copper(II) complex. Likewise, the in vivo chronic toxicity outline of complex was also studied on all of the major organs of the mice, with short toxicity outcomes[19].

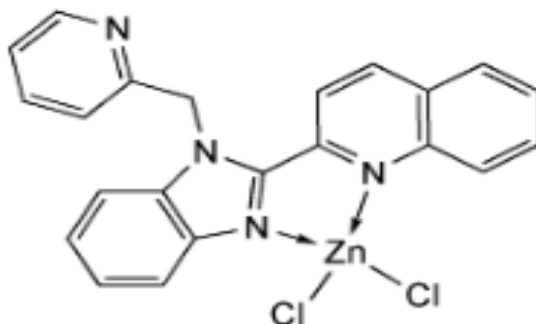


Figure 5

The tetrahedral zinc derivative exhibited adequate antitumor activity (average IC_{50} 57.25 μ M at 72 h), differently from the most promising copper derivative (average IC_{50} 18.91 μ M at 72 h) which was the object of more detailed studies [20].

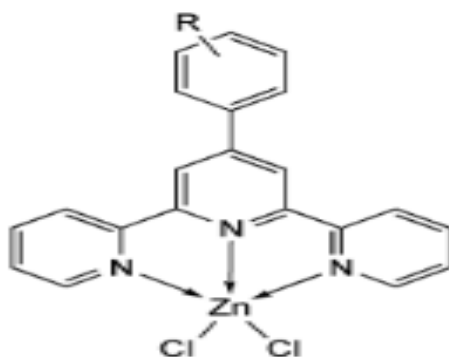


Figure 6

Diverse substituents on the terpyridine phenyl ring permitted to fine tune the lipophilicity and the steric hindrance of the concluding complexes, in order to find a possible SAR. The figure 6 compound display photoluminescent properties, the intensity of fluorescence emission peaks decreasing by CT-DNA interaction. Intercalation into the base pairs of DNA is confirmed by molecular docking studies [21].

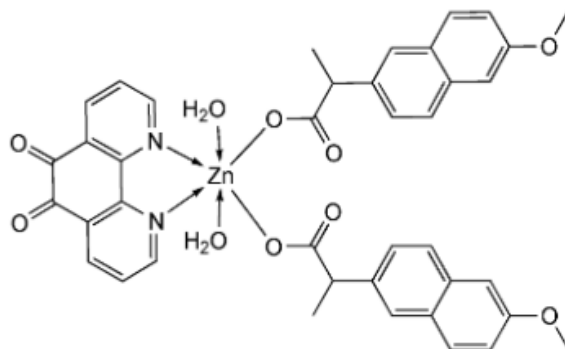


Figure 7 phendione

The bidentate chelating ligand phendione has been informed to displayant proliferativeaction and to interrelate with DNA by its aromatic ring. The complex exhibited cytotoxic activity on MDA-MB-231 cells with IC₅₀ values after 72 h of 0.5 μM and 0.4 μM, respectively and were less toxic in the RAW 264.7 cell line (with IC₅₀ values after 72 h of 2 μM and 1.7 μM, respectively). Whereas, free NaNPR (sodium naproxen), HMFN, and [Zn (ClO₄)₂]-6H₂O did not have any significant antiproliferative properties, co-treatment with free phendione and naproxen or mefenamic acid (1:2 ratio) determined in both case an IC₅₀ value of 0.4 μM, confirming that phendione acts independently and that the anti-proliferative properties of the Zn ternary complexes are due to the phendione unit[22]. Complexes explained a dual activity, as it also withdrawn the cyclooxygenase path exhibiting anti-inflammatory activity.

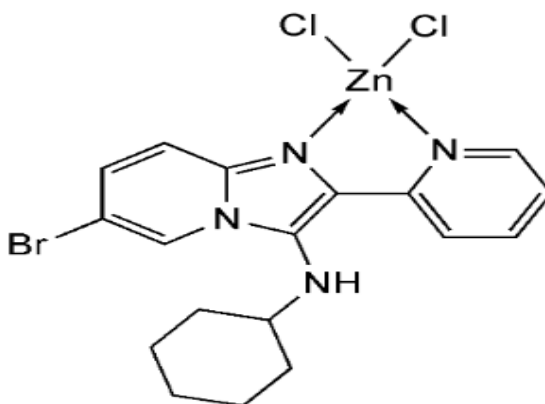


Figure 8

Zn(II) possesses a very resourceful chemistry. It may implement a variety of coordination numbers giving escalation to diverse geometry, even though particularly in solution octahedral stereo-chemistries control. Zinc can synchronize various donor atoms, specifically the first-row donor atoms oxygen or nitrogen rather than second-row sulphur or phosphorus, according to its hard acid nature. Accordingly, N-donor ligands are essentially the most illustrative category. Homoleptic and diverse-ligand complexes have been informed and, due to the unpredictability of available arrangements, a great range of outlines (from mono- to hexadentate chelates) have been promised[23].

Future Scope of Transition Metal Complexes:

The therapeutic applications of transition metal complexes is an under-developed area of research and it may be considered as full of projections for advanced development. Inventions of new methodologies will be cooperative in the synthesis of inorganic compounds as therapeutic agents.

Conclusion:

With the advancement in the area of research of medicinal chemistry, the role of transition metal complexes as therapeutic compounds is becoming increasingly significant. The Zn II complexes are reported to be useful in targeted drug delivery, protein labeling, and imaging of bacterial infections. Zinc complexes show prominent antimicrobial activity as well. To find out a conceivable correspondence among the cytotoxic activity in vitro and the chemical features of the surveyed complexes, we have cumulated the most active informed species. All the complexes which display an antitumoral activity contrary to one or more cancer cell lines, getting in some cases the nanomolar range. In aspect, penta-coordinated terpyridine derivatives as well as hexacoordinate bis-terpyridine demonstrated very high activity en route for a large panel of cancer cell lines, and similarly demonstrated a good specificity for tumor cells. On the other hand. As it can be observed in the table, this performance can be witnessed also with other complexes. In these classes of compounds, zinc coordination of active ligands did not regulate an apparent synergic effect, but the activity of the concluding complexes was comparable to that of the free ligands.

The recent time has seen an outburst of progression in the application of Zn(II) and Cu(II) complexes in the field of chemical biology, precisely in their application as influential sensory implements as well as developing medicinal therapeutics for humanoid cancers and HIV. In this review we have endeavored to establish the remarkable assortment of applications in which metal complexes plays a significant role.

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ULTRASONIC INVESTIGATION OF BIS[5-CYANO-1,6-DIHYDRO-6-IMINO-2-ISOPROPYL-4-(P-PIPERAZINYL) PYRIMIDINE] DIAZENE IN DMSO AT DIFFERENT TEMPERATURE AND CONCENTRATION

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Abstract;-

Intermediate ketene that has functional groups to α -positions are extremely multifunctional intermediates important for organic compound synthesis. Since it contains carbonyl group, halo group and sulphur like hetero atom there would be possibility of different types of interactions. Based on these interactions in the present study, excess thermo acoustic parameters for bis [5-cyano-1,6-dihydro-6-imino-2-isopropyl-4-(p-piperazinyl) pyrimidine] in DMSO solution at different temperature were studied. Parameters likes ultrasonic velocity, adiabatic compressibility, acoustic impedance, linear free length etc. were calculated at 303.15 K, 308.15 K, 313.15 K and 318.15 K. These parameters are used to represent the solute-solvent and electrostatic interaction as illustrated by the measured values of these parameters.

Introduction;-

Pyrimidine is a six-member ring compound containing two nitrogen atoms and four carbon atoms that is pharmacologically inactive but still substituted derivatives are active(1). Pyridazine, oxygenated pyridazinone derivative, and pyridazine or phthalazinebenzereae are heterocyclic compounds containing two adjacent nitrogen atoms (1,2-diazine) in the ring structure. They exhibit a high range of pharmacological activities and are found in various natural compounds with different biologics activies(2). Few of pyrimidine derivatives exhibit marked chemotherapeutic activities such as antioxidant, anti-inflammatory, HIV-1 and HIV-2 protease inhibitors, anticancer, anticonvulsant and sedative-hypnotic (3). Because of this broad application of 1-(4-fluorophenyl)-2-iodo-3,3bis(methylthio) prop-2-in-1-one make us interested in investigating its excess acoustical parameter.

The investigated values of ultrasonic velocity (u), adiabatic compressibility (β), acoustic impedance (z), linear free length (L_f^E) etc [4-5] gives idea regarding types of interaction present in the bis[5-cyano-1,6-dihydro-6-imino-2-isopropyl-4-(p-piperazinyl) DMSO solution.

Material sand Methods; -The solvent, i.e. DMSO used in this study, was of AR quality and used without purification (99% Sigma-Aldrich purity). The compound 1-(4-fluorophenyl)-2-iodo-3,3bis(methylthio)prop-2-en-1-one synthesized by known method. The compound bis[5-cyano-1,6-dihydro-6-imino-2-isopropyl-4-(p-piperazinyl) pyrimidine] diazenes synthesized by known method. The solutions were developed according to a standard method by dissolving the quantity of solute in the solvent and measuring the mass using (Adair Datta of accuracy ± 0.01 mg). The ultrasonic velocities of bis[5-cyano-1,6-dihydro-6-imino-2-isopropyl-4-(p-piperazinyl) pyrimidine] diazene solutions of different concentration were measured by ultrasonic interferometer (Mittal enterprises, model F-81s) at 2MHz with accuracy $\pm 1 \text{ m}\cdot\text{s}^{-1}$ in velocity. The densities of experimental solutions measured by using digital density meter (Anton Paar DMA35 of accuracy ± 0.001) . A thermostatically

controlled water bath having temperature uncertainty to ± 0.1 K was used for all the measurements. Measure values of ultrasonic velocity, density and refractive indices shows good concordance to the literature values [6,7].

Theory;-

Following equations used to calculate acoustical parameter

$$[\text{Ultrasonic velocity } (u) = v\lambda \quad (1)]$$

Where u = ultrasonic velocity, λ = wavelength.

$$\text{Isentropic compressibility } (\beta_s) = 1/\rho u^2 \quad (2)$$

Where ρ = density u = speed of sound.

$$\text{Intermolecular free length } (L_f) = K\beta_s^{1/2}$$

(3) Where K = Jacobson constant [8].

$$\text{Acoustic impedance } (Z) = \rho u \quad (4)$$

(RA) Relative association = $U = u - u_0 / u_0 c \quad (6)$

[U] = sound velocity number, c = concentration of the solute.

Results and discussion;-

The experimentally determined values of density and ultrasonic velocities for bis[5-cyano-1,6-dihydro-6-imino-2-isopropyl-4-(p-piperazinyl) pyrimidine] diazene -DMSO solutions quantified at (303.15 K, 308.15 K, 313.15 K and 318.15 K) are given in Table 1. From Figure 2 it is visually examined that density increases as the concentration of solute increases but it decrements with an incrementation in temperature. A Figure 1 shows that ultrasonic velocity increases with an incrementation in concentration where as it decrements with an incrementation in temperature which betokens molecular sodality in the experimental system it is eminent that molecular interactions are less at lower values of velocities [12]. This may be due to breaking of hetero and homo molecular cluster at high temperature [13] and withal may be due to dipole-dipole interaction between solute and solvent molecules. From Table 2 and Figure 3 it is found that isentropic compressibility decreases with increase in concentration of solution it is due to the fact that circumvented molecules experience electrostatic field [12] due ions.

Table 1

Experimental and literature values of ultrasonic velocity, density and refractive indices for DMSO at different temperature.

T/K	u, ms^{-1}		$\rho, \text{kg m}^{-3}$	
	Expt	lit	Expt	lit
303.15	1485.04	1483.00(9) 7 gsd art acd	1.0931	1.0902(10) 8 gsdacd art
308.15	1454.24	1450.90(9)	1.0842	1.0852(9)
313.15	1442.65	1438.85(11) 9gsd art acd	1.0796	1.0802(11)
318.15	1424.37	1422.30(11)	1.0788	1.0768(11)
Uncertain ties in temperature, velocity and density are 0.1 K, 1 m s ⁻¹ , 0.0005 k g m ⁻¹ and 0.0001(n) respectively				

Table 2 Experimental values of ultrasonic velocity, density and of bis[5-cyano-1,6-dihydro-6-imino-2-isopropyl-4-(p-piperazinyl) pyrimidine] diazene-DMSO solutions at temperatures 303.15 K , 308.15 K , 313.15 K ,318.15 K.

C/T	u, ms ⁻¹				ρ, kg m ⁻³				
	303.15 K	308.15 K	313.15 K	318.15 K	303.15 K	308.15 K	313.15 K	318.15 K	
0	1480.04	1450.24	1446.65	1420.37	1.0923	1.0864	1.0796	1.0816	1.0816
0.01	1486.06	1456.12	1452.03	1432.45	1.1004	1.0965	1.0853	1.0843	1.0843
0.02	1496.18	1460.02	1456.39	1442.02	1.1076	1.1034	1.0923	1.0895	1.0895
0.03	1503.11	1468.46	1462.01	1450.19	1.1124	1.1108	1.0989	1.0953	1.0953
0.04	1508.27	1478.04	1472.24	1464.88	1.1186	1.1189	1.1066	1.0991	1.0991
0.05	1514.31	1486.55	1480.06	1472.01	1.1237	1.1263	1.1209	1.1055	1.1055
0.06	1517.53	1492.78	1488.12	1484.25	1.1296	1.1315	1.1271	1.1116	1.1116
0.07	1522.08	1504.28	1496.04	1490.34	1.1353	1.1367	1.1334	1.1197	1.1197
0.08	1530.44	1510.07	1504.53	1498.03	1.1418	1.1427	1.1396	1.1259	1.1259
0.09	1538.26	1518.17	1510.01	1504.89	1.1483	1.1491	1.1452	1.1321	1.1321
0.1	1544.01	1532.01	1524.03	1512.08	1.1569	1.1569	1.1506	1.1468	1.1468

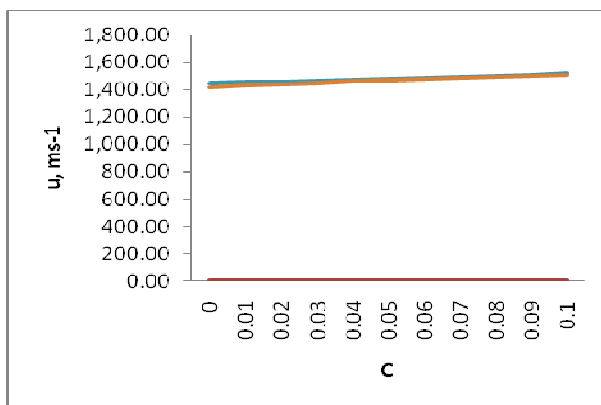


Figure 1 Ultrasonic velocity (u) plotted against concentration of bis[5-cyano-1,6-dihydro-6-imino-2-isopropyl-4-(p-piperazinyl) pyrimidine] diazene DMSO solutions at temperatures 303.15K(-), 308.15K(-), 313.15K(-), 318.15K(-)

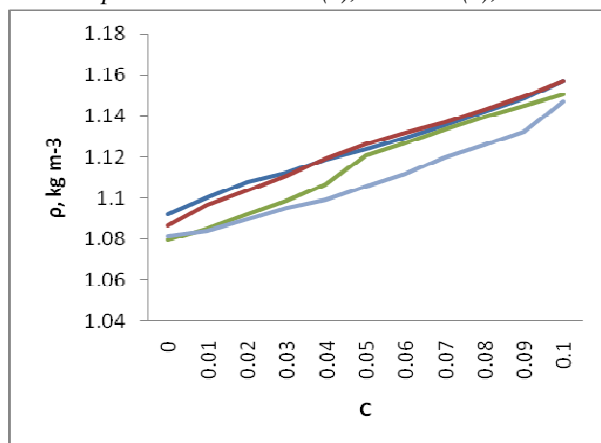


Figure 2 Density (ρ) plotted against concentration of bis[5-cyano-1,6-dihydro-6-imino-2-isopropyl-4-(p-piperazinyl) pyrimidine] diazene DMSO solutions at temperatures 303.15K(-), 308.15K(-), 313.15K(-), 318.15K(-).

These decrease values of compressibility betoken that there is an incrementation in molecular sodality with increase in solute concentration, as incipient species form due to the molecular sodality become compact and less compressible. These additionally suggest that compressibility of solvent is more preponderant than that of solution. As a result more possibility of contact of solute with solvent due to increment in mobility of solute which is responsible for interaction between solute and solvent [12]. The decrementing value of intermolecular free length denotes more proximate packing [14] which is conspicuous from Figure 4. The intermolecular free length on mixing of solute to the solvent is responsible for the variation of ultrasonic velocity of the same solution. On the substratum of a model for sound propagation given by Eyring and Kincaid [15] free length decreases with increase of ultrasonic velocity and vice versa. The variation of ultrasonic velocity in liquids and their solutions can be tenacious on the substratum of intermolecular free length [16]. Intermolecular free length (LF) is the distance between the surfaces of the neighboring molecules and betokens a paramount interaction between solute-solvent as well as dipole-dipole interaction [17] for bis[5-cyano-1,6-dihydro-6-imino-2-isopropyl-4-(p-piperazinyl) pyrimidine] diazene-DMSO solutions [18]. When the ultrasound wave propagates through a solution, some part of it peregrinates through the medium and remaining part of ultrasonic wave gets reflected by the solute [19] it signifies solutes contract free flow of sound wave. The property that decrements this contraction or rearward kineticism of ultrasonic waves is kenned as acoustic impedance (Z). The categorical acoustic impedance is dependent on both concentration and temperature of the solution. As the internal pressure and cohesive energy [20] increases with solute concentration, vigorous dipole-dipole interaction occurs between bis[5-cyano-1,6-dihydro-6-imino-2-isopropyl-4-(p-piperazinyl) pyrimidine] diazene and DMSO molecule. Hence, an incrementation in concrete acoustic impedance is due to an incrementation in instantaneous pressure exert at any molecule in the above experimental solutions with propagation of a sound wave (Figure 5). From Figure 6 visually examines that the relative sodality(RA) increases with increase in temperature and the incrementation of concentration of bis[5-cyano-1,6-dihydro-6-imino-2-isopropyl-4-(p-piperazinyl) pyrimidine] diazene. This is due to the solute- solvent interaction and dipole-dipole interactions (Table 3). It depends on either the breaking up of the solvent molecules on additament of solute molecules in solvent at certain temperature or the solvation of ions that are present [21, 22]. In general sound velocity number increases with increase in concentration of solute [23] and increment in temperature; however in present investigation there is constant trend visually examined with reverence to the concentration of solute but with reverence of temperature it goes on increases (Figure 7).

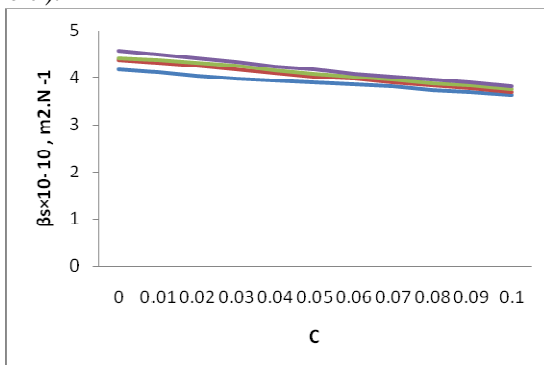


Figure 3 Adiabatic compressibility(β_s) plotted against concentration of bis[5-cyano-1,6-dihydro-6-imino-2-isopropyl-4-(p-piperazinyl) pyrimidine] diazene DMSO solutions at temperatures 303.15K(-), 308.15K(-), 313.15K(-), 318.15K(-).

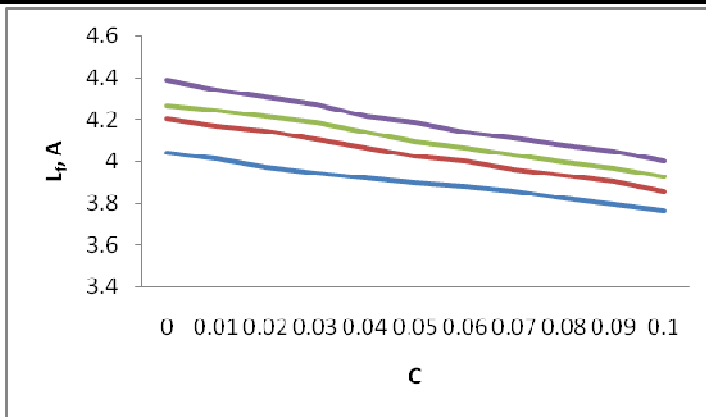


Figure 4 Linear free length (L_f) plotted against concentration of bis[5-cyano-1,6-dihydro-6-imino-2-isopropyl-4-(p-piperazinyl) pyrimidine] diazene DMSO solutions at temperatures 303.15K(-), 308.15K(-), 313.15K(-), 318.15K(-).

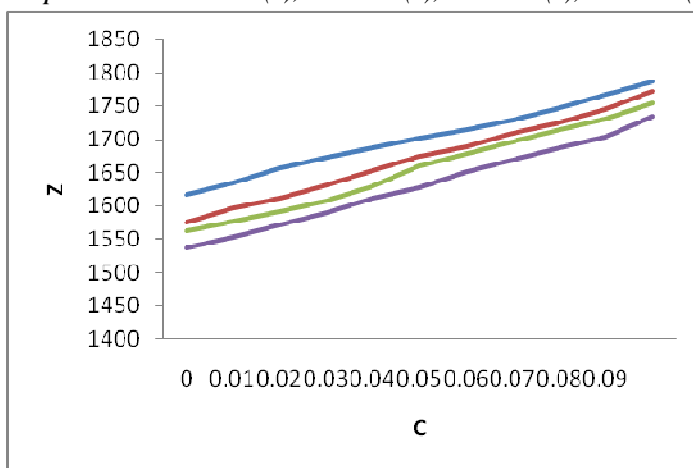


Figure 5 Acoustic impedance (Z) plotted against concentration of bis[5-cyano-1,6-dihydro-6-imino-2-isopropyl-4-(p-piperazinyl) pyrimidine] diazene DMSO solutions at temperatures 303.15K(-), 308.15K(-), 313.15K(-), 318.15K(-).

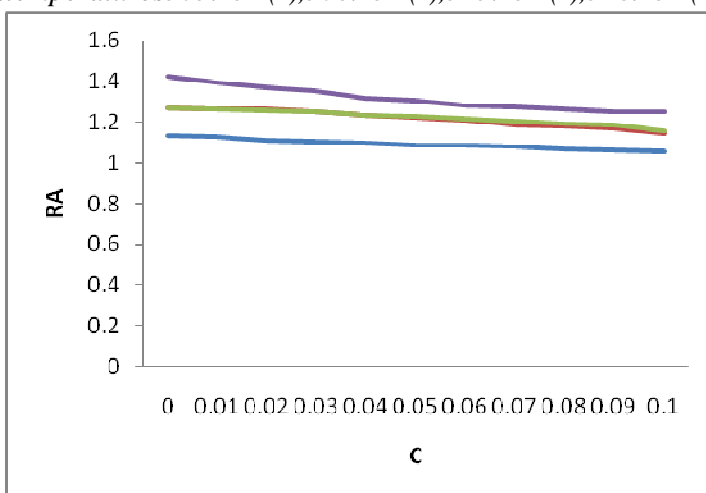


Figure 6 Relative association (Z) plotted against concentration of bis[5-cyano-1,6-dihydro-6-imino-2-isopropyl-4-(p-piperazinyl) pyrimidine] diazene DMSO solutions at temperatures 303.15K(-), 308.15K(-), 313.15K(-), 318.15K(-).

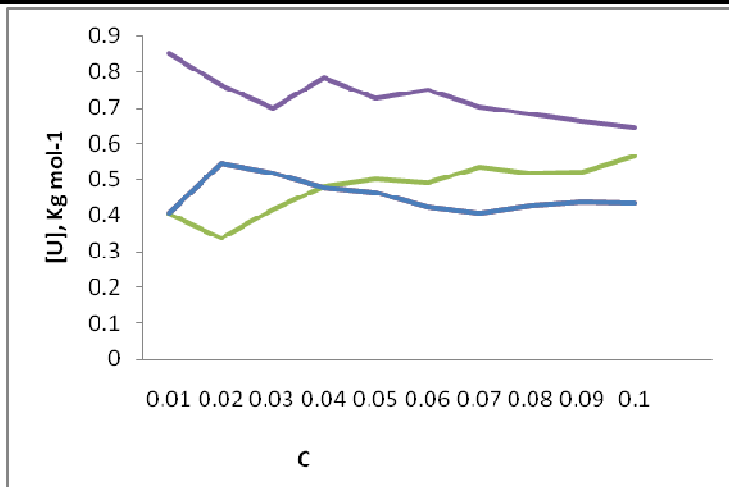


Figure 7 Sound velocity number(U) plotted against concentration of bis[5-cyano-1,6-dihydro-6-imino-2-isopropyl-4-(p-piperazinyl) pyrimidine] diazene DMSO solutions at temperatures 303.15K(-), 308.15K(-), 313.15K(-), 318.15K(-).

Table

Isotropic compressibility, relative association, acoustic impedance, linear length and sound velocity number of bis[5-cyano-1,6-dihydro-6-imino-2-isopropyl-4-(p-piperazinyl) pyrimidine] diazene-DMSO solutions at different temperature and concentration.

C	$\beta_s \times 10^{-10}, \text{m}^2 \cdot \text{N}^{-1}$	R_A	$Z \times 10^{-5} \text{kg} \cdot \text{m}^2 \cdot \text{s}^{-1}$	L_f	$[U], \text{Kg mol}^{-1}$
			303.15 K		
0.00	4.17	-	16.16	4.2424	-
0.01	4.11	1.1351	16.35	4.2182	0.40674576
0.02	4.03	1.1296	16.57	4.1903	0.54525553
0.03	3.97	1.1141	16.72	4.1650	0.51958055
0.04	3.92	1.1035	16.87	4.1402	0.47684522
0.05	3.88	1.0983	17.01	4.1160	0.46309559
0.06	3.84	1.0909	17.14	4.0947	0.42217327
0.07	3.80	1.0890	17.28	4.0704	0.40578054
0.08	3.73	1.0847	17.47	4.0384	0.42566417
0.09	3.68	1.0731	17.66	4.0188	0.43707527
0.10	3.62	1.0628	17.86	3.9818	0.43221805
			308.15 K		
0.00	4.37	-	15.75	4.3500	-
0.01	4.30	1.2686	15.96	4.3081	0.40545013
0.02	4.25	1.2649	16.1	4.2736	0.33718557
0.03	4.17	1.2627	16.31	4.2311	0.41878126
0.04	4.09	1.2494	16.53	4.1942	0.47923102
0.05	4.01	1.2342	16.74	4.1656	0.5007447
0.06	3.96	1.2211	16.89	4.1336	0.4888846
0.07	3.88	1.2115	17.09	4.0951	0.53232568
0.08	3.83	1.1894	17.25	4.0716	0.51569051

0.09	3.77	1.1819	17.44	4.0359	0.52045025
0.10	3.68	1.1696	17.72	4.0048	0.56383771
313.15 K					
0.00	4.42	-	15.61	4.3943	-
0.01	4.37	1.2715	15.75	4.3665	0.37189369
0.02	4.31	1.2641	15.9	4.3334	0.33663982
0.03	4.25	1.2609	16.06	4.2979	0.35392113
0.04	4.16	1.2539	16.29	4.2647	0.44222860
0.05	4.07	1.2365	16.58	4.215	0.46189472
0.06	4.00	1.2328	16.77	4.1749	0.47777048
0.07	3.94	1.2196	16.95	4.1467	0.48772780
0.08	3.87	1.2070	17.14	4.1066	0.50012097
0.09	3.82	1.1932	17.29	4.0709	0.48664155
0.10	3.74	1.1860	17.53	4.0346	0.53489095
318.15 K					
0.00	4.58	-	15.36	4.4524	-
0.01	4.49	1.4247	15.53	4.4263	0.85048262
0.02	4.41	1.3924	15.71	4.3890	0.76212536
0.03	4.34	1.3714	15.88	4.3595	0.69981765
0.04	4.23	1.3555	16.10	4.3231	0.78342263
0.05	4.17	1.3197	16.27	4.2870	0.72713448
0.06	4.08	1.3082	16.49	4.2528	0.74956995
0.07	4.02	1.2831	16.68	4.2069	0.70374017
0.08	3.95	1.2767	16.86	4.1624	0.68344868
0.09	3.90	1.2641	17.03	4.1283	0.66117358
0.10	3.81	1.2538	17.34	4.0700	0.64567683
Uncertainties in isentropic compressibility (β_s) 0.01×10^{-10} , $\text{m}^2 \cdot \text{N}^{-1}$, Relative association (R) 0.010, Acoustic impedance (z) velocity 1×10^5 , $\text{kg} \cdot \text{m}^2$, A Linear free length (L) 0.00 A and in sound velocity number 0.1×10^5 , $\text{kg} \cdot \text{m}^2$ respectively.					

Conclusion;-

In present article, the densities, ultrasonic velocities at temperatures 303.15 K, 308.15 K, 313.5 K and 318.15 K over the gamut of composition of 1-(4-fluorophenyl)-2-iodo-3,3-bis(methylthio) prop-2-en-1-one in DMSO have been quantified. From these quantified physical property data, isentropic compressibility, acoustic impedance, relative association and linear free length have been calculated. The intermolecular interactions of the components are interpreted and found presence of solute-solvent and dipole-dipole interaction in experimental system.

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SYNTHESIS OF 3-(1-HYDROXYNAPHTHALENE-2-YL)-5-STYRIL-1-(2-4-DINITROPHENYL) PYRAZOLINE.

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Abstract :

Various synthetic pathways of pyrazolines have been reviewed. It was found that the most convenient method of the synthesis of pyrazoline is through the action of hydrazine or phenyl hydrazine on α - β -unsaturated carbonyl compounds. The reaction proceeds through the intermediate phenyl hydrazone which undergoes cyclization to pyrazoline, with suitable cyclizing agent. Literature survey shows that the synthesis of 3-(1-hydroxynaphthalene-2-yl)-5-styryl-1-(2-4-dinitrophenyl) pyrazoline from chalcone and 2,4-dinitrophenyl hydrazine in DMF medium, have not yet carried out. Hence it was decided to synthesize these pyrazolines. The present work deals with the synthesis of 3-(1-hydroxynaphthalene-2-yl)-5-styryl-1-(2-4-dinitrophenyl) pyrazoline.

Introduction

Five membered heterocyclic compounds containing two adjacent nitrogen has been named as "pyrazolines" by Knorr 1 in 1883. Pyrazoline is a dihydro form of pyrazole. The case to correlate formation of pyrazoline with stereoisomeric forms of phenyl hydrazone have attempted by Gheorghiu and Matai. Pharmaceutical chemistry is devoted to the discovery and development of new agents for treating diseases. Pyrazole derivatives have a history of application in agrochemicals and pharmaceutical industry as herbicides and active pharmaceuticals. Literature survey reveals that pyrazoline derivatives exhibits anti-bacterial, fungicidal, anti-inflammatory, anticonvulsant, diuretics, and anti-histaminic, The recent success of pyrazole COX-2 inhibitors has further highlighted the importance of these heterocyclic rings in medicinal chemistry.

MATERIALS AND METHODS

Step 1 :Synthesis of 2-acetyl-1-naphthol:

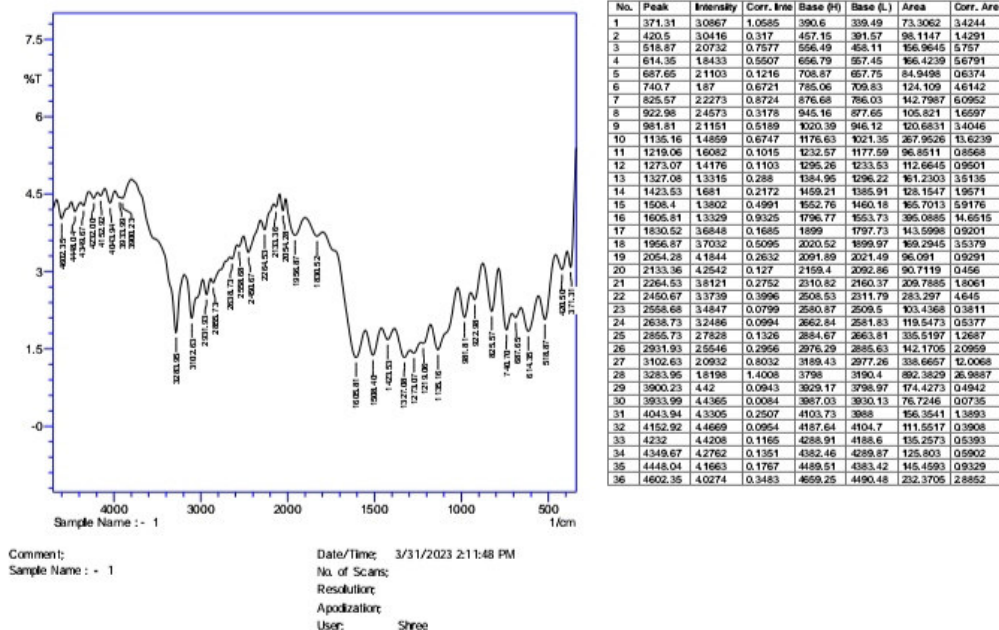
2-acetyl-1-naphthol was synthesized by modified Nenchi's method in which hot glacial acetic acid and fused ZnCl₂ were added and refluxed, then powdered 1-naphthol was added. The mixture was refluxed for about 8 hours. Then it was cooled & poured in acidulated water and crystallized from rectified spirit to obtain 2-acetyl-1-naphthol

Step 2 :Synthesis of 1-(1-hydroxynaphthalen-2-yl)-3-substituted-prop-2-ene-1-ones:

2-Acetyl-1-naphthol (0.01mole) and Cinnamaldehyde (0.02 mole) were added in ethanol solvent (20ml). To this mixture KOH (10%, 10ml) solution was added drop wise with constant stirring. The reaction mixture was kept overnight. Then this mixture was poured over crushed ice & little HCl. The product was filtered and crystallized from ethanol to obtain the chalcone

Step 3:Synthesis 3-(1-hydroxynaphthalene-2-yl) -5- styryl-1- (2-4-dinitrophenyl) pyrazoline:

The mixture of chalcone (0.01M) and 2,4-dinitrophenyl hydrazide (0.01 M) in DMF (20ml) was refluxed for 2 hours. On cooling the reaction mixture was diluted and the semisolid so obtained was triturated with ethanol to get a solid which was crystallized from ethanolic acetic acid mixture to obtain the titled compound. The structures of the synthesized compounds have been elucidated by IR analysis. IR spectra showed absorption bands at desired values.

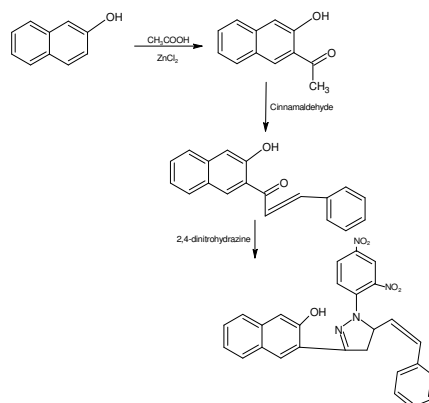


Results and Discussions : The purity of all the compounds were examined by TLC and structure confirmation was carried out by IR. The peaks in IR spectra were matched with literature and found at desire values. Elemental analysis was also carried out and calculated values of % Nitrogen values were match with the experimental values.

Conclusion :

In conclusion we have reported a facile route for synthesis of 3-(1-hydroxynaphthalene-2-yl)-5-styryl-1-(2,4-dinitrophenyl) pyrazoline. The procedure for this synthesis is going completed in 3 steps in this first step we synthesis 2-acetyl-1-naphthol by modified Nanchi's method. After completing first step we get our first product then with this we synthesis our second product which was chalcone. After getting the product we go for final synthesis i.e. the mixture of second product and 2,4-dinitrophenyl hydrazine in 20ml DMF reflux for 2 hours after this synthesis we get our final product and structure of compound have been confirmed by chemical properties elemental and spectral data (IR analysis)

Scheme:



Physical Data :

Sr. No.	Name of compound	Melting Point	% Yield	%N	
				Calculated	Found
1	2-acetyl-1-naphthol	98	75%	--	--
2	Chalcone	127	72%	--	--
3	3-(1-hydroxynaphthalene-2-yl)-5-styryl-1-(2-4-dinitrophenyl)pyrazoline	202	62%	11.66	11.05

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SYNTHESIS OF 3-(1-HYDROXYNAPHTHALENE-2-YL)-5-PHENYL-1-(2-4-DINITROPHENYL) PYRAZOLINE.

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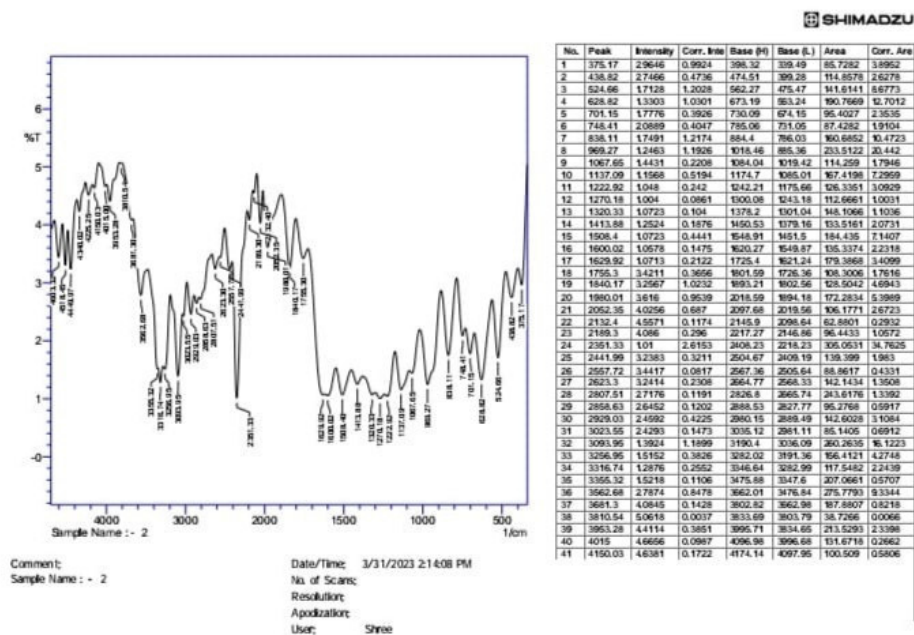
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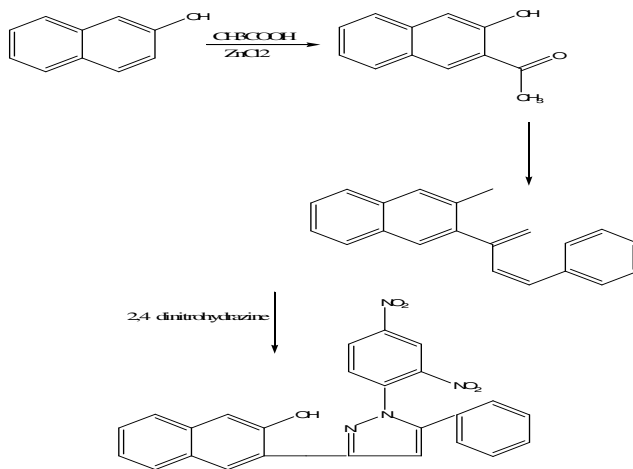
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Analysis of Melghat Honey and Kutki



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Analysis and Use of Melghat Honey and Kutki

Studies on Analysis of *Melghat* Honey and
Development of Value Added Products from Honey
and *Kutki* (*Panicum sumatrense*)

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CHAPTER 1 INTRODUCTION

1.1 TOPIC BACKGROUND

Melghat is a tribal region located in the laps of *Maikal* ranges of *Satpuda* hills in the Amravati district. *Amravati* is a district of Maharashtra State, situated in the central region of India. *Melghat* is the combined area of Sanctuary of *Wan* and *Melghat* as well as '*Gugamal* National Park'. These sanctuaries and parks are part of two tehsils, viz. *Chikhaldara* and *Dharni* of Amravati district.

Chikhaldara is also a well-known and only one hill station of the *Vidarbha* region of Maharashtra state, which is at a height of about 1100 meters above sea level. It is a gigantic forest area with an exclusive and representative ecosystem with rich biodiversity and varied habitats.

More than 769 naturalized species were listed in the *Melghat* plant life that includes species of trees, herbs, climbers, and sedges. Plenty of species of shrub and grass were also identified.

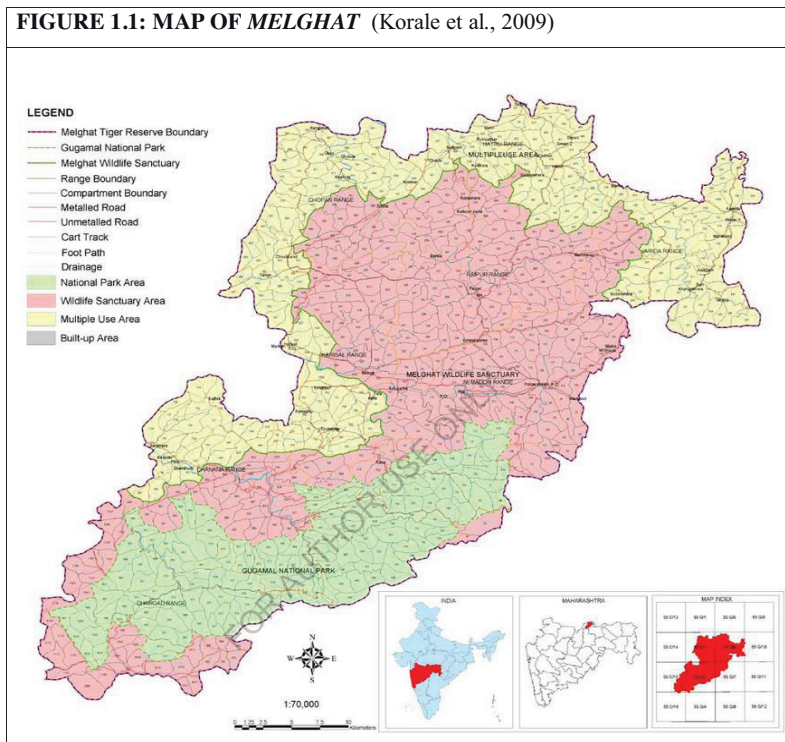
Schedule tribes including *Nihal*, *Korku*, and *Gond* are the predominant inhabitant of the *Melghat*, while *Balai*, *Gaoli*, and *Gaolan* are other most important tribes. *Gaoli*'s are traditionally involved in the occupation of cattle nurture and agriculture. Usually, the *Gaoli*'s have large packs of cattle. They approximately own 20 to 40 animals per family. Trading of milk and milk-based products is the central resource of their income.

The prevalent and biggest community of the *Melghat* is '*Korku*'. They had been earning their bread primarily by collecting forest produce that includes honey. The chief labor force involved in the preservation and development works of the forest is from the *Korku* neighborhood. They also engaged in agriculture as a source of income but in a very limited mode. Agriculture is considered as a supplementary activity by them. (Melghattiger.gov.in) Figure 1.1 is showing the map of the *Melghat* region.

These ancestral people are strongly dependent on the resource from the woods. They necessitate grasses, bamboo, poles, and timber from the forest, for constructing houses, farm-animal shades as well as agricultural equipments. The other goods from the forest like hay, fodder, fruits, and flowers are also helpful to use as food and to

feed their animals. Some forest products such as gum, honey, lac, tendu-patta, herbs, and roots are also useful as medicinal and nutritional sources in their life. (MTR buffer plan, 2015)

FIGURE 1.1: MAP OF MELGHAT (Korale et al., 2009)



Malnutrition among the kids is the most rigorous problem in this region. Many children have died and at rest dying because of undernourishment. Poverty and consumption of a diet with low nutritional value are some of the very important grounds for malnutrition. Due to unemployment and poor economical conditions, the literacy rate is also little. Many students depart from their education in the meantime only due to these reasons. (Singh, 2008)

1.2 HONEY

Honey is one of the most vital and especially a natural creation obtained from natural combs or combs of commercial beekeeping. This highly nutritious produce is

generated from the nectar available in the head of flowers or the emissions of the plant-sucking insects, surviving on the sap of plants. The raw material is collected for development by the honey bees. Honey might be one of the prime substances used as a sweetener by our ancestors in human history.

Honey plays a role as an efficient nourishing agent in the life of humans, right from the prehistoric era, but it acquired scientific importance and came into the limelight recently. The reason behind the increasing research of honey in the field of its composition and its thousands of properties is due to the increase in the consumption of honey.

People are now fascinating more regarding the consumption of natural food. More ever it is now difficult to get the original honey for consumption because the possibilities of adulteration are increased. These phenomenons are the driving forces behind the increase in the research of honey by researchers.



1.2.1 DEFINITION AND MAKING OF HONEY

We may define honey as a natural product, which may be termed as the supersaturated solution composed of sugars. It is synthesized by the honey bees by gathering the nectar from flowers and treated it by adding their secretions. The nectar and various secretions are brought together by the bees to initialize the process of formulating the honey.

The nectar and the emissions are brought by the bees to the hive in her inbuilt honey sac. The honey sac is a more modified part in the honey bees that resembles the gut. The liquid carried out by her is regurgitated and passed from mouth to mouth of the honey bees. In the process of ingesting the liquid and regurgitating it again, the required changes are taken place. As the content of moisture decreases, the protein quantity increases.

Before keeping the sweet liquid to the honey cells it passes through the chain of honey bees. The processing of the mixture is continued by the bees even after putting it into the honey cells. Temperature is maintained and the amount of water is decreased continuously by accelerating the process of evaporation. Once the moisture decreased approximately below 20 %, the cell is being sealed by the bees with the help of wax and the honey is kept for ripening and to avoid fermentation. (Codex Alimentarius, 2001)

This is a concentrated and stored food kept by the honey bees for the period with no availability of flowers. Some substances from their own metabolic systems such as enzymes are added and mixed in the nectar. The mixture thus obtained is stored in the honey cells of the bee-hive and left for the process of ripening. During ripening the sugary liquid is converted into golden liquid i.e. honey, by altering the pH and chemical composition in order to make it a long time storable. After maturation, the material is converted to a precious substance which is termed as honey. Thus honey is a stored food of the honey bees to feed their larvae as well as to eat during the starvation period.

Water plays an important role in the making of honey. Water strongly affects the quality of honey, since it is an important factor affecting the storage potential of honey. The moisture of the liquid is controlled by the bees during the ripening period. In order to drag out the excess water from honey, the honey bees use their wings for fanning the honey cells with the intention of accelerating the process of evaporation of water.

Honey possesses numerous medicinal and therapeutic as well as functional properties which make it an important food and food ingredient in the preparation of many dishes.

1.2.2 TYPES OF HONEY

There are varieties of honey available throughout the world. The taste, consistency, color, and properties of different kinds of honey have remarkable differences in their values. These differences in the properties of honey are due to the differences in their botanical sources, geographical location, type of season of harvesting, types of honey bees that producing the honey, and many more. Some classifications of honey are as follows.

1.2.2.1 ON THE BASIS OF TYPES OF SOURCE

Broadly honey can be classified into two categories. This classification is based on the basic ingredient used by the honey bees to produce the honey.

A. HONEYDEW HONEY

It is the honey produced by the honey bees from the sweet secretions of some special insects which are nourished on the sap of plants and are the member of the genus *Rhynchota*. They suck the plant sap and ingest it. The sap was secreted again by the insects. It is known as honeydew. Bee can use the honeydews as food. Thus it is produced in the period of high temperature.

The honey produced from the honey dews is having dark color as well as it has a strong taste. The color of honeydew honey diverges from very light brownish or green to very dark, almost termed as black (Codex Alimentarius, 2001). The honeydew honey is considered as low-quality honey. (Singh & Singh, 2010)

B. NECTAR HONEY (BLOSSOM HONEY)

The honey, which is formulated by the honey bees using the juices collected from the nectaries of the flowers. It is the most common honey produced by the honey bees. It is the most natural creation produced by the honey bees and it is higher quality honey than the honeydew honey. It needs to be mentioned that nectar honey is used for this research. Further blossom honey or nectar honey is classified as

1.2.2.2 AS PER THE BOTANICAL ORIGIN (Honeypedia)

These are the different varieties of honey depending upon the floral origin of honey. They not only differ in the source of botanical origin but in the properties also.

When in any area there is a dominance of any particular flowering plant then it may produce monofloral honey or otherwise, multi-floral honey is obtained. Thus under this category, the honey can be categorized as

A. UNIFLORAL HONEY:

Theoretically, it is the honey that is produced by the honey bees by collecting the nectar from a single kind of flower species. These types of honey are also known as single flower, mono-floral, or varietal honey.

Practically it is very difficult to get a unifloral honey. No one can restrict the bees to alight on a particular flower. Practically unifloral honey too content the nectar collected from various kinds of flowers. Only the difference from the multi-floral honey is that the nectar from the single species of plant flower is predominantly present.

Thus any honey is considered as a single floral or mono-floral honey if the pollens of that particular flower are present there with an amount of more than 45% of the total pollen count of the honey. The mono-floral honey is named according to the origin of the plant.

The common examples of single floral honey are clover honey, acacia honey, sunflower honey, etc.

B. MULTIFLORAL HONEY:

It is the honey created by honey bees by collecting the nectar from a variety of species of flowers. No special plant is predominant in these types of honey but it is a mixture of all types of nectars. Forest honey is the best example of multi-floral honey

Commercially, single floral honey is sold at a high price than multi-floral honey.

1.2.2.3 AS PER THE METHODS OF PROCESSING

The methods of processing and extraction also have an influence on the taste as well as properties of honey. There are various methods applied for the processing as well as extraction of honey throughout the world. Depending upon the methods of the processing of the honey, the honey may be classified as

A. EXTRACTED HONEY

The honeycomb is made broodless first and then the cells are decapped. The honey which is extracted by centrifuging these decapped combs without broods is known as broodless honey. This honey is also termed by the name apiary honey. This honey is high in quality and purer as compared to other honey.

B. SQUEEZED HONEY

Sometimes the broodless honeycombs are squeezed or pressed to get the honey. The honey may be obtained with or without the application of heat. The water content of these types of honey is high and thus the honey may be more susceptible on the way to fermentation. As compared to apiary honey it is somewhat inferior in quality.

C. DRAINED HONEY

The broodless honeycombs are drained to obtain this type of honey.

1.2.2.4 AS PER THE PHYSICAL STATE OF HONEY

Depending upon their physical state the honeys can be classified into the following types

A. COMMON HONEY

Common honey normally appears as a viscous liquid or sometimes may be in the crystalline state or a combination of two.

B. CHUNK HONEY

This type of honey is having some pieces of the comb honey in it.

C. COMB HONEY

It is a honey, which is still in a comb and is stored by the bees in the broodless cells of the hive. This type of honey is traded in the form of whole combs or pieces of combs. The honey cells are generally in a sealed position.

D. GRANULATED OR CRYSTALLIZED HONEY

Sometimes honey undergoes the process of crystallization of sugars. It is a usual process of solidification of honey. It appears to be granulated due to the presence of crystals of glucose.

1.2.3 COMPOSITION OF HONEY

Honey is a concentrated solution mainly of sugars. Besides sugars, many compounds are found in honey. It was said that more than 600 different ingredients were noted to comprise the honey (Boussaid et al., 2018).

1.2.3.1 CARBOHYDRATES AND SUGARS:

Carbohydrates are the nutritionally important and health improving constituents of many food items. Carbohydrates structure the largest part of the honey also. Honey has a large amount of carbohydrates contains in it. It was stated that about 95% of the dry material present in honey is in the form of carbohydrates (Bogdanov et al., 2008). On the other hand, the carbohydrates in attendance in the honey are mostly in the form of sugars may be mono and disaccharides.

Oligosaccharides also present in honey but they are comparatively in a lesser amount. As said earlier, sugars are the most imperative and abundant constituents of honey. Owing to its huge amount in the honey most of the physicochemical as well as other properties of honey are influenced by the existence and amount of sugars.

It was stated that honey is a saturated solution of more than 22-25 different types of sugars among which dextrose (glucose) and levulose (fructose) are the primes (White & Doner, 1980). Some names are sucrose, rhamnase, maltose, maltotriose, iso-maltose, maltotetraose, palatinose, eralose, maltulose, nigerose, melibiose, trehalose, turanose, nigerobiose, etc (Abeshu & Gelata, 2016).

It was told that the higher percentage of sugar, sometimes represents an indication of the adulteration of honey with added sugar or of under-ripened honey. The harvesting of honey before proper ripening keeps the process of inversion of sucrose incomplete. The reducing sugars such as dextrose and levulose (i.e. glucose and fructose) are the key sugars present in the honey they are almost in equal amounts. The properties of honey are affected due to the amount and types of sugars present.

A high concentration of sugars is accountable for the higher density of honey. It gives the honey its typical sticky and viscous consistency. The wound healing tendency of honey is primarily due to its hygroscopic character and it is because of the sugar profile of honey. The property of honey to show its potential against microorganisms is due to the occurrence of sugars in honey. H_2O_2 , the compound formed during the oxidation of sugars is reported to be responsible for most of its medicinal properties. Honey is said to be a high and instant energy source. It is due to the levulose and dextrose present in honey, those digest quickly and thus as a result work as a tremendous source of energy (Shobham et al., 2017; Amabye, 2017; DaSilva P et al., 2016; Bogoviku & Gedeshi, 2015; Islam et al., 2012; Manu Kumar et al., 2013).

Besides carbohydrates, the prime contents of honey especially glucose and fructose the other important components of honey are proteins, amino acids, vitamins, minerals, etc.

1.2.3.2 WATER

Moisture is the second leading component of honey both by weight and volume (Krell, 1996). It plays an important job in the process of preparation of honey as it serves as a solvent that dissolves all the other components or keeps them as the suspended particles. It has a strong influence on its quality since the storage capacity of honey, its vulnerability to ferment, the tendency of granulation, as well as plenty of other properties are water dependant. Those are the efforts taken by the honey bees which work in the maintenance of moisture, as the bees control the water level by using their wings for fanning the honey to accelerate the process of evaporation of the excess water.

There are tremendous variations occur in the moisture content of honey throughout the world depending upon the plenty of internal and external factors such as surrounding temperature, humidity in the atmosphere, the period of harvesting and the extent of the process of ripening, the locational and ecological factors, botanical source of nectar, methods of handling the honey by the beekeepers, types and condition of hives, and types of the bees (White & Doner, 1980). The grading of honey and its trade value is influenced significantly by the moisture. Besides this many of the physical properties of honey such as its flavor, taste, color, solubility, and

viscosity, etc. are having variations due to the change in its moisture content (Dimins et al., 2006).

1.2.3.3 TOTAL PROTEIN

It is also an important ingredient in the composition of honey. Though it is present in a very low amount it has some significant importance in the quality of honey. The protein content of honey varies according to its variety. Many other factors such as the sources of nectar, the amount of pollen collected and its quality, the type of the species of honey bees, etc. also put an effect on protein content.

Initially protein present in a very negligible amount in the nectar, but it was added by the bees during the process of ripening and maturation. The natural secretions containing enzymes, added by the bees during the making of honey are the prime sources of proteins.

There are 8-11 kinds of proteins reported to have in honey. Invertase, glucose oxidase, and diastase are some of the chief enzymes added by the honey bees. A very negligible amount of amino acids present in honey among them proline is the highest one. The dark color of honey produced during its storage or heating is mainly formed due to the reactions of proline with sugar (Bogdanov, 2011).

1.2.3.4 ACIDS IN HONEY

Honey is found always acidic in nature, whatever may be the botanical sources or the geographical or climatic conditions. The presences of many kinds of organic acids that present in honey are responsible for its acidity and low pH. The acidity of the honey is because of the presence of numerous kinds of organic acids that present in honey.

Some inorganic ions like phosphate, formed during the reactions of glucose, also contribute to the acidity of the honey. The differences in the season of harvesting the honey have an effect on the acid profile of honey. The honey has its own characteristics acid content thus the measurement of the acidity of honey can be useful for determining the freshness and originality of the honey.

Fermentation increases its acidity (Shobham et al., 2017). Most of the acids in honey are synthesized from sugars by the action of enzymes. Succinic acid, oxalic acid, pyroglutamic acid, maleic acid, malic acid, acetic acid, citric acid, formic acid,

etc are some important acids found in honey. Gluconic acid is the chief acid of honey. Many physical properties, taste, and aroma of honey are strongly affected by its acidity.

1.2.3.5 5-HYDROXYMETHYLFURFURAL (5 HMF)

It was mentioned in some studies that 5-HMF produce due to the long time storage or application of temperature to the honey. It is practically not present (or present in a very small amount) in fresh honey. It was said that the formation of HMF is a result of the Millard reaction that taken place in honey during storage or heating.

It is a cyclic aldehyde compound that is produced due to the degradation of sugars through the non-enzymatic browning reaction. Some minerals, acids as well as mainly sugars are responsible for these reactions. In addition, many physical properties such as pH, acidity, water activity, type of container that is used for storage are affecting the content of HMF. Heated honey sometimes can be proved toxic due to the formation of 5-HMF (Misato et al. 2019; Boussaid et al., 2018; Gomez et al., 2012).

It was concluded on and after the studies that the amount of HMF is increased above the permitted limit, as well as the diastase activities are decreased below the given standard values when the honey samples under observations are stored above the temperature of 35°C for more than six months (Korkmaz & Kuplulu, 2017). The level of activity of the enzyme diastase, a natural enzyme found in honey, depends on the freshness over and above the floral and geographical sources of the product. Thus both HMF and diastase activity are said to be the indicators of freshness as well as the aging of honey (Gomes et al., 2010).

1.2.3.6 MINERALS

A variety of minerals is there that found in honey in different amounts. Some minerals that are found in honey are potassium, calcium, manganese, copper, sodium, iron, magnesium, phosphorous, nickel, zinc, Iodine, etc. The mineral content of the honey is found generally in a very less amount. It was said that potassium is present in the largest amount among all the minerals of honey. The mineral profile of honey was stated to be valuable for appraising its floral origin for the reason that the content of

mineral in honey is appreciably depending on its floral origin as well as the geographical location (Amabye, 2017).

As the minerals are generally not affected by the external factors such as pH, oxidizing agents, heat, light, etc. that may affect the other constituents of honey (DaSilva et al., 2016; Abeshu & Gelata, 2016). There is a significant relationship found between the mineral profile of honey and the ash content, color, as well as electrical conductivity of the honey (Krishnasree & Mary, 2015).

1.2.3.7 PHYTOCHEMICALS IN HONEY

“Phytochemicals are the products that are essentially formed by the vegetation and which have plentiful and different functional properties.” Phytochemicals are imperative for the medicinal and restorative properties of honey. These are the biologically dynamic compounds, commonly acknowledged as the secondary metabolites. These compounds formed in the route of metabolic actions of plants obligatory for their growth. The various plant instigated drugs and medicines that are used in the *Ayurveda* or any other prehistoric curative theories for the treatment of various disorders, were found to have a rich phytochemical profile.

It was cleared that honey is the greatest natural stuff originated by the honey bees. The unrefined material used for the making of honey was the nectar congregated from the flowers of plants. So it can be understood that the honey must be rich in an assortment of phytochemicals, and these phytochemicals are accountable to a greater level for the medicinal and other functional properties of honey.

Some polysaccharides, saponins, tannins, flavonoids, gums, triterpenoids, glycosides, phenols, and phenolic compounds are included in this group. These are the compounds that are behind the antipathogenic activities of honey. Other therapeutic properties of honey, like anti-inflammatory effect, antioxidant potential, etc. are also due to the presence of phytochemicals.

1.2.3.8 OTHER SUBSTANCES

In addition to the above constituents, plenty of other substances are found to contain in honey but at a very minute amount. Some vitamins are also found in honey such as vitamin B1, B2, Nicotinic acid, pyridoxine (Vit B6), Ascorbic acid (Vit C), pantothenic acid, etc. Besides this, there are more than that of 600 different substances

are reported to be characterized in honey in which some volatiles and phytochemicals are included.

1.2.4 HONEY STANDARDS AND ITS AUTHENTICATION

There are varieties of honey found in the world. The properties of honey may vary according to the geographical and climatic changes in the location of the production area. Its properties may also be altered due to the variation in the species of honey bees as well as its floral sources. Many other factors are also accountable for the variation in the quality of honey. The properties of honey may be altered manually by adding some food ingredients such as additives, objectionable materials, aroma, flavor, or any other similar substances that may create a mess in its originality and authentication.

By keeping in mind all the above issues some standards are created by the various authorized agencies. In this regards various standard values for its composition are set by these agencies such as Codex Alimentarius, European Union of Standards, Bureau of Indian Standards (BIS), etc (Bogdanov & Martin, 2002).

1.2.4.1 AUTHENTICATION ISSUES

The authentication issues are related with respect to the production, and description of the botanical or geographical origin, its natural state, processing details, etc. of the honey. In the case of the production, it includes the details about the methods applied during extraction and processing and the parameters involved such as temperature, method of filtration, use of mesh size, maturity condition, etc.

A. ORIGIN: Certain honey from a particular location or of particular botanical origin, are sold comparatively at higher rates. Thus the origin of honey regarding the botanical source as well as to the geographical location should be designated correctly.

B. UNHEATED OR RAW, ORGANIC HONEY: The processed or unprocessed honey should be mentioned correctly Methods used for detecting the authenticity

C. USE OF STANDARD METHODS: The standard methods should be used for testing the various parameters of honey.

1.2.4.2 BIS STANDARDS

Bureau of Indian Standards (BIS, 1994-2002) decided the honey specifications for extracted honey. For this, BIS has adopted the draft prepared by the sectional committee of the Indian apiary industries and approved by the Council of Food and Agriculture. It was first published in 1968 and then revised in 1974. The existing practices in trading and grading in India were taken into consideration. The restrictions that are given by the PFA (Prevention of Food Adulteration), act 1954, were also considered while framing these standards. These specifications are given in table 1.1

1.2.5 PROPERTIES OF HONEY

The trade value of honey is strongly dependant on the various physical, compositional, nutritional as well as other properties of honey. The physical properties such as color, appearance are the properties that attract the consumer at the first sight. The chemical, nutritional as well as medicinal properties of honey also play an important role in the selection of honey by the consumer. The functional properties of honey such as antioxidant, antimicrobial, and anti-inflammatory potential have special importance in the consumer's point of view.

1.2.5.1 PHYSICAL PROPERTIES

Physical properties of honey such as taste and flavor, color, pH and acidity, the content of ash, and moisture content, etc. are depended upon the various parameters. The parameters affecting the above properties are

- Type of the honeybees producing the honey
- Various ecological aspects
- The geological origin of honey
- Treatment given by the beekeepers to the bees
- Botanical source i.e. the dominant flora from where the nectar was collected
- Presence of dirt
- Contamination if any

TABLE 1.1: REQUIREMENTS OF EXTRACTED HONEY (BIS, 1994-2002)

S N	Characteristics	Minimum/Maximum	Special Grade	A Grade	Standard Grade
1	Specific gravity at 27°C	Min	1.37	1.37	1.37
2	Moisture	Max	20	22	25
3	Total reducing sugar, (gram /100 g honey)	Min	70	65	65
4	Sucrose, (gram /100 g honey)	Max	5	5	5
5	Fructose: Glucose Ratio	Min	1.0	1.0	1.0
6	Ash, (gram /100 g honey)	Max	0.5	0.5	0.5
7	Acidity (gram /100 g honey)	Max	0.2	0.2	0.2
8	Hydroxymethylfurfural (HMF) mg / kg of honey	Max	80	80	80
9	Total count of pollens and plant elements (per gram of honey)	Max	50000	50000	50000
10	Optical density, in % at 660 nm	Max	0.3	0.3	0.3
11	Fiehe's test	--	Negative	Negative	Negative

Activities of enzymes present in honey also diverge their properties. Several physicochemical properties are found to be helpful in the detection of the botanical, regional, and environmental origin of honey. (Khan et al., 2018; Manzoor et al., 2013)

It was mentioned by the researchers that the numerous physic-chemical characteristics of honey are having dissimilar values for the samples gathered from topologically distinct areas. Ash content for an instance varies directly with respect to the amount of minerals there in the honey (Gomez et al., 2012).

Consumer's acceptability, their preferences, quality of the honey, as well as a market response are the factors that are highly influenced by the physical characteristics especially the color of honey. The physical properties of honey have a strong impact on the success of the commercialization of honey (Da-Silva et al.,

2016). As per the observations drawn from a lot of studies, it was mentioned that during the storage of honey, there is a change in the color of honey from light to dark. The development of shady color in the honey can also be correlated with the composition of honey or the temperature at which honey is stored.

The color and flavor of honey are influenced by its mineral content too. The acidity of honey was also affected due to the mineral content of honey. All the above parameters are in a linear relationship with the electrical conductivity of honey (Sahinler & Gul, 2005).

According to the botanical origin, honey varies in taste and aroma. The typical taste of honey is principally due to the sugar content. The flavor and aroma of honey mainly depend on the acid content, which may be the organic acids as well as the amino acid.

Volatile compounds of honey also contribute to the aroma significantly. In accordance with the research findings, the numbers of volatile compounds identified in honey were approximately above the figure of 500. Among these volatiles, polyphenols have a very important place, as these compounds are also mainly responsible for the typical taste as well as the aroma of honey (Bogdanov, 2017).

The amount of water in honey is also very significant in accordance with its characteristics. Water content greatly influences the properties of honey during preservation. It has an effect on other physical distinctiveness of honey. The physical characteristics affected by the water content are specific gravity, color, flavor, solubility, taste, crystallization, and viscosity. Acidity electrical conductivity and ash content are interrelated with each other. (Gomez et al., 2012; Da-Silva et al., 2016)

1.2.5.2 FUNCTIONAL PROPERTIES

Besides the therapeutic and nutritional values, honey shows many functional properties. It confirms the antimicrobial and anti-inflammatory effects. Honey also serves as an antioxidant substance. In consequence of its functional characteristics, honey can be used as a drug or a preventing agent in many kinds of disorders. Whatever functional properties honey covers, are mainly due to the prosperous phytochemical profile of honey.

The important functional properties of honey are the antimicrobial and antioxidant activities shown in many cases. These activities shown by the honey,

protect the biological system of the host from the substances causing oxidation furthermore microbial infections are prevented. Honey shows numerous medicinal and curative characteristics and serves as an antitumor, anti-browning, anti-inflammatory, and antiviral agent to a considerable level. There are the bioactive compounds of honey that are found accountable for their functional properties. The bioactive content of honey is strongly influenced by again the botanical and the ecological source of the product.

It is revealed that some probiotics are also provided through honey. Probiotic may be defined as the biologically active materials or living organisms which contribute to maintaining the intestinal balance. They were found to be very useful in preventing pathological conditions in the host.

The oligosaccharides present in the honey in a very small amount have the capacity to show probiotic activity. These probiotic substances help beneficial microorganisms in their growth. The beneficial microorganisms are *Lactobacillus* and *Bifidobacterium* in the GI tract (Luchese et al., 2017).

The functional properties of honey described in various studies are summarized and listed together. Overall honey shows functional properties such as honey is antiviral and antimicrobial, anti-inflammatory, anti-cancerogenic, anti-mutagenic, radiation protective, antioxidant, hepatoprotective, anti-nociceptive, source of probiotic, and prebiotic, anti-atherogenic, Immunoactivating and immunosuppressive, anti-osteoporosis, anti-neurogenerative, anticonvulsant, anxiolytic, antidepressant, anti-nociceptive. Also, it improves the fertility of rats.

1.2.6 USES OF HONEY

Honey has several uses as a food, food ingredient, medicine, cosmetic, functional agent, etc. Some of the uses of honey are

1.2.6.1 HONEY AS AN INSTANT SOURCE OF ENERGY

Honey has the capacity to provide instant energy without undergoing the complicated and lengthy process of digestion. Owing to this property honey is proved to be beneficial for athletes as well as sportspersons to enhance their performance. It is useful to prolong the endurance of the players by keeping them energetic

throughout the event. Sir Edmund Hillary, a famous mountaineer told that he used honey as an energy drink while climbing on the peak of Mount Everest.

1.2.6.2 HONEY AS A MEDICINE

As already mentioned above, it was proved that the properties of honey show a discrepancy as per the variation in the geographical location along with the flower source, from which the nectar was collected by the bees.

Lots of studies mentioned that honey has ancient and religiously significant importance. It has been treated as a holy food and included in religious ceremonies. Honey has been used as medicine as well as food by almost all civilizations for the treatment of plenty of diseases for maybe thousands of years.

Ayurveda, the Indian medicinal system, scripted the use of honey as a medicine or as a supportive agent with many drugs and it is practiced commonly. Medicines were suggested to take with honey in order to improve their curative effects.

In many ancient works of literature all over the world such as in Egyptians, Romanians, Chinese, Greeks, and Assyrian civilizations, the use of honey in curing and preventing numerous diseases was mentioned.

Honey is found effective in the treatment of wounds and sore eyes. In the curing of all ulcers, coughs, throat infections, tonsils, and sunburns honey is very effective. Honey is useful as a source of instant energy to take before and after athletic or sports events. Honey is proved to be very effective in infectious diseases.

Due to the antiviral potential of honey, it is useful in the treatment of viral disorders. The antioxidant potential of honey increases its importance in preventing aging. More ever, honey may be applicable as a medicine in the treatment of cancer also. Honey is proved to be protective as well as therapeutically effective in liver-related disorders.

Since honey reduces the level of glucose in the blood and also reduces the level of those compounds which are responsible for the progress of diabetes mellitus, it is found effective in the prevention of diabetes. More ever since honey contains a high amount of fructose, honey has a lower GI (glycemic index) as compared to the other sweeteners. Thus honey has the potential to serve against diabetes mellitus. Furthermore honey has therapeutic effects in fever as well as in digestive tract-related

disorders. Honey proves its importance in the healing of cardiovascular mess and it serves for raising the blood level of High-Density Lipids effectively.

Honey works in such a way that it treats digestive tract ailments, stomachache, and helps in increasing the appetite. Honey is getting acceptance to work as a laxative agent in preventing constipation and against some allergic compounds to prevent the allergies. (Saranraj et al., 2018; Khan et al., 2018)

The combination of the various constituents of honey and the extracts obtained from plants have shown a new way of creating natural medicine with a high level of safety and potential against many transmittable diseases for instance influenza, human immune deficiency syndrome, tetanus, hepatitis, and tuberculosis.

Thus there are plenty of uses of honey as medicine or protective and preventive agent in many disorders and diseases.

1.2.6.3 HONEY AS A COSMETIC

Honey has been used as a cosmetic from ancient times. More ever it can be said that it is the only true cosmetic. Due to its special properties, nowadays honey is being used in many creams and lotions. Honey is found to be very nurturing, refining, and supportive to the skin.

With some other ingredients, honey is proved to be a beautifying agent for the skin. Honey is used as a face pack to increase the glow of the skin. Honey has a moisturizing as well as a softening effect on the skin, thus many companies are using honey as a primitive ingredient in many cosmetic products.

1.2.6.4 HONEY AS FOOD OR FOOD INGREDIENT

Honey is extensively used as a food or food ingredient in many products. The use of honey increases the market value of that product. People are now fascinating regarding the use of natural products more and more.

The honey is now commonly used commercially as an ingredient in many foodstuffs such as in bakery products, chocolates, confectionaries, ice cream, jams, marmalades, etc. Honey has the capacity to add sponginess as well as softness to the bakery products. Due to the hygroscopic property of honey, it has the capacity of holding the moisture and thus it prolongs the drying process which results to keep the products more tender and juicy.

The honey-containing products do not develop cracks easily and the consistency of these products is found to be very delicate.

Honey is used to prepare caramel in many confectionery products. Honey is used to add flavor to gum-based products. The use of honey in breakfast cereals for the consumer appealing as well as to enhance the nutritive value is common. Honey is also used to mix with the dried fruits or cereal flakes. In many products containing sugar such as jam, jelly, marmalade, chocolate, etc. honey is used as a replacement for sugar.

In the latest industries in the sector of biological products and health care products, honey is the first choice as a sweetener as a substitute for refined sugar. The use of honey as a substitute for sugar may prove to be useful in curing and prevention many diseases (Singh & Singh, 2010).

1.2.6.5 OTHER USES

- 1) In the tobacco industry: For improving and preserving the moisture as well as the aroma of tobacco, honey is used extensively. As per the reports, in the year 1981, it is said that more than two thousand tones of honey are used in the tobacco industries throughout the world
- 2) Honey is used in the solutions prepared for promoting pollination in agricultural products.
- 3) Honey is used in the packaging materials as a coating, especially in meat products, to get better results and to increase the flavor and aroma of the products (Singh & Singh, 2010).

1.2.7 PHYSIOLOGICAL BENEFITS OF HONEY

- Useful in the calcium fixation in bones and growth
- Effective in constipation relief, lever related disorders, and duodenal ulcers
- Honey is effective in the promotion of higher mental competence.
- Useful in any kind of weakness
- Effective in colds as well as infections and irritations of mouth or throat
- Helpful in diabetics
- Normalizes the function of the kidney
- Help in alcoholism and intoxication by protecting the liver

- Boost heart functions

1.2.8 MELGHAT HONEY

Honey is one of the most important forest-generated products of *Melghat* territory. Most of the honey from the forest is created by the rock bees *Apis Dorsata*,

FIGURE 1.3: APIS CERANA AND APIS DORSATA (en.wikipedia.org and indiabiodiversity.org, 2020)



Apis Flores or it may be collected from the wild nests of *Apis Cerana* (Honey mission, 2018).

Honored as a Heaven of Vidarbha; the *Melghat* region belongs to the Amravati District of Maharashtra state, famous for the intense and deep jungle. The *Melghat* woods have prosperous biodiversity of plants having therapeutic and healing properties. Due to its fabulous bio-diversity, the forest proved to be the basis of a high nectar source and thus it provides an amazing natural atmosphere for the nurture of honey bees (KVIC, 2019).

It was reported that at all times of the year, there are ample flowers available in the *Melghat* forest for the nourishment of honey bees. The *Melghat* forest is a good habitat for the bees producing honey owing to the diversified flowery season all the way through the year.

The major vegetation that is useful for honey bees includes *Behada* (*Terminalia bellirica*), *Pangara* (*Erythrina variegata/ erythrina indica*), *Kumbhi* (*Careya arborea*), *Jamun* (*Syzygium cumini*), *Shirish* (*Albizia lebbek*), *Amaltas* (*Cassia fistula*), and some other medicinal plants of different varieties. The plants listed above are having a great potential for medicinal use. The term '*Melghat Honey*' has been used for the honey created by the honey bees of the *Melghat* region by bringing the nectar together from the flowers of the above-mentioned plants of the same region. It is observed that honey has been shown to suck up the therapeutic properties. (Deshmukh, 2012)

1.2.8.1 A GLANCE AT MELGHAT HONEY

- i.** Primarily collected by the tribal for centuries
- ii.** Due to diversified flora there is rich phytochemical content in the *Melghat* honey
- iii.** As the ethnobotanical potential of the *Melghat* is tremendous, the *Melghat* honey shows remarkable therapeutic potential.
- iv.** '*Melghat* honey' encompasses antibacterial potential as well in addition to the antioxidant properties
- v.** It may have a unique taste
- vi.** Due to its high nutritional potential, it may help in dealing with the problem of malnutrition faced by the locals
- vii.** There are shreds of evidences for the wound healing properties of the *Melghat* honey, since it has been used extensively by the tribal people for wound healing.

viii. If the *Melghat* honey brand developed, it may supply the source of earning for the native inhabitants through beekeeping

The honey assortment and selling may be proved as a fine opportunity of employment for the tribal people to raise their financial status. Improving the financial status of these people may automatically turn as a remedy for conquering malnutrition.

The value-added products which may be built up from the *Melghat* honey possibly will be useful to fetch the attention of the consumers towards *Melghat*. It was mentioned in lots of research articles that honey is a gift furnished by nature to humans. Though the protein content is said to be low in honey, it comprises a high dietary value. Honey plays many roles, for instance as an antioxidants, anti-bacterial agent, and as an anti-inflammatory material in the host.

In the past thirty years, numerous published stories relating to the physicochemical properties of kinds of honeys of various botanical and geological sources illustrated the consequence of deciding honey's worth. An extremely small number of studies, however, have scrutinized honey's physicochemical characteristics, and not a bit of them has found out the physicochemical parameters as well as the antioxidant potential of any type of *Melghat* honey.

1.3 MILLETS

Millets are one of the oldest crops cultivated by humanity. It is estimated to be cultivated since 8000 BC. We know that while choosing food for consumption its nutritional quality is one of the most important characteristics that should be considered for making the choice.

The complete health and the physical maintenance of humans are precisely dependent on the quality of food that is consumed. The problem of malnutrition can only be overcome by the choice of the right food that can help in maintaining overall fitness with maximization.

Some crops are having excellent potential regarding nutrition but are not used by the people extensively only due to the lack of awareness. Millets are an example of such types of food grains. It has tremendous nutritional and therapeutic potential as they are known as the Nutri-cereals. The special characteristics of the millets that

make them important food material are their resistance to drought and other adverse climatic conditions

- They are resistant to crop diseases as well as pests.
- The harvesting period is comparatively shorter.
- The expenditure for the cultivation and maintenance is comparatively very low (Sarita & Singh, 2016).

Due to the above splendid properties millets are now receiving attention to promote the cultivation and utilization, by the governments and the cultivars in developing countries. The remarkable nutritional profile and other benefits may be helpful towards food security and in the reduction of malnutrition.

1.3.1 IMPORTANCE OF MILLETS

After over seventy years of Independence, India is still suffering from the dilemma of malnutrition. Deficiencies of some micronutrients, as well as consequences of undernutrition, etc are the big issues faced by the group of economically weak people. On the other hand, many people are suffering from over-nutrition such as fatness and some common chronic diseases like cancer, heart disorders, and diabetes.

It was said that the change in food consumption practices may be the part of causes for the arrival of these situations. Nowadays there is the nonappearance of millets in the diet of the typical Indian populace which may be one of the causes of health-related problems.

Being a rich source of micronutrients especially B vitamins, some minerals as well as nutraceuticals, millets put forward an exclusive advantage in nutrition. The splendid phytochemical profile of millets may prove them as the brand ambassador for the evergreen revolution. (NAAS, 2013)

As discussed above, due to the capacity of millets to provide lots of nutrients, millets are given the name 'Nutri-cereals'. During the green revolution, the whole responsibility was given to wheat and rice. The cultivation of millets decreased remarkably. There are many reasons behind this decrease.

But still, there is a scope for the development in the demand of the millet. The demand for gluten-free cereals is increasing. The preparation of value-added products from millets may fulfill the demand of the market. (Rao et al., 2018)

The common varieties of millets found in India are

- Sorghum or Jowar (*Sorghum bicolor*)
- Pearl millet or Bajra (*Pennisetum typhoides*)
- Fingur millet or ragi or nagli or nachni (*Eleusine Coracana*)
- Foxtail millet or kakum or Kangni or Rala (*Setaria Italica*)
- Little millet or *kutki* or Halvi (*Panicum Sumatrense* or *Panicum Miliare*)
- Kodo millet or Kodra (*Paspalum Scrobiculatum*)
- Barnyard millet or Jhangora or Sanwa (*Echinochloa Frumentacea*)
- Proso millet or Cheena or Vari or Barri (*Panicum Miliaceum*)
- Brown top millet or Korale (*Brachiaria Ramosum*)

In marginal conditions of environment i.e. in drylands the performance of millet is superior to other cereals. The high micronutrient content of millet with low glycemic indices makes them an excellent choice of food. They possess a rich profile of dietary fibers and plenty of phytochemicals that blessed them with excellent medicinal properties.

It was reported that the unique nutritional pattern of millet that rich in all nutrients, as well as phytochemicals, will be useful in decreasing the issue of malnutrition in India.

1.3.2 POTENTIAL OF MILLETS IN NUTRITION AND HEALTH

The health potential of millets is tremendous. There is a glance at the nutritional details of millet taken (Sarita & Ekta Singh, 2016). The nutritional profile of various millets is given in table 1.2.

1.3.2.1 NUTRIENTS IN MILLETS

Millets are dense in nutrients. They are rich in carbohydrates. A considerable amount of protein and fat is there in the millets.

They are rich in minerals, vitamins as well as crude fibers. The essential amino acid profile of millets is comparably good. Besides this, they are good sources of some essential fatty acids too which are present in free and bound form. These are gluten-free cereals.

TABLE 1.2: NUTRITIONAL PROFILE OF MILLETS AND CEREALS**(all values for 100 g of cereal/millet grains)** (Jaybhaye et al., 2014)

NUTRIEN TS	CEREAL AND MILLETS										
	Wt	Rc	Sg	Mz	Pm	Cm	Ftm	Ltm	Km	Fm	Bm
Protein (g)	11.6	7.9	10.4	9.2	11.8	12.5	11.2	9.7	9.8	7.7	11.0
Fat (g)	2.0	2.7	3.1	4.6	4.8	3.5	4.0	5.2	3.6	1.5	3.9
Ash (g)	1.6	1.3	1.6	1.2	2.2	3.1	3.3	5.4	3.3	2.6	4.5
Crude Fibers (g)	2.0	1.0	2.0	2.8	2.3	5.2	6.7	7.6	5.2	3.6	13.6
Carbohydra tes (g)	71.0	76.0	70.7	73.0	67	63.8	63.2	60.9	66.6	72.6	55.0
Energy (kcal)	348	362	329	358	363	364	351	329	353	336	300
Calcium (mg)	30	33	25	26	42	8	31	17	35	350	22
Iron (mg)	3.5	1.8	5.4	2.7	11	2.9	2.8	9.3	1.7	3.9	18.6
Thiamin (mg)	0.41	0.41	0.38	0.38	-	0.41	0.59	0.30	0.15	0.42	0.33
Riboflavin (mg)	0.1	0.04	0.15	0.2	0.21	0.28	0.11	0.09	0.09	0.19	0.10
Niacin (mg)	5.1	4.3	4.3	3.6	2.8	4.5	3.2	3.2	2.0	1.1	4.2

(Wt- Wheat, Rc- Rice, Mz- Maiz, Pm- proso millet, Cm- Common Millet, Ftm- Fox tail Millet, Ltm- Little Millet, Km- Kodo Millet, Fm- Fingure Millet, and Bm- Barnyard Millet)

A. PHYTOCHEMICALS AND MICRONUTRIENTS IN MILLETS

Milletts are rich in many phytochemicals such as phenolic compounds, resistant starch, tocopherols, tannins, and lignans, etc. Flavonoids also present in millets in little amount. Flavonoids play a central role as an antioxidant in the body to enhance the immune system.

B. PROBIOTIC AND PREBIOTIC

Milletts act as natural probiotics when used through fermented products. Many fermented products can be prepared from millets such as porridge, drinks, or traditional Indian fermented products which are beneficial for health. The whole grain of millet shows the activity as a prebiotic. Prebiotics are the substances that help in promoting the growth of digestion-friendly bacteria. These bacteria are useful in the digestion process as well as work in digestion-related disorders.

C. MILLETS AS A NUTRACEUTICALS

The world scenario behind the consumption of food is changing now. The satisfaction of hunger for survival and maintenance of health are not the only reasons behind the consumption of food, but promoting the foods with nutraceuticals for better help is also important.

Nutraceuticals are helpful in reducing the risk of many chronic diseases including cardiovascular diseases, diabetes, and obesity, etc. The antioxidants in millets are found to be used as nutraceuticals by the body for the prevention of health-related disorders.

1.3.2.2 HEALTH BENEFITS

Due to their nutritional content, millets serve as a healthy food option especially for people with low economic backgrounds. Though the consumption of millets is decreased, still they are essentially a bulk of the diet of many people.

As discussed above the nutraceuticals found in millets have many positive effects on maintaining health. The gluten of wheat is reported to have many adverse effects in accordance with health. On the other hand, millets offer a gluten-free bulk to your food. It was reported that due to the composition of millets, they are proved to

be efficient in the prevention of many diseases. Millets are beneficial as they increase the time interval of emptying the stomach.

In addition, millets are reported as an alkaline-forming food. The alkaline-forming foods are recommended for good health as they show useful effects in maintaining the pH balance which is important in the prevention of illness.

Millets are having the following health benefits

- **Diabetes and Millets**

It was reported that vulnerability to diabetes and the consumption of millets are having an inverse relation. Studies show that in millet-consuming people there is a low rate of having diabetes.

- **Celiac Diseases and Millets**

Celiac diseases are related to the effect of gluten on the body. As millets are gluten-free an excellent option is available for people with celiac disorders.

- **Anti-Inflammatory effects of millets**

The compounds in the millets are found to have anti-inflammatory as well as free-radical scavenging potential. They can stimulate the healing process of wounds.

- **CVD and Millets**

The excellent amount of magnesium found in millets is having the capacity to work for preventing the consequences of heart attacks as well as migraines. The phytic acids that are found in millets tend to lower the cholesterol in the host.

- **Aging and Millets**

The occurring of non-enzymatic glycosylation is found to be responsible for aging. According to the studies, the antioxidants of millets are having a good effect on the prolongation of aging

- **Cancer and Millets**

It was demonstrated in the studies that the tannins, phenolic compounds, and other phytochemicals work to decrease the risk of some cancers.

- **Antimicrobial activities of Millets**

The studies show that millets are having antimicrobial potential.

1.3.2 KUTKI OR LITTLE MILLET (*PANICUM SUMATRENSE*)

'Kutki', is a Hindi/ Marathi or local language name of the foremost crop, which extensively grown in *Melghat* province along with jawar (sorghum/ *sorghum*

bicolor), bajra (pearl millet/ *Pennisetum glaucum*), jagani; a kind of oilseed (ramtil/ niger/ *guizotia abyssinica*), kodo (kodo millet/ *paspalum scrobiculatum*), and tur (pigeon pea/ *cajanus cajan*).

Kutki is a kind of minor millet. These types of minor millets are a group of species that are genetically varied and have a capacity to grow in insignificant environmental situations where the further major cereals such as wheat, rice, maize, etc, proved to be unsuccessful to grow.

Kutki is regularly known as **little millet** in English. The botanical name of *Kutki* is '*Panicum Sumatrense*'. In some literature scientifically *kutki* is named '*Panicum Miliare*'. *Kutki* is a native crop of India. It can be termed as the bioenergy crop because of its short duration as well as the high yield of biomass produced (Hemalatha et al., 2006).

It is cultivated throughout India but to a very limited extent. The seeds or the grains of little millet are small in size as compare to the other common millets. Many properties of *kutki* are similar to that of Proso millet.

It is a plant of annual herbaceous type. It grows vertically in a line with a height of thirty to a hundred centimeters. The pattern of leaves is linear with sometimes hairy lamina and ligules. The grains are smooth in texture and rounded in shape with a diameter of around 1.8 millimeters. It is a beneficial crop due to its early period of harvesting as well as it forms a good fodder for cattle. It can endure drought and water logging more and over also can be cultivated in the mountainous area (Rao et al. 2017; Wikipedia).

They also found to be having more nutritional values when compared to the major crops of the same kind. (Stefano Padulosi 2015). It is reported to be very rich in iron and many other minerals and micronutrients. The nutritional composition of *kutki* (little millet) as per the values published is... (Jaybhaye et al., 2014)

- Carbohydrates - 60.9 g
- Fats – 5.2 g
- Proteins – 9.7 g
- Dietary fibers - 7.6 g
- Ash- 5.4 g
- Thiamine -0.3 mg
- Riboflavin- 0.09 mg

- Niacin- 3.2 mg
- Phosphorous - 220 mg
- Calcium - 17.0 mg
- Iron - 9.3 mg

If we compare these values with wheat, rice, and maize we will find that the *kutki* is the richest in iron among all the cereals. The other nutrients are also present in *kutki*, in considerable amounts.

1.4 MILK

Milk is a liquified food created by the mammary glands of the female mammal for the nutrition of their sibilings. Milk comprises the entire crucial nutrients that are required for the nourishment of the kid. The milk of many mammals such as sheep, goat, cow, and buffalo is readily utilized by the human as a food or food ingredient in many products.

We may describe milk as an organic colloid or emulsion made up of water and fat/butter. Dissolved proteins, carbohydrates, some vitamins, and essential minerals are also in attendance there in milk.

1.4.1 COMPOSITION OF MILK

Generally, milk is composed of many nutrients that are carbohydrates, proteins, vitamins, minerals, and fats. The only carbohydrate present in milk is the disaccharide lactose. It is as well known as 'milk sugar'. Lactose is comprised of two molecules of six-carbon monosaccharides glucose and galactose. The amount is approximately 4.9 % in milk.

More or less 3.5 % triglycerides or fats with very complex but typically made up of edible fatty acids composition are present there in the milk. There are more than 400 fatty acids are identified in the milk fat but 90 % of the part is comprised of 15-20 fatty acids. Mostly saturated fatty acids form the fat part of the milk.

The total protein content of milk is approximately about 3.3 %. Milk is made up of two types of proteins. One is the family of caseins, which forms about 82 % portion of the total protein. The caseins have phosphorous in their structure. These

proteins got coagulate at low pH. This property of caseins is accountable for the development of curd, paneer, cheese, or similar milk products.

The other kind of milk protein is recognized as serum proteins that do not contain phosphorous in their structure. These soluble proteins are separated in the liquid formed during coagulation. Serum proteins are also known as whey proteins. The milk proteins are comprised of amino acids with all nine essential amino acids.

Almost all the vitamins are present in the milk. Milk is a good resource of water-soluble i.e. vitamins B₁ (thiamine), B₂ (riboflavin), and B₁₂ (cobalamin). The other water-soluble vitamins for instance vitamin C and other B complex vitamins were present in small quantities in milk.

Phosphorous, calcium, magnesium, zinc, selenium, and potassium are the minerals present in milk in a considerably good amount. Sodium, iron, copper, and manganese were also in attendance in the milk but a little amount.

Some beneficial enzymes are also present in the milk. These enzymes are responsible for the plenty of functional properties performed by the milk. Some of these enzymes are heat sensitive and get deactivated during pasteurization but some are heat stable.

Milk is readily available in the *Melghat* province. As mentioned earlier, 'Gaoli', one of the prime locality of the *Melghat*, involves in their traditional business of animal husbandry. Keeping the cattle such as buffalo and cows for the purpose of milk is the common occupation of the Gaolis'. They traditionally have the knowledge of nurturing the animals and making a variety of milk products. The traditional milk products prepared by the Gaolis' of chikhaldara and nearby villages, like Khoa, Rabri, Dahi, etc are famous in the whole region.

1.5 LADOO

It is an Indian sweet item used extensively as a 'Prasadam' (kind of sweet distributed in the people after worshipping the God), in almost all the temples. It is said to be a favorite dish of 'Lord Ganesha', Lord Krishna as well as many other Gods. Besides this, it is that sweet dish without which the Indian marriage cannot be completed. 'Giving *Ladoo*' is the kind of phrase used in parallel for getting married. It is said that *ladoo* is originated in the southern region of India but no doubt it is

famous throughout the India. The name *ladoo* is said to be originated from the Sanskrit word 'Lattika' used for the sphere-shaped object.

In India, *ladoo* are made from a variety of ingredients, but as it is a sweet dish, sugar or jaggery are the essential elements in the making of *ladoo*. Another prime substance that is utilized in the recipe of *ladoo* is mostly wheat flour or besan (chickpea flour), or rava (semolina). The flours made from any other cereal or legume such as green gram, black gram, etc can be used. The *ladoo* can be made by using coconut powder too.

Boondi *ladoo* are very famous in India especially on the occasion of marriages which are made from the small bead-like deep-fried and sugary balls of chickpea flour. Motichur *ladoo* is another type of *ladoo* that resembles with the boondi *ladoo*. Only the difference is in the size of the small fried balls that are much smaller in this case than the boondi. Dry fruits, some condiments, and ghee are the other ingredients that are used in its preparation.

In India, various types of *ladoo* are consumed varying with the occasion and the season. In the winter season, the *ladoo* made from dry fruits and/or black gram flour with added gum, are consumed by many people. These *ladoo* are highly nutritious due to the quality of ingredients and it is said that these *ladoo* help for the maintenance of good health. The pregnant women after delivery are fed with the specially made medicinal *ladoo* containing fenugreek seeds for the better recovery of their health.

On the occasion of one of the Indian festivals 'Sankranti', there is a traditional practice of preparing and giving the *ladoo* to relatives and friends that are made from the sesame seeds and jaggery which are medicinally very helpful in maintaining the body temperature during the winter.

It is the product that is selected in the current study for the development of a new recipe by using the *kutki* or little millet flour. Honey is used as an additional sweetener with sugar.

1.6 KHEER

Kheer is a traditional Indian sweet dish basically prepared from milk and sugar. Some cereals are added in the *kheer*, while cooking, as a thickening agent. The cereals used in the *kheer* may be in whole grains, cracked, or ground form (suji,

semolina, etc.). Some condiments like cardamom, cinnamon, etc may be used for the taste and the *kheer* may be garnished by using dry fruits. Variety of *kheer* are prepared in India such as rice *kheer*, semolina *kheer*, dalia *kheer*, Dudhi *kheer*, shabudana (sago) *kheer*, coconut *kheer*, and many more.

Harold McGee said about *kheer* that using milk as a primary ingredient no other cuisine in the world can compete with the *kheer* invented in India. As told above *kheer* is an Indian dessert or may be called a pudding of rice primarily made from milk. For the preparation of *kheer*, any one of the substances such as rice, semolina, broken wheat, vermicelli, etc can be boiled with milk. Sugar or jaggery is used as a sweetening agent.

Dry fruits, nuts, and some condiments may be used for garnishing as well as to add flavor to the *kheer*. Milk has a very holy and important place in human life as per Hindu mythology. The role of milk starts from the birth of a man (mother's milk) to the end of life as a part of some rituals. Thus in the life of Indian people, *kheer* can be considered as an ultimate milk-based sweet cuisine that has to combine dietary and nutritional dimensions in addition to religious importance.

Kheer has great cultural, social, religious, economic, and medicinal importance in Indian society. It is a premier milk dessert associated with the celebrations and festivities of almost all communities. Milk and sugar are the compulsory and common ingredients of *kheer*, while the dry fruits and the condiments were added as per the taste, need, and more ever economical condition.

The cereals were added as the other compulsory ingredient in *kheer* in various forms e.g. whole grain, partially broken (suji), coarsely grounded (Semolina), or flour. The nutritional value of *kheer* is varied according to the type of cereal taken and the condiments and dry fruits used. But generally, the plain *kheer* prepared with milk, sugar, and rice has the following nutritional composition (Pariskar, 2015)

- Moisture - 66.7 %
- Total solids - 32.8 %
- Fat - 10.94 %
- Proteins - 6.79 %
- Ash - 0.92 %
- Total sugar - 14.74 %

1.7 SENSORY EVALUATION

The quality of the food product is the final criterion for its desirability and for the attraction of the consumers. For the determination of the quality, the nutritional value, quantity of the material, other hidden considerations, and the sensory parameters are the most important.

Quantity parameters are related to the cost and amount in net and drained volume and weight. In the hidden and nutritional considerations, the composition of the food, in terms of the nutrients, as well as the presence of additives, preservatives, and other toxic or harmful materials, are involved. These nutritional and hidden parameters are not easy to identify the consumer and hence restricted by the laws and regulations by the governing authorities.

The sensory attributes are the most important aspect regarding the determination and evaluation of the quality of the food. It is not only important from the consumers' point of view but for the manufacturer also. The sensory parameters are the factors that attract the consumer at first and they play a key role in his satisfaction related to his gustatory and aesthetic intellect. These are the combinations of different parameters related to the sensory organs of the man.

1.7.1 SENSORY PARAMETERS

These parameters are judged by the sensory organs of the human such as eyes, tongue, mouth, and nose.

A. APPEARANCE

This parameter is mainly judged by the sensory organ eye. Size, shape, uniformity, defect detection, and color of the food material are the factors that are judged. There is always a specific and desirable appearance for each type of food. For example, biscuits should be proper in shape and size, and color. There should be uniformity in its consistency without defects.

B. KINESTHETICS

Include the texture and the consistency of the food item. It is judged by the touch. In modern techniques, instruments are developed to determine these attributes.

C. FLAVOR

It includes the senses developed by the combination of nose and tongue. It is a sense of the feeling, smell, and taste of the foodstuff. The tastes that are related to the human being are sweet, bitter, sour, and salty. The feeling is judged by its bite and astringency etc.

D. ODOUR

It is a very complex sensation and can be considered as the important factor of the flavor. In modern methods, the attempts are made to judge it by gas chromatographic techniques.

Earlier the sensory judging was done by the established experts in this field. They became experts by trained themselves towards distinguishing between the various tastes and odors. But now after the development of the new techniques the sensory evaluation is carried out by applying the panel of judges. The judges are trained by establishing their consistency and sensitivity. The panel generally consists of a small group of experts.

1.7.2 EQUIPMENTS AND LABORATORIES

The laboratory setups can be made in a simple way also. The important thing is of giving a relaxed atmosphere for the independent judging with full concentration and enthusiasm without the external disturbances. Three divided areas are recommended for the reception, preparation, and the panel in the laboratory set-up. The facilities of water with clean glasses, basin for washing hand with a proper washing agent, and a clean towel should be available there. The serving materials should be made up of stainless steel, or china cups, or dishes. Plain serving trays, necessary fork, and spoons are ideal.

1.7.3 PANEL OF JUDGES AND TRAINING

It is recommended that while selecting the panel members the members with the following qualities should be selected

- Good health
- An elevated level of personal integrity
- Superior concentration

- Good learning ability
- Intellectual curiosity
- Interest in the work of sensory evaluation
- Availability of time
- Willingness of giving the time

The members then evaluated through the basic tests of recognizing the taste and odor. The panel members then trained for the purposes and the products in particular with their specific characteristics regarding the quality and differences intensities. The design of the experiment and the choice of the panel depend on the type of product and the expected results. The samples are to be prepared carefully that may be the experimental or the control. The samples are given the code numbers before presenting to the panel of judges.

It is recommended that individual booths should be provided for the judging in order to assure independence of the judging. The communications between the judges should be avoided for the reason that may influence the individual opinion. The time after one hour of the normal meal should be selected as it is the best time for the sensory evaluation. The care was recommended to take that no members of the judges should smoke or chew any type of material like tobacco or pan-supari at least before half an hour of the judgment.

The cards for the evaluation should be ready before the judging process with simple tables and instructions. It should be either clearly typed or may be printed with all the essential contents.

1.7.4 METHODS OF TESTING

According to the techniques used for the evaluation as well as the type of experimental design the methods are classified. Depending upon the objectives of the particular test the selection for the use of the method is done. It should be kept in mind that the method must be simple and easily possible as well as it must be practical, and appropriate to the situation.

1.7.4.1 DIFFERENCE TESTS

The below-included tests are applied for the comparison of products.

A. Paired Comparison Test: Used for the determination of the differences and intensities of similar products. Two types of samples, one is standard and the other is experimental are presented to the judges and they asked to point out that whether the samples are the same or different, and what is the degree of intensity towards the particular sensory parameter.

B. Duo-Trio Test: For three samples, out of which one is different and the other two are identical, this test is employed. The first pair of identical samples is provided initially and then the other two samples are provided in a randomized manner for matching with the initial sample pair. It is a comparison and discrimination method between a pair essentially though it contains three samples. The results are drawn by using the probability techniques.

C. Triangle Test: This test is also used in the case of the three samples in which two samples are identical and one is different. The difference is that all three samples were presented at the same time to the judges. It is asked the judges to identify the odd sample. Similar to the above tests the positive answer is necessary even if it is a presumption. The rules of probability are used here also for drawing the results.

1.7.4.2 RATING TESTS

Here in these types of tests, the products are given ratings by using the proper indicators.

A. Ranking Test: For differentiating a number of samples on the basis of only one parameter, this test is used. Here in this test, there is no need for the determination of the control. All the samples are presented at once before the panel. According to the intensity of the specified parameter, all the judges are asked to give ranking to the samples presented.

B. Single Sample Test: It is also known as a monadic test. It is used for analyzing the foods having after-taste flavor. The intensity of a particular parameter is identified. It is a consumer-oriented test based on the supposition that only one sort of food is tasted by the customer at a time.

C. Two Sample Difference Test: It is similar to the paired comparison test with some variations in the measurement of the amount of difference. Here four pairs of samples are provided to each individual and each pair is asked to judge separately.

D. Multiple Sample Difference Test: This test is used for the evaluation of more than one variable. A standard sample is also included. Three to six samples are provided according to the testing parameters.

E. Hedonic Rating Test: It is the test used in the current research work. Depending upon the pleasant and unpleasant experiences the testers are asked to rate the food items. Consumer acceptability is measured in this test. The consumer satisfactoriness with the food products was detected with the help of hedonic ranking tests.

During one session of evaluation, one to four samples are served to the panel for assessment. The different scale ranges or the phrases of explanation can be used. But usually, the scale containing nine points of rating, from 'extremely like' to 'extremely dislike' is used.

F. Numerical Scoring Test: In this test, each panelist is provided with one or more samples in random order. The sequence of randomization is decided at the beginning of the whole process. On the base of the specific scale, the ratings are indicated as mentioned previously.

G. Composite Scoring Test: In this test, the specific characteristics are separately rated for the products. This method is useful not only in the grading but also for the comparison of the quality parameters. Thus the sensory evaluation is the essential technique for estimating the quality of product through the sensory organs (Shariff et al., 2017; Ranganna, 2007; Lawless & Heymann, 2010).

1.8 PROBLEM IN HAND

As discussed earlier, there are dense woods found in the *Melghat* region with varied biodiversity. Plenty of widely grown species of plants were reported in the flora of the *Melghat* including trees, herbs, climbers, and sedges. Many of these plants are having tremendous therapeutic properties and are used extensively by tribal

people for years as medicines. Honey is one of the most important forest products collected and sold by the local inhabitant. Owing to the rich biodiversity and the medicinal characteristics of the plants the honey that is produced in this area must be having tremendous nutritional and functional properties.

It was observed from the literature survey that very little or almost zero research was carried out related to the analysis of the *Melghat* honey. Though there is increasing interest of the consumers regarding the use of honey as a food owing to its medicinal properties, the honey from the *Melghat* is not in the race due to lack of awareness. There is a requirement of the analysis of honey for the detection of its nutritional, antibacterial, and functional properties for the proper branding of the *Melghat* honey.

Another material that is chosen for the study, is a variety of millet i.e. *kutki* or little millet. It is an important crop of the *Melghat*. The surveys showed that millets are excellent food, also known as nutri-cereals due to their splendid nutritional profile. The presence of other micronutrients in abundant quantity made them the grains with the first choice of nutritionist over the other popular cereals.

Owing to the nutritional as well as therapeutic benefits of the millets they are now becoming popular among diet-conscious people. Again it was observed from the study of the literature that very little work was done regarding the analysis of the *kutki*. More ever no research paper was found related to the analysis of the *kutki* from the *Melghat*. There is a need for the analysis of the *kutki* or little millet from *Melghat* in order to know its nutritional status. Milk is another substance that produces in *Melghat* at a considerable amount. Owing to the unawareness of the modern techniques and new recipes most of the milk is sold at a very lower rate to the traders. There is a need for the use of milk in some novel recipes to get the proper recognition.

The analysis of the honey and *kutki* is not enough until and unless some value-added products are not made from them. The products should be popular, liked by most of the people and should have been made from the easily available materials from *Melghat* only. The products chosen should be such that they need to have the potential to fight against malnutrition. *Ladoo* and *kheer* are such products as they are popular, liked by most of the people and in addition, they are nutritious. Keeping in the mind all the above situations and problems the present title, “**Studies on Analysis**

of Melghat Honey and Development of Value Added Products from Honey and Kutki with Different Combinations”, is chosen.

1.9 NEED OF THE STUDY AND SOCIAL SIGNIFICANCE

The study was carried out by keeping in mind the following needs and social significance

- Analysis of the honey from the *Melghat* for its physical, nutritional, phytochemical, and antibacterial properties to explore the brand honey
- Analysis of *kutki* for its physical, functional, and nutritional qualities to promote its use.
- Analysis of both the material may improve the commercial values.
- Promoting the use of milk in the product development
- Development of some novel recipes from the above ingredients
- Checking their acceptability from the consumer’s point of view
- It has social significance as the developed products can be used commercially to boost up the economic status of the Melghat and enhance the living standard of people.

1.10 RESEARCH OBJECTIVES

Keeping in mind above all the aspects associated with the *Melghat* region and the problems of the people and the need of the study the following objectives were set for the current research

- To study the properties of *Melghat* honey
- To study the properties of *Kutki* (*Panicum sumatrense*)
- To develop some value added and durable products using honey and *kutki* such as *Kheer* and *ladoo*
- To prepare replica of these products using different combinations of honey and *kutki*
- To assess the sensory attributes of these products

1.11 SCOPE OF THE STUDY

The work considered the studies on the analysis of the *Melghat* honey only. The physical, nutritional, and compositional analysis, antibacterial potential, and

qualitative screening of phytochemicals were also considered during the study. The analysis of *kutki* from the *Melghat* for the physical, functional, and nutritional parameters was also considered. Detection of the various said parameters experimentally and analysis of the results were conducted. The results were compared with the previous studies done in the related field for the related parameters.

The products such as *ladoo* and *kheer* were developed by using the already analyzed honey and *kutki* of *Melghat* only. The products were evaluated for the evaluation of their quality. The present study considered only the sensory evaluation of the products for their quality checking and acceptability.

1.12 PLAN AND DESIGN

The current study is designed systematically and presented through the following chapters

CHAPTER 1: INTRODUCTION

The chapter provides the information of the region *Melghat* regarding its location, locality, social and economic status, and the kinds of problems facing by the local people. It provides the basic information related to honey and *kutki* (little millet). It also takes a glance at the products such as *ladoo* and *kheer* regarding their importance and nutrition. It overlooks the techniques of sensory evaluation and its importance. The chapter also covers the need, scope, and objectives of the study.

CHAPTER 2: REVIEW OF LITERATURE

The reviews of the publications on the past studies regarding the properties and importance of honey and *kutki*, types of *ladoo* and *kheer* prepared by the researchers and the results obtained in the sensory evaluation.

CHAPTER 3: MATERIALS AND METHODS

The chapter gives the details about the materials used in the study. The parameters considered for the study, the methods and procedures used for the experimental works, detailed of recipes applied for the development of value-added products and the types of sensory evaluation method with the process are covered under this chapter.

CHAPTER 4: RESULTS AND DISCUSSION

In this chapter the result that obtained during the analysis of honey and *kutki* as well as other experimental works are given in this chapter. It also includes the discussion on the results obtained with comparison with the previous studies.

CHAPTER 5: SUMMARY AND CONCLUSIONS

Summary of all the current work is given in this chapter. On the basis of results the findings and conclusions are also covered in the chapter.

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CHAPTER 2

REVIEW OF LITERATURE

2.1 INTRODUCTION

Honey has been studied by many researchers. The physicochemical properties, nutritional importance, antimicrobial, antioxidant, and anti-inflammatory activities of honey were studied extensively. *Kutki* (Minor millet) was also studied by many food scientists. Here the systematic review of the work done by the researchers has been taken.

2.2 HONEY PROPERTIES

Krell (1996) has discussed the various products obtained from beekeeping in his book. In the first introductory chapter, the summary and the purpose of the book were discussed. In the second chapter the physiological effects, composition, and physical characteristics of honey were discussed. The uses of honey as a food, food ingredients, ingredient in medicine like products, and the fermented products were given. The various techniques of processing honey, its purification, the prevention of honey from fermentation, and the packing of honey were studied. The chapter contained the recipes of the various honey products like liquid honey, creamed honey, mead and beer, fruit marmalade and jelly, caramels, honey containing bakery products, etc. In the next chapters the physico-chemical properties, composition, uses as a food and food ingredients, and recipes of other beekeeping products like pollen, wax, propolis, royal jelly, venom, and honeybees were incorporated. In the book, the methods for the analysis of various physicochemical properties were also mentioned. Harvesting of honey and its processing details were also given. The causes of contamination of honey and the prevention measures were discussed in detail.

Jeffrey & Echazarreta (1996) reviewed the uses of honey regarding various health disorders in humans. He started with a discussion about the composition of honey. Later in his paper, he described the effect of honey on the growth of various strains of pathogenic bacteria. The effect of honey as a medicine in various diseases like gastroenteritis, gastric ulcers, wounds, and other disorders was also reviewed finally. He concluded in his article that, honey found to help control the growth of

microorganisms. It is also proved effective in the treatment of certain health disorders. He added that while helping in the treatments, honey has no side effects like other drugs.

Sanna et al. (2000) carried out work to determine the various heavy metals in honey. For this purpose, they used the Differential Pulse Anodic Stripping Voltammetry (DPASV) technique at Hg microelectrode. They applied this methodology for the determination of Lead (Pb), Cadmium (Cd) copper (Cu), and Zinc (Zn) in the mineralized honey samples. It is found in their study that, the quantification of all metals simultaneously was difficult due to the formation of Cu-Zn inter-metallic species. However, the problem was sorted out by adding Ga(III) salt to the honey solution. They concluded that the method used was effective in fast determining the content of heavy metals in mineralized honey samples. But for the raw honey samples, the method has to be optimized and there is a scope for further research.

BIS (2002) described the specifications for the extracted honey. The requirements and the ways for the test and sampling of extracted honey were prescribed in this standard. The standard definition of honey in India is also given. It is recommended that the package of honey should be clean, with a wide mouth. The container may be of glass or acid-resistant tin or suitable polyethylene material. It is also mentioned that the packet must have the compulsory labeling showing the names of the materials and the grade designation, name of the packer, date of packing, batch or code number, and net weight. The recommended values of the parameters like specific gravity, moisture, total reducing sugar, sucrose, fructose to glucose ratio, ash, acidity (expressed as formic acid), fische's test, hydroxyl methyl furfural (HMF), a total count of plant elements, and pollens, optical density, at 660 nm, are mentioned in this publication. The standard procedures to determine the above-mentioned characteristics are given.

Kamal et al. (2002) worked on the 40 honey samples collected from the colonies of *Apis Melifera* bees by the Honeybee Research Institute and National Agricultural Research Centre Islamabad. The honey samples were from five different

flora viz. *Ziziphus* spp., *Acacia modesta*, *Eucalyptus* spp., *Citrus* spp., and *Trifolium* spp. These samples were analyzed for the comparative study and quality determination of honey for fifteen standard physic-chemical parameters. Due to the difference of floral origin, significant variations were found in the honey composition of the samples. The *Ziziphus* honey was high in pH, ash and diastase value but with low content of acids and sucrose. There were high moisture, acids, and sucrose content reported in *Trifolium* honey with a low amount of reducing sugars. *Acacia* honey was highest in hydroxymethylfurfural (HMF) content, but at the same time found to be lowest in diastase and ash content.

Cooper et al. (2002) studied the sensitivity of Gram-positive bacteria isolated from wounds to honey. These bacteria are clinically significant. The aim of the study was also to express that the antibacterial potential of honey is not only due to the osmotic effect. Importantly with manuka honey, phenol honey and pasture honey samples, a sample of artificial honey also used for this study. It was assumed that the high sugar in honey is responsible for the antimicrobial activity of honey. It is reported that the artificial honey with more concentration of sugar fails to show the preventive activity against bacteria under study but the natural and diluted honey shown good activity against bacteria even at low concentration of sugar. They reported that the mode of action of honey was not yet cleared. But acidity, generation of hydrogen peroxide, phytochemical components of honey, and osmolarity might be the important causes. The enzymes present in honey also play an important role.

Al-Qassemi and Robinson (2003) reviewed some special nutritional properties of honey. They reported water, reducing sugars, total sugars, sucrose, ash, and some soluble substances as generalized constituents of honey. They also quoted Codex Alimentarius compositional standards for honey. Honey was reported to contain some free fatty acids like palmitic (16:0), oleic (18:1) and linolenic (18:3) acids which were noticed in white clover honey. They supported the fact that honey has antibacterial activities. Honey used to control eye infection and also has wound healing capacity. They emphasized the prospective importance of the oligosaccharides found in honey which acts as prebiotic to stimulate species of *Bifidobacterium* that

inhabit the human colon. The healing properties of the antioxidants in it and the importance of adding royal jelly in honey were briefly discussed.

Hussein et al. (2003) studied the properties of wild honey on cardinal diseases. For the treatment of asthma, nasal congestion and some cardiovascular disorders catecholamine have been developed synthetically which has many side effects. In this study, the cardiac arrhythmias were produced in isolated toad's heart. It is found that the application of wild honey nearly manages the side effects of catecholamine. Thus it is suggested that wild honey may be useful in the treatment of some cardiac arrhythmias.

Mossel (2003) analyzed the rheological characteristics of four types of unifloral honeys such as tea tree honey, yellow box honey, heath honey, yapunya honey, and artificial honey at 20°C temperature. It was stated that the viscosity of honey may vary with the floral origin due to the difference in the content of sugars and other colloidal materials. The results of the investigation stated that the viscosity of honey strongly depends on the concentration of carbohydrates present in honey.

Adebiyi et al. (2004) carried out the chemical and physical characterization of honey from Nigeria. They collected the samples of honey from five locations of Nigeria. Some elementary physical properties and chemical constituents were detected by using Total Reflection X-ray Fluorescence (TXRF) spectrometer and Infrared spectrophotometer. It was stated that potassium was the most abundant trace element in all honey samples among the twelve elements (Ti, Cr, Mn, Ni, Cu, Zn, Se, Br, and Rb) detected. Calcium and Iron were also reported at a significant amount. Carboxylic acids, aldehydes, nitrites, alkynes, and ethers are the other compounds detected by infrared spectrophotometer. Color, pH, refractive index, moisture, and ash contents were some physical properties which also determined.

Bogdanov et al. (2004) reviewed the methods of characterization of unifloral honeys by assessment of physicochemical properties. The parameters reported to be used for the identification of floral origin of honey were determination of the physicochemical properties, determination of polyphenols, determination of the

volatile compounds by various techniques such as GC-MD or electronic noses, amino acid profile, immunoblot assay of proteins, trace element content, infrared spectroscopy, determination of aliphatic carboxylic acids, and mass spectroscopy. Besides these parameters, electrical conductivity, color, enzyme activities were also useful for the recognition of the floral origin of honey. Many other parameters were also discussed including the determination of the content of polyphenols and other phytochemicals. Thus the methods used the need and importance of this classification, advantages and disadvantages were discussed.

Piazza and Oddo (2004) reviewed the European unifloral honey samples bibliographically. They compared the data published by the International Honey Commission of Apimondia (IHC) for the fifteen important European unifloral honeys with the data published related to the same types of honey. The data was converted into uniform units for comparison. They found that most of the results available in the literature were significantly equal to the IHC standards. It was concluded that some variations observed might be due to the difference in the analytical methods used.

Sahinler and Gul (2005) studied the consequence of storage and heating on HMF content and diastase activity of honey. The honey samples were heated to 55, 60 and 65°C temperature for 6, 9, 15, 20, and 30 minutes. The samples were then stored at 21°C temperature (room temperature) for 29 weeks. It was observed that the diastase action was not affected by either heating or storage. On the other hand, the HMF content was changed significantly.

Tuzen and Soylak (2005) studied the honey samples gathered from the middle Anatolia region from Turkey. The honey samples were digested with HNO₃ and H₂O₂ in the microwave oven and the content of trace heavy metals was detected. Flame and graphite furnace atomic absorption spectrometry was used. Fe, Mn, Zn, Cu, Cd, and Pb were the metals estimated. It was reported that the honey samples were containing the heavy metals but the amount was at the acceptable level.

Dimins et al. (2006) discussed the criteria used to determined the quality of honey and studied the changes occurred in honey during storage and heat treatment.

For this purpose, different honey samples from the varied regions of Latvia with diverse floral origin were procured. Physicochemical properties, enzyme activities, and oxidation-reduction potential were determined. The parameters were compared to find out the change during the storage and heat treatment of honey samples. The investigation indicates that the honeys were of superior quality and it was found that HMF content was increased with a decrease in enzyme activities during storage and heat treatment.

Ingle (2006) carried out the research to compare honey with the Intra-Site Gel, used as a wound-healing agent. The objective was to record the side-effects of honey if any, the satisfaction of patients, to calculate the cost and its comparison. The research was designed to carry out the randomized, double-blind, prospective, and controlled trials among goldmine workers. The results were measured in terms of healing times of shallow wounds and abrasions, the satisfaction of the patient, the amount of the gel and honey used and importantly, the side effects. As the conclusion drawn by the authors, they did not find any shreds of evidence to differentiate between the gel and the honey as a healing agent. Honey was proved to be a more safe over and above satisfying and effective healing agent. Adding more natural honey was found particularly cost-effective as the average cost of treatment with honey was rupees 0.49 per patient and with Intra-site gel, it was rupees 12.03 per patient.

Munoz and Palmero (2006) investigated the honey samples to determine the heavy metals in honey using potentiometric stripping analysis techniques as well as continuous flow methodology. The heavy metals found in honey works as an indicator of environmental conditions. For this investigation, the honey samples were collected from various regions of Spain. Zn, Cd, Pb, Cu, and Ga were the heavy metals detected. The data obtained were analyzed and compared with the other reference values.

Bogdanov et al. (2007) determined the mineral profile of 95 honey samples from Swiss areas. The samples selected were from recognized geographical and botanical origins. The samples were grouped according to the area from which they were collected as city, village, rural, and mountain. Pb, Ni, Cd, Cr, Cu, Zn, Fe, and

Mn are the minerals that were detected quantitatively. The data were analyzed using ANOVA, to find out the correlations between the mineral and other parameters such as botanical origin and electrical conductivity. It was stated that the trace elements detected were from natural as well as anthropogenic sources.

Chepulis (2007) evaluated the change in weight of young rats fed with various types of diet based on honey and various amount of sugars. The groups of the rat were fed by a powdered diet containing sugar, mixed sugar, sugar-free diets, and honey. The assessment of weight gain and food intake was done once a week. The total percentage of protein and body fat were measured after mincing the animals. The weight increase was found to be lowest in the honey fed rats, but no difference in lipid profile was reported.

Joseph (2007) determined the quality of honey from the West zone of Cameroon. The microbial and physicochemical characteristics were assessed for this quality determination. A total of forty-nine samples were collected from the West Cameroon local markets. Glucose content, glucose to water ratio, moisture, ash content, density, and viscosity were estimated for each sample. Mineral contents were also evaluated and the samples were subjected to microbial analysis also. It was observed that the values of physicochemical characteristics were within the standard limits. Most of the honey samples were found to be contaminated due to unhygienic conditions.

Krushna et al. (2007) explored the preservative properties of honey for the preservation of milk. It was mentioned that there is a role of hydrogen peroxide behind the antibacterial properties of honey. In this study, the role of honey as an antibacterial agent was determined. For these purpose honey solutions of different concentrations were added into the milk samples. The spoilage was checked. The results confirmed that the honey can act as a safe and effective preservative agent for the milk samples. Both the peroxide and non-peroxide compounds of honey played an imperative role in the method of preservation.

Osman (2007) studied the properties of honey collected from the Al-Qassim region of Saudi Arabia. The honey samples obtained from the five different locations were subjected to determine the physicochemical properties and mineral content. Mg, Fe, Cd, Pb, Mn, and Zn were the elements detected with the analysis of other common physicochemical properties. All the parameters checked were found within the prescribed standards and the metals were found in such an amount that they could not be harmful for human consumption.

Rasooli (2007) studied the various aspects of food preservation. He tried to find out the role of bio-preservatives. It was mentioned that essential oils were identified as strong antibacterial agents. The potency of naturally-occurring antimicrobial agents was studied. It was said that the phenolic components in honey were acted as antioxidants. The properties of various compounds as natural preservatives and the mechanism of action were studied.

Bibi et al. (2008) detected the heavy metals and carried out the pollen analysis of honey samples from seven selected countries. The samples obtained from Austria, USA, Australia, Pakistan, Canada, Saudi Arabia, and Germany were examined for the identification and characterization. Pure honey from Soon Valley was considered as a control for comparison. The pollens from 12 plant families were detected in the samples. Among the minerals, iron was found at the highest concentration in all samples except Australian honey. The concentrations of all heavy metals were found within a limit in all samples except in the Saudi Arabian honey sample the concentration of lead was significantly high.

Cantarelli et al. (2008) detected the chemical composition and the content of trace elements for the assessment of the quality of Argentinean honey samples. Thirty-eight natural honey samples from the La Pampa region were subjected to this study. Trace elements such as K, Mg, Ca, Na, P, Cu, Zn, Mn, Al, and Fe and other common physicochemical characteristics were measured. The low content of analytes was observed in the honey from central Argentina. The Central Argentina honey showed the novel results as it was analyzed for the first time till that date. The overall

quality of honey from Argentina was found good and might be helpful for the commercialization.

Chepulis (2008) reported the healing property of honey in her book "Healing honey: A Natural Remedy for Better Health and Wellness". In the first chapter, brief information about the sugars and their properties was given. The second chapter was an overview of honey and its basic properties and composition. The antimicrobial activity of honey, reasons for these activities, the role of osmolarity, acidity, and hydrogen peroxide in the antimicrobial activity was discussed in the third chapter. The antioxidants in honey and their crucial role in the healing properties of honey were discussed in the fourth chapter. The next few chapters contained the anti-inflammatory properties of honey, the role of honey on weight gain and reduction of fats, the prebiotic effects of honey, and its importance on gastric health. An effect of honey on blood sugar, level of cholesterol, use of honey in burns and wounds, and other health benefits of honey were discussed in the preceding chapters. The book also contained some honey recipes.

Leblebici and Aksoy (2008) checked the quality of honey samples by determining heavy metals content using Plasma Optical Emission Spectrophotometry. Thirty-four locations of Central Anatolia were selected for the collection of honey samples. The emission spectrophotometry technique was used to estimate the content of heavy metals such as Zn, Cu, Fe, Cd, Pb, Se, Ni, Cr, and Mn in the honey samples. It was reported that the honey samples analyzed content the heavy metals but the amount was found in acceptable limits.

Mairaj (2008) examined the honey samples produced in the Peshawar Valley of Pakistan for the quality assessment. The quality parameters were determined for checking the possibilities of its market potential. Reducing sugars, HMF, ash, moisture, and acid contents were the parameters checked by the researchers. The values obtained were compared with the standard values. All the parameters evaluated were observed to be within a range of international standards given by the statutory bodies.

Oddo et al. (2008) determined the composition and the antioxidant activities found in the honey samples of the *Trigona carbonaria* from Australia. *Trigona carbonaria* is the stingless honey bee species. Eight honey samples were collected for this study. Color, moisture, ash, EC, HMF, pH, acidity, nitrogen content, and sugars were the physicochemical parameters determined. In addition to this, the activities of enzymes, water activity, flavonoids and polyphenols content, antioxidant activity, and radical scavenging activity of the honeys under consideration were also measured. It was reported that with some exceptions the other parameters determined were significantly in comparison with the other honey standards. The honey showed additional antioxidant activity which may be beneficial.

Radojcic et al. (2008) studied the properties of natural honey as a tin corrosion inhibitor together with radish juice. The weight loss and polarization techniques were used to find out the corrosion of tin in sodium chloride and aqueous solutions. Acacia honey and chestnut honey were used in the experimentation. It was observed that the inhibitory effect of chestnut honey was higher than that of acacia honey. The inhibitory efficiency was found to be increased with the addition of juice of black radish. The layer of adsorption was formed which was following the Langmuir adsorption isotherm.

Dubey et al. (2009) studied a case that was related to the poisoning effects of honey. It was reported that a patient was admitted to their hospital which was suffering from bradycardia and severe hypertension. The reason investigated was the consumption of wild honey. It was reported that the wild honey produced from the nectar of the flower of rhododendrons contains some poisonous compounds such as grayanotoxin. It was added that the toxicity of wild honey not fatal and may affect a maximum of 24 hours. The need for precautions was suggested for the consumption of wild honey.

Ghori and Ahmad (2009) demonstrated the antibacterial activities of sandal oil, black paper, and honey. The products were collected from the local market. Dimethyl sulphoxide and distilled water were used as a solvent for the preparation of the stock solution. The antibacterial activities of these products were determined

against the bacterial species isolated from the clinical samples viz. *Bacillus subtilis*, *Salmonella sp.*, *Staphylococcus aureus*, and *Escherichia coli*. All the samples showed inhibitory activities against the selected bacteria. Among all the products honey illustrated a broad spectrum of its activity against bacteria thus found to be most potent.

Gomez-D et al. (2009) investigated the effect of temperature on the viscosity of honey. He reported that the viscosity of honey was decreased with the increase in temperature. The change in viscosity was different according to the range of temperature used. This characteristic was also studied by determining the glass transition temperature and water activity of honey and relating it with the change in viscosity at different temperature range. Total 11 variety of honey samples collected from the local Spanish market was taken for the experiment.

Gupta and Sharma (2009) took a review of the production characteristics of mead and fruit-honey wine. It is reported that mead is the world's one of the oldest and easily made fermented drink made from honey. It was mentioned that the mead is the nutritious and digestive drink with a good effect on metabolism. In conclusion, it was reported that the research to words preparation of mead was not sufficient and systematic. Though there was a lot of research done on the preparation technology of mead, the mead was still not easily available in the market commercially. It was suggested that more research is required to popularize the drink commercially.

Kaskoniene et al. (2009) determined the phenolic compounds in honey both quantitatively and qualitatively. The bioactive compounds such as phytochemicals were found to have an importance in the recent years. The present research was carried out keeping this fact in mind. Four honey samples from Poland were collected for the analysis. The methanolic extracts were prepared for the experimentation. HPLC (high performance liquid chromatography) was the analytical technique used for the qualitative analysis of honey. Dark colored honey was found highest in the phenolic contents. Caffeic, benzoic and ferulic acids, quercetin were the phenolic compounds recognized in the samples.

Makhdoom et al. (2009) studied the use of the honey in the treatment of diabetic foot ulcers. It was mentioned that the use of honey in wound healing was reported in many articles. The honey has a capacity of clearing the wound infections. A total of 12 patients of all ages and both genders from the department of Orthopaedics of Liaquat University of Medical and Health Sciences, were treated with honey. The honey was used as an anti-inflammatory agent for the dressing of diabetic foot ulcers. The results showed that the disability was minimized in diabetic foot patients. The productivity and quality of life of the patients were found to be enhanced by the application of honey.

Mohammed and Babiker (2009) studied the honey samples from the honeybees *Apis mellifera* for the detection of physicochemical characteristics, composition of minerals, and protein structure. The honey samples under study were of different floral origins. The protein structure was studied by using gel electrophoresis. It was observed that each sample of honey showed 12 different bands in protein structure. The relation between the floral origin and the structure of the protein was analyzed to find out the relation. The values of other characteristics were found to be varied in all the samples. The heavy metals were within the safe level except lead.

Popa (2009) studied the quality of honey from the region of Transylvania of country Romania. Twenty different poly-floral and uni-floral honey samples were collected for this study. The Physico-chemical characteristics and the microbiological parameters were determined and compared with the standard values. Some contaminations, especially of mold species, were due to inadequate hygiene conditions. The physicochemical parameters were found in limits proposed by the legislation.

Annapoorani et al. (2010) investigated the physicochemical parameters of heated honey. Honey mixed with *ghee* and their effects on the rats were also assessed. It was reported that according to *Ayurveda*, the mixture of heated honey and *ghee* in equal amount produce harmful effect. The study was carried out to verify this postulate. The specific gravity was observed to be decreased and pH was increased in

the heated honey and ghee samples. The HMF was also increased significantly. The mixture of ghee and heated honey did not show any significant change in the rats. It was concluded that the production of HMF may be responsible for the harmful effect.

Chauhan et al. (2010) investigated the raw and processed honey samples for the assessment of activities. The ethyl acetate, methanol, and ethanol extracts were prepared. The extracts were compared with the common antibiotics for determining the antibacterial potential. The strains of Gram-negative bacteria such as *Pseudomonas aeruginosa*, *Escherichia coli*, *Salmonella typhi*, and Gram-positive bacteria, *Bacillus subtilis*, *Bacillus cereus*, and *Staphylococcus aureus* were used for the determination of antibacterial activities. It was reported that Processed as well as raw honey showed antimicrobial activities. The honey samples had effects on both Gram-positive and Gram-negative bacteria. It was concluded that the honey extracts could be the potential and sustainable alternatives to the common chemical antibiotics.

Gangwar et al. (2010) detected the characteristics of Ethiopian honey samples of different floral origins. Total acidity, free acids, diastase activity, lactones, pH, moisture, ash, and electrical conductivity were some physicochemical parameters investigated in this study for the analysis of honey samples. The microscopic analysis was also examined. They tried to find out the relations between the parameters under consideration. The interpretation obtained from the data analysis was applied to categorize the samples as per the plant origin. The pollen content was also found useful for the characterization.

Mohamed et al. (2010) studied the antioxidant properties of honey, which was collected from the hives on Tualang trees of the rain forest region of Malaysia. The Tualang honey produced by the wild honeybees was used extensively in the treatment of many diseases. The color, total phenolic contents, antiradical activity, and antioxidant activity was measured for the study. The honey was irradiated by gamma rays to detect the antiradical activity. It was reported that the irradiation with gamma rays does not make any change in the antioxidant activities of Tualang honey. The need for more study was suggested to identify the biologically active compounds.

Sampathkumar et al. (2010) studied the uses and benefits of honey as a medicine and health-promoting agent. In this review article, the composition of honey, especially the content of minerals, vitamins, and antioxidant profile of honey were discussed. The use of honey as a medicine in many disorders without its side effects was one of the highlighted points of discussion. The potential of honey as a strong antimicrobial agent was also explored. The special remedies suggested in the *Ayurvedic* literature such as the use of honey in cancer treatment were discussed briefly. The wound healing capacity was discussed in this study. In conclusion, the authors suggested a daily consumption of honey for a strong and healthy life.

Zamudio et al. (2010) investigated the use of honey as a food and medicine. The comparison was made between the wild honey samples of the Atlantic forest, Misiones, and Argentina. The questioner method was used for this investigation. The purpose of this study was to find out whether medicinal or/and nutritional honey exists in real. They worked with the Polish and Criollos. It was concluded that honey used as a medicine in the treatment of a variety of diseases. The use of honey from more species was practiced by the Criollos than Poles.

Adenekan et al. (2011) characterized the honey samples from Ibadan of Nigeria. The samples were subjected to the physicochemical and microbial examination. A total of ten samples were analyzed. *Bacillus* spp., standard plate count, total coliforms, molds, and yeast are the microbial species for which the microbial analysis was taken place. The data obtained were analyzed for the comparison with literature values.

Rotarescu and Vidican (2010) studied the impact of thermal processing and condition of storage on the HMF content and diastase enzymatic activity in honey. Chestnut, acacia and poly floral kinds of honey were used for the experimental assessment. After a transient heating stage, the samples were kept at different temperatures for a different time. Then the diastase activity and the HMF content were analyzed. It was observed that after the aggressive treatment of heating the honey at 800 C for three hours, the diastase enzyme activity was completely destroyed in all types of honey samples. Heating of honey at 800 C for three hours also resulted

in the formation of a high amount of HMF, which is above the permitted limit of international standards and regulations. As per the formation of the HMF concert, chestnut honey was affected mostly while poly floral honey affected least due to heat processing.

Alagwu et al. (2011) studied serum cholesterol, triglycerides and lipoprotein levels in albino rats after feeding them with honey. The benefits of honey on the risk of coronary heart disease were also studied. 20 adult male albino rats were subjected to this study. The rats were sorted into two groups. Out of which one was a control and another was a test group that was fed for 22 weeks by widely consumed unrefined honey from Nigeria. The effect of this fed honey on cardiovascular risk predictive index (CVPI) and plasma cholesterol (HDL, VLDL, LDL, TG) of rats were studied. It was found that there was an increase in the plasma TG, HDL, and VLDL at a significant level in the rats fed with honey as compared to the control group. On the other hand, a significant decrease was found in the levels of plasma LDL and total cholesterol in the test group rats in comparison with the control group. The CVPI value showed a significant increase in the test group. Finally, the result of the study showed that the consumption of unrefined honey not only got better profile of lipids but also good cardiovascular disease predictive index in male albino rats significantly.

Badis and Kheira (2011) characterized the honey samples from Algeria for the quality assessment. A total of 50 kinds of honey were collected from the central region of Algeria. The samples were identified by their geographical and floral origin. The parameters such as HMF, color, moisture content, pH, and electrical conductivity were assessed. The other micronutrients and phytochemicals were identified by HPLC. It was observed that the 74 % honey samples under consideration met the standards of the codex. The remaining had some lacunas in the values of some attributes. The rate of free acids and HMF are the parameters which were not matching the standard values.

Balasubramanyam (2011) studied the changes in the chemical properties of honey during each stage of ripening. The honey from *Apis cerana indica* was acquired for this study. Nectar of flower, honey crop of foragers, honey crop of house bees,

honey in unsealed cells, and honey in cells in sealed cells are the five stages in the ripening process of honey. Total reducing and non-reducing sugar, pH, ash content, and acidity were the five parameters tested during this study. All the parameters determined by standard methods and the data were analyzed using statistical methods, F-test and ANOVA. It was observed that there were variations found in all parameters during each stage of ripening. The ripened honey contains the essential nutrients that can be easily absorbed.

Bartakova et al. (2011) collected 22 honey samples from the various regions of the Czech Republic. The crystallized honey samples heat conventionally for re-liquefying. The HMF (Hydroxymethylfurfural) formation was facilitated by heating. The work was done to determine the HMF in the crystallized samples heated in a microwave oven for re-liquefying. The samples were categorized according to the harvesting time. It was observed that in the honey samples heated at the highest temperature and periods, not much raise in HMF content was found as expected in general heating. The HMF content was varied in individual sample heating.

Cozmuta et al. (2011) evaluated the quality of poly-floral honey samples on thermal processing. The samples were brought together from different regions of Romania. A general physico-chemical characterization was carried out. The change in activities of honey enzymes and the change in the content of HMF (Hydroxymethylfurfural) were the parameters observed to find out the effect of heating. The samples were heated for different time ranges and at different temperatures. The activity of diastase enzyme was observed to be more responsive to the interval of heating than the temperature of heating. The results showed that the formation of HMF was influenced by the temperature and time of heating equally.

Dave (2011) investigated honey as a nutraceutical ingredient for the functional foods in her research thesis. She collected a total of nine samples of honey among which five are the branded honey available in the market and the remaining five samples were collected from the different forest of Gujarat. The antioxidant activity, over and above the flavonoids and total phenolic contents, were estimated. The color, moisture, and total sugar were also estimated. The biscuits were manufactured using

honey at a different level as a replacement of sugar. It was found that the incorporation of honey at level 15% tends to increase the resistant capacity to words breakage. The overall quality of 5% honey incorporated biscuits was found best.

El-Biale and Sorour (2011) studied the properties of honey and the effect of adulteration on these properties. The samples of clover honey from Gharbia governorate were taken for this study. The honey samples were adulterated by starch, glucose, molasses, and water. The pure and adulterated honey samples were analyzed for the detection of physicochemical and rheological parameters. The data obtained were compared to determining the relationship. There was a significant difference observed in the values obtained for pure and adulterated honey.

Nafea (2011) studied the HMF content of honey and its effect on antibacterial activities. The levels of HMF and antibacterial activities were determined at the different concentrations of honey samples. *Pseudomonas aeruginosa*, *Escherichia coli*, *Staphylococcus aureus*, and *Bacillus subtilis* are the pathogenic bacteria against which the antibacterial activities were evaluated. The observations obtained were analyzed to conclude. There was no trend found in common for all samples. The bactericidal activities were found against a broad spectrum of bacteria with different levels of HMF values and concentrations of honey.

Nemoseck (2011) investigated the effect of sucrose and honey in the weight gain, metabolism of adipose tissues, and triglycerides profile of rats. Carbohydrates especially sugars affect all the above parameters. The influence of honey on these parameters, when used as a sweetener, was investigated. The two groups of rats were fed with a 20 % carbohydrate diet containing sugar for one group and containing clover honey for the second group. After thirty-three days the rats were examined for the blood test. It was observed that the honey fed rats gained low weight and low epididymal fat weight. It was postulated from the overall analysis that honey may be effective in lowering weight and adiposity with all favorable benefits.

Tandlich (2011) characterized the selected honey samples from South Africa for understanding the antioxidant and antimicrobial in addition to the chemical

properties of honey. The eight commercial honey samples purchased from the local market were subjected to the determination of fecal coliform, mesophilic bacteria, and mesophilic fungi concentration. The pH and electrical conductivity were also determined. The antioxidant activity was evaluated by ATBS and DPPH assays. In conclusion, all the samples were found safe for consumption and shown the antioxidant activities.

Kacaniova (2011) studied the antiradical and antimicrobial activities of honeydew honey samples from Slovakia. Honeydew honey is a sugary and sticky secretion of some scale insects or aphids, which feed on plant sap. Nine different honeydew honey samples were collected from the various regions. The antibacterial and antioxidant activities were determined. DPPH scavenging activities were determined spectrophotometrically at 517 nm. The conclusions were drawn from the collected data. It was reported that the antioxidant potential of dark color honeys were better than the light one. The quality of honey was influenced by floral origin.

Ajibola et al. (2012) reviewed the various properties of honey as a source of nutraceutical. The health benefits of honey with the economical benefits were discussed in this article. The use of honey as a therapeutic agent and its medicinal properties were documented. It was reported that honey is accepted as a food as well as medicine by all types of civilizations and traditions. Both the ancient and modern generations approved the beneficial properties of honey. It was mentioned that honey is beneficial for all the human organs and the systems extensively. The economic importance of honey is also discussed in the article.

Erejuwa et al. (2012a) took a glance at the antioxidant properties of honey. They titled honey as a novel antioxidant. Many diseases like Mellitus, Alzheimer's, cancer, atherosclerosis, and hypertension were mentioned to associate with the oxidative stress. The lack of a proper balance between oxidants and antioxidants is known as oxidative stress. The increase in the level of oxidants and reduction in antioxidants is the reason for the susceptibility of an individual to these chronic diseases. It was reported that honey provides the antioxidants to overcome the

damage. The article highlighted the various medicinal properties of honey and the effects of honey.

Erejuwa et al. (2012b) highlighted the anti-diabetic properties of honey in their review article. They called honey as a novel anti-diabetic agent. The beneficial effects of honey on gut microorganisms, gastrointestinal tract, pancreas, and within the liver, were explained. The mechanism of honey to control the glycemic index and metabolic derangements was also discussed. The possible mechanism of the anti-diabetic effect of honey-based on the composition of honey was proposed. The mechanism-based above all factors were discussed with the shreds of evidence in detail. The need for more studies was suggested.

Gomez-Diaz et al. (2012) characterized the Galician honey samples for studying their physicochemical properties. The basic parameters such as refractive index, glass transition temperature, water activity, sugars, ash, electrical conductivity, pH, viscosity, and density were measured. The effect of some characteristics and composition of honey on the properties of honey was also detected. It was reported that all the eleven honey samples followed the requirements of Spanish, European, and Galician standards. Certain differences were found in properties depending on geographical origin.

Iglesias et al. (2012) characterized 60 samples of honey with PDO (Protected Denomination of Origin). The samples were collected from the Northeast region of Portugal. The physicochemical, microbiological, and pollen analysis was done. The data was studied statistically by employing one way ANOVA and Tukey's HSD test. It was postulated that all the samples analyzed were found to meet the European Legislation, but some samples failed in the requirements of the PDO specifications. The pollens found in the honey samples were predominantly of rosemary flowers.

Islam et al. (2012) measured the antioxidant and physicochemical properties of honey. Five mono-floral and three multi-floral honey samples from various parts of Bangladesh were subjected to the evaluation. The 1,1-diphenyl-2-picrylhydrazyl (DPPH) and ferric reducing antioxidant power (FRAP) assays were used for the

determination of antioxidants, phenolics, ascorbic acid, flavonoids, proline, and protein contents. These properties were studied for the honeys that were kept for more than a year. It was reported that the formation of HMF on storage was low in Bangladeshi honey. There were high antioxidant properties detected in multi-floral honey.

Khalil et al. (2012) studied the antioxidant and physicochemical parameters of the honeys collected from Algeria. Four different Algerian honeys were analyzed to study their antioxidant, physical, and biochemical properties. The common factors such as moisture, electrical conductivity, pH, color, sugars, and TDS were determined. Their antioxidant properties were assessed by performing several tests. It was postulated that the Algerian honey had an excellent antioxidant potential as they are good sources of several antioxidants.

Moussa et al. (2012) tried to explain the mechanism responsible for the antioxidant activities of honey. It was accepted in the article that honey is beneficial to health and the antioxidant properties of honey play a key role in these activities. It was mentioned that there are plenty of ingredients involved in the process of antioxidant behavior. The substances responsible were listed as nitrite and nitrates, sugars and their oxidases, hydrogen peroxide, pH, minerals in honey, and phytochemicals. Various theories proposed by different authors were discussed in this editorial. It was concluded that the mechanism of the antioxidant properties of honey is very complex to explain exactly. Numerous studies are needed to carry out in this field.

Ramnath and Venkataramgowda (2012) were carried out the detection of physicochemical parameters in addition to the pollen analysis of the honeys from Western Ghats of Karnataka, South India. A total of thirty samples of honey were brought together from different locations of the region, out of which 8 were unifloral honey samples. The analysis of these samples was carried out to determine several physicochemical parameters such as total sugars, proteins, total acidity, pH moisture, ash, alkaloids, and phenols. Pollen analysis was also carried out to find out the floral origin of these samples. In eight samples some particular types of pollen were found

above 45 %. These eight samples were found to be unifloral. In the present study, it was reported that the total phenolic content fluctuated. The uppermost value was observed to be 0.96 mg/g. It was also revealed that the dark-colored honeys were found rich in phenols. The overall quality of honey samples was assessed based on physicochemical composition, pollen content, flavor, and color. The results showed that 75% of the honey samples were confirmed the requirement of Codex Alimentarius 2001.

Temamogullari et al. (2012) characterized the honey samples to determine the heavy metals found in honey. The samples were pulled together from twenty dissimilar villages of Sanliurfa, a city of Turkey. Total hundred honey samples were examined for the estimation of heavy metals using a graphite furnace atomic absorption spectrometer. Lead and Cadmium were detected in the honey samples almost in the same amount range. It was mentioned that manganese was not present in the honeys. There was reported that the theories recommend consumption of 20 g of honey for a person in a day is good. The amount of heavy metals in 20 g of honey was found at a safe level as per the WHO guidelines.

Champagain et al. (2013) developed a functional drink made from buttermilk. In this yogurt drink, they used banana and honey for value addition. The physicochemical, sensory and microbiological characteristics of this drink were determined for its quality assessment. The values thus obtained were compared with the plain and skim milk yogurt drinks. The probiotic bacterial culture of *Lactobacillus acidophilus* (La5) was used in the preparation of functional drinks. The storage capacity of product drinks was also assessed in terms of some parameters such as acidity, consumer acceptability, and strain viability. It was observed that the addition of banana and honey resulted in a decrease of acidification, while the content of carbohydrate, ash, and protein found to be increased. The effect of honey and banana on other parameters was also discussed.

Eteraf and Moslem (2013) studied the uses of natural honey as a medicine in the traditional and modern context in their reviewed article. They defined honey as a by-product made from the nectar of the flower and the secretion of the digestive tract

of honey. The composition of honey depends on various factors including the botanical source. The honey was reported as the food and medicine used by humankind since the Stone Age. They mentioned that honey is now getting the place as medicine in modern therapy also. It was reported that the inhibitory action of honey against approximately 60 species of bacteria, fungi, and viruses, is useful in the prevention and treatment of some diseases. Its antioxidant capacity is also responsible for making it a medicine. They discussed the physicochemical properties and composition of honey in addition to its medicinal properties.

Kadirvelu and Gurtu (2013) discussed the various potential benefits of honey in type 2 diabetes mellitus. The research was carried out to review the various medicinal properties of honey. From the studied pieces of evidence, it was reported that honey has many health beneficial effects. Honey was found to be reproductive and hepato-protective. It has anti-bacterial, anti-fungal and anti-inflammatory properties. Honey is also shown the properties as gastro-protective, hypoglycemic, and antihypertensive. The study supported the fact that honey has numerous medicinal and nutritional values and it serves as a novel anti-diabetic and antioxidant agent. The honey might be having the potential for the management of diabetes and its complications.

Manukumar et al. (2013) evaluated the antioxidants and physicochemical properties of honey. For this purpose, the honey of four varied varieties was collected from different regions of India. The samples were subjected for the analysis to estimate pH, electrical conductivity, HMF, TDS, total sugars, range of sucrose, reducing sugar, moisture, and color intensity. Total flavonoids content, total flavonols, and total phenolic contents were also determined as an indicator of the antioxidant activity of honey. Some minerals and metals were also estimated. It was concluded that all the honeys that were analyzed were of good quality with significantly high antioxidant and nutritional potential.

Manzoor et al. (2013) analyzed the various honey samples from the Anantnag District of the state Jammu and Kashmir. The samples collected were of the honeybee species *Apis cerana indica* and *Apis mellifera*. The samples were analyzed to estimate

the physicochemical characteristics such as viscosity, surface tension, ash content, moisture content, density, pH, and refractive index. It was found that the pH, density, moisture, and ash content of honey samples of *Apis mellifera* were slightly low than that of honey samples from *Apis cerana*. While in the case of the other parameters such as viscosity, refractive index, surface tension, and optical density the results were reverted. It was said that the honeys were found significant in the quality.

Rahman et al. (2013) evaluated thirteen honey samples from the particular area of Pakistan for the nutritional and phytochemical analysis. Both branded and unbranded honey samples were utilized for this study. Physicochemical parameters such as ash, pH, acidity, electrical conductivity, moisture, and sugars were determined. The analysis of various phytochemicals was also carried out. It was stated from the results that the unbranded honey samples were found to be rich sources of nutrients and phytochemicals as compared to branded samples. It was concluded that there is a strong need of more research work for the examination of honey in order to accelerate the utilization of honey as a medicine and of course food.

Zhou et al. (2013) evaluated the physicochemical characteristics of Jujube honey from China. Jujube is a kind of fruit in China. The properties measured were moisture, ash, free acidity, lactic acid, total acidity, pH, color, glucose, fructose, sucrose, HMF, and the enzyme activity i.e. diastase activity. The mineral content was also evaluated. The minerals estimated were Al, Ca, Cr, Fe, Cu, Co, Zn, Pb, Cd, As, Ni, Na, Mn, Mg, Li, and K. The total proline content and total protein content was also determined by them. A total of twenty three kinds of jujube honeys were brought together from the dissimilar regions of China for this investigation. ICP-OE spectrometry was used for the determination of minerals. The physicochemical values of all the honey samples analyzed were found to be conforming with EU legislation. Calcium, Sodium, Potassium, and Magnesium were the minerals found abundantly in Jujube honey. There was a remarkable variation found in all the parameters depending on the geographical origin of honey.

Alvarez et al. (2014) weighed up the biological activity and composition of manuka honey. The medicinal properties of honey were explored. The classification

of honey was also discussed. The biological properties of manuka honey especially antimicrobial and antioxidant potential were discussed. The composition and nutritional benefits of manuka honey were studied. The constituents of manuka honey responsible for the properties of manuka honey were explored in this study.

Erejuwa (2014c) investigated the application and effect of honey in the incurable disorder. It was reported that a bunch of intense research was done on the disease diabetes mellitus. There are limitations to the use of medicines due to their adverse effects; the work is going on the use of herbs and other natural products as medicine. It was reported that owing to the antioxidant properties of honey, it can be useful in the management of diabetes mellitus. It was suggested that there is a need for a well-designed study for the medicinal use of honey.

Islam et al. (2014) studied the toxic compounds in honey. The commonly found compound hydroxyl methyl furfural (HMF) in honey, was not naturally present in honey but might be formed due to heating or storage. HMF reported as a mutagenic, carcinogenic and cytotoxic. Honey might have content heavy metals such as lead, arsenic, mercury, and cadmium. Some honey might have contained alkaloids that can be fatal to humans. Honeys created from *Andromeda* flowers contained grayanotoxins which may paralyze. They mentioned that the honey collected from the *Datura* flowers, belladonna flowers, *Kalmia latifolia*, *Serjania lethalis*, *Gelsemium sempervirens*, and *Hyoscyamus niger* plants are not safe for human consumption. It was stated that the symptoms of poisoning due to the consumption of toxic honey may differ depending on the source. It had been suggested that one should not consider honey as entirely safe food.

Kavapurayil et al. (2014) have done the examination of fifteen Indian honeys gathered from different locations of India to determine some physicochemical, biochemical, and antibacterial properties. The samples were classified into three categories viz. market honey samples, raw/ wild honey samples, and industrial honey samples. Their analysis was done for the parameters such as organoleptic features, biochemical characteristics, physicochemical properties, and microbiological state. The physicochemical and biochemical values determined were compared with the BIS

(Bureau of Indian Standards) standard values. It was revealed from the findings that among all the samples no honey sample was conformed to the parameter standards given by BIS. The reason predicted might be the improper handling of the samples. The polyphenol content was found at a significant level in almost all honey samples. All the samples were showed effective antimicrobial properties. Proper storage conditions affect antimicrobial activities.

Koula (2014) carried out the physicochemical and phytochemical characterization of Algerian honey. A total of five honey samples were collected from different regions of Algeria. Physico-chemical parameters such as density, moisture content, ash, electrical conductivity, total acidity, HMF, reducing, and total sugar as well as phenolic content and antioxidant activity were evaluated. The conclusions were drowned after comparing the results obtained for each sample. Though there were differences in the properties of all samples depending on the geographical and botanical origin, the overall quality was good.

Nwankwo et al. (2014) subjected the honey from honeybee *Apis mellifera* for the chemical analysis and the determination of antimicrobial activity. Alkaloids, flavonoids, reducing sugar, glycosides, saponins, and steroids were the phytochemicals detected in the honey samples under study. Antimicrobial activity was also determined against *Staphylococcus aureus*, *Candida albicans*, and *Escherichia coli*. The honey showed antimicrobial activity against all species except *C. albicans*. It was concluded that honey may be proved as an effective antibacterial agent in the treatment of bacterial infections.

Roy and Ganguly (2014) reviewed the extensive properties of honey. They studied the physicochemical and antioxidant attributes of honey. The use of honey as an ancient medicine was discussed. The application of honey in wound healing was also discussed in this article. It was reported that honey is an organic product containing natural sugar and created by the honey bees, from the nectar of flowers and the exudation of plants. It was reported as a powerful agent as an immune system booster. Honey was mentioned as a digestive system helping agent. The composition

of honey was studied in the article. The importance of phenolic compounds of honey as antioxidants was explained.

Ajibola (2015) reviewed the health benefits of natural honey. The apitherapy was discussed in accordance with the treatment of some diseases. The extensive and ancient utilization of honey as a medicine was documented based on evidence-based data. The curative use of honey for many ailments was discussed. The mechanism of action of honey was also discussed. It was concluded that the unique factor behind the medicinal and antioxidant activities of honey is only a SMIF (Synergistic Multiple Ingredients Factor).

Bogoviku and Gedeshi (2015) researched to determine the crystallization tendency and level of HMF in Albanian honey products. Crystallization of honey is because of the precipitation of glucose present in honey. The major problem reported about the honey crystallization was, it increases the amount of moisture in the liquid phase. This promotes the growth of yeast cells present in the honey resulted in the fermentation of honey. They also discussed the honeydew honey, the honey that is made from the honeydew deposits left by various hemipterous insects on their host plant. Honeydew honey contains a more complex mixture of sugars predominantly reducing disaccharides in comparison with floral honey. It was reported that the trisaccharide melzitose was also present in honeydew honey, which is absent in floral honey. Granulation tendency of glucose was predicted by the glucose to water ratio. The high content of HMF was the indicator of adulteration in honey.

Dhahir and Hemed (2015) analyzed the honeys from the different regions of Iraq for the determination of trace elements and heavy metals. The results were compared with the other available non-Iraqi honey samples. Trace elements such as Calcium, Iron, Magnesium, Potassium, Sodium, Selenium, Copper, and Manganese as well as toxic heavy metals such as Lead, Cadmium, Vanadium, Nickel, and Arsenic were determined for the study. Flame atomic absorption spectrophotometry (FAAS) and Graphite furnace atomic absorption spectrophotometry methods were applied for the analysis. It was reported from the observed values that the amount of Selenium

and Potassium was found at an elevated level, while Copper was found in a lower amount.

Gebru (2015) studied the physicochemical characteristics of Ethiopian honey from Debre-Nazret Kebelle from the Tigray region. HMF (hydroxymethylfurfural), pH, acidity, diastase enzyme activity, electrical conductivity, insoluble solids, ash, and moisture were determined. The results were compared with set standards. A total of 21 samples were analyzed in this study. All the samples were found within the Codex Alimentarius Commission standards. It was suggested that there is a need for more studies based on the analysis of pollens.

Saber (2015) reviewed the properties of honey as a functional food as well as nutrient. It was reported that honey was the only sweetener used in the long history of humans. The use of honey as a food, drug, as well as an ointment for the wounds was documented in this article. The therapy of treatment of various diseases using honey as a medicine, known as apitherapy, was discussed. The composition of honey and its relation to its properties was highlighted. The trace elements in honey and their health benefits were discussed briefly.

Sohaimy et al. (2015) evaluated the quality of honey from different origins by characterizing their various physicochemical parameters. The Egyptian, Yemeni, Saudi, and Kashmiri honey samples were analyzed during this study. Color, sediment content, moisture, ash, optical density, pH, sugars, and protein were the parameters that are estimated and compared. Anova technique was used for the comparison. Only Yemeni honey was not in the codex range of standard ash content.

Abeshu and Geleta (2016) reviewed the medicinal properties of honey and its uses as a medicine. It was stated that though honey has numerous medicinal properties, the use of honey as a medicine is limited. This is due to the lack of proper reports. Here the authors enlighten the composition and functional properties of honey. They also discussed the possible mechanism responsible for its medicinal properties.

Da-Silva et al. (2016) wrote this review article in which they studied the chemical characteristics of honey. The stability of honey on heating and long-time storage was studied for some properties. The content of phenolic and volatile compounds, protein, amino acids, organic acids, vitamins, minerals, and sugars as well as the activity of enzymes was evaluated. For the identity and for determining the quality standards some characteristics such as color, HMF, diastase activity, electrical conductivity, acidity, moisture, and ash were evaluated as established by the Codex Alimentarius.

Matysek (2016) studied the 18-month freezing and room temperature storage effect on the quality of raw rapeseed honey. They carried out the study to compare the color, physicochemical parameters, and dynamic viscosity of the stored honey at room temperature and freezing, with fresh rapeseed honey treated as control. The pH was decreased significantly on storage. The HMF content was increased and the diastase activity was decreased in the honey stored at room temperature, while both were decreased in freeze stored honey when compared to control. Diastase activity and HMF content found a negative correlation. The color parameters were significantly influenced by the storage temperature, to a greater extent in RT stored honey while almost the same in the freeze stored honey. The dynamic viscosity was found almost double in RT honey as compared to control one and it was found significantly higher in FRO than RT and control honey samples. The freshness was maintained in FRO honey.

Mohamed et al. (2016) studied the Sudanese honey and Sudanese *Solanum dubium* seeds for their phytochemical screening and antioxidant activities. The characterization was carried out for seeds and honey separately as well as by taking in combination. The extraction of samples was done by using ethanol, water, and methanol. The outcome of the study showed that the combination of seed and honey had shown better potential as a source of antioxidants.

Rao et al. (2016) reviewed the biological and therapeutic effects of honey. They compared the samples produced by the stingless bees and normal honey bees. The biological and clinical importance of honey was studied and highlighted. It was

said that the phenolic acids and the flavonoids of honey are primarily responsible for the medicinal properties of honey. The antimicrobial, cardio-protective, anti-inflammatory, anti-hyperlipidemic, and antioxidant properties of honey were discussed in this review article. In addition to this other uses of honey such as in eye disorders, wound healing, neurological disorders, and fertility-related disorders were also explored.

Amabye (2017) carried out a study for the investigation of biochemical and phytochemical composition of wild honey from Tigray, Ethiopia. The samples were evaluated to find out ash, moisture content. The protein, fat, carbohydrate, and energy value was also determined. In trace compounds, the polyphenols and vitamin C were also determined. It was found that the samples evaluated were found to fall within international standards. They suggested the need for more study for these honey samples.

Asokan and Jayanthi (2017) analyzed three honey samples collected from the various areas of Western ghats of the Theni District, South India. The evaluation of the content of phytochemicals was undertaken by the researchers for the collected honey samples. Ethyl acetate, ethanol, methanol, and water are the solvents used for the extraction of honey samples. The carbohydrates, proteins, and amino acids content were determined. The phytochemicals such as glycosides, saponins, phenols, terpenoids, phlobatannins, alkaloids, and flavonoids were evaluated using standard methods. The honey sample named as S1 was found as a very good source of phytochemicals.

Fernandez et al. (2017) appraised the microbial quality of honey from Argentina. The samples subjected for the evaluation were taken from the different processing points. A total of 163 samples were assessed. The presence of *Shigella spp.*, *Salmonella spp.*, and fecal coliforms as well as mold and yeast, CHMB (culturable heterotrophic mesophilic bacteria), and other spore-forming bacteria were evaluated. It was observed that the honey houses showed no sanitary risk, but the care must be taken while proper honey handling and during the sanitation.

Harun et al. (2017) evaluated the chemical and microbiological properties of honey from Istanbul to study its quality. It was stated that the quality of honey depends on many factors such as the maturity level, methods of production and processing, floral origin as well as on the climatic and storage conditions. 35 varied honey samples from the market of Istanbul were subjected for the examination of moisture content, HMF content, pH, and titrable acidity. The microbiological analysis was also carried out. It was concluded that all the samples examined were by the standards and regulations accepted in Turkey.

Ismail (2017) reviewed the prebiotic and antibiotic properties of honey. It was reported that honey is a food with high nutritional value, and was advocated by all religions and civilizations. He discussed the composition and medicinal properties of honey. The effect of honey on the microorganisms was also discussed. It was reported that honey is highly nutritious food with ample of medicinal properties.

Luchese et al. (2017) investigated the functional properties of honey. Antimicrobial and antioxidant properties are the most important and popular functional properties of honey. It was mentioned that these bioactive agents of honey deeply affected by its floral and geographical origin. According to them phenolic compounds, reducing sugars, and amino acids are mainly responsible for the antioxidant properties while other many compounds and properties are responsible for the antimicrobial activity of honey. It was stated that Oligosaccharides of honey helps the beneficial microorganisms in the gut. The phenolic compounds in honey and their antioxidant and microbial activities, as well as other bioactive contents of honey, were studied.

Liyanage and Hewageegana (2017) took a review of the traditional uses and benefits of honey for maintaining health. Honey was defined by them as a sweet and flavorful liquid produced by the honey bees from the nectar of flowers. The chemical composition and physical properties of honey were explored by the authors. The medicinal properties of honey and its extensive use in the treatment of various diseases throughout the world were discussed. The use of honey in especially in the Ayurvedic medicine was discussed chiefly.

Mohan et al. (2017) studied the properties of honey which are effective in improving the intestinal microbial balance after reviewing the research articles. They studied probiotics, prebiotics, and synbiotics for their beneficial effects on human health. It was reported that honey has a promoting effect on the beneficial microorganism in the gut. Honey content some unique oligosaccharides compounds which are responsible for maintaining the beneficial microflora in the host. The need for more research in this field was also suggested.

Parise and Abraham (2017) evaluated the honey samples from the varied sites of Tamale metropolis of Ghana. Standard microbiological methods were used. Honey samples from six locations were collected. *Escherichia coli*, *Streptococcus spp.*, *Bacillus spp.*, and *Staphylococcus spp.* were some species of bacteria isolated from the honey samples. The count of bacteria was found in a positive correlation with the pH of the honey sample. The hygienic conditions at the sites, production practices, and the location of the honey collection were found to be related to the bacterial load.

Saad et al. (2017) examined the effect of various honey samples on the bacteria *Staphylococcus aureus*. Some imported and some local honey samples (total 5) were collected for this study. The activity of these honey samples collected was assessed against the bacteria *Staphylococcus aureus*. Manuka honey was found to be most effective against the bacteria. It was reported that the antibacterial action of honey depends on its type and concentration. The need for future study was suggested.

Shobham et al. (2017) characterized the five samples of commercial honey of India. They investigated the parameters such as acidity, total sugars, reducing and non-reducing sugars, pH, and moisture content of the honeys subjected to the study. They also carried out the pollen count. The study encompassed the comparison of these samples based on the chemical, physical, and sensorial characteristics. The investigation showed that all the honey samples under study were almost had similar values of all parameters, including their floral origin.

Sreeja (2017) studied the effect of supplementation of milk with some substances including honey on some probiotic products. Toned milk supplemented with carrot, oat, Safed musli, and honey was used. The culture of health-promoting bacteria i.e. probiotics, *Lactobacillus helveticus* was used for fermentation of milk to prepare fermented milk products. The products were assessed to evaluate pH, fatty acids, probiotic and started viability, and sensory parameters between fixed time intervals. It was stated that the carrot supplemented milk product showed the highest probiotic viability. In general, a positive effect of supplementation was observed.

Ahmad et al. (2018) studied the health benefits of honey from honey bee species *heterotrigona itama*. It is a stingless bee species that are commonly found in the section of Southeast Asia. The anti-obesity property was found predominantly in this honey. The conclusion was made after studying the weight change, biochemical characteristics, and morphology of the experimental rats. BMI, adiposity index, body weight percentage, and relative weight of organs were reported to be decreased in the stingless bee honey fed rats. It was stated that the stingless bee honey possesses the hepato-protective potential, which is useful in the reduction of obesity-related health risk.

Bobis et al. (2018) reviewed the properties of honey as a diabetes preventing agent. The authors reported diabetes as a metabolic disorder with multifactorial and heterogeneous etiologies. It was said that there are two types of diabetes i.e. type 1 and type 2. When an immune system is attacked and destroyed then it is type 1 diabetes while in type 2 diabetes several factors were involved. Honey was used as a medicine for a long. It was reported that the hypoglycemic effect of honey is an important factor behind the medicinal properties of honey. The researchers termed honey as a novel antidiabetic agent. The potential effect and hopeful perspectives of the use of honey as an antidiabetic agent were also studied and reported. It was concluded that though honey is used as an anti-diabetes agent there are many obstacles and challenges. The need for more studies was suggested to reach better conclusions.

Boussaid et al. (2018) studied 6 honey samples obtained from a range of floral origins from the country Tunisia. The samples were subjected to determine the physicochemical and bioactive properties. All the parameters determined for six honey samples were appeared to conform to the EC Directive (European Legislation). The colors of the honey samples were found to be varied from pale yellow to dark brown. There was considerable variation found in the content of phenolic compounds, carotenoids, and flavonoids, with the highest values in the dark color mint honey. There was a statistically significant correlation between the parameters analyzed. It was suggested that the Tunisian honey is good as a functional and nutraceutical substance which may prevent some stress-related diseases.

Khan et al. (2018) investigated the properties of honey as a drug in many diseases. They reported that the importance of honey is given in almost all religious books also. They stated that though the anti-biotic, anti-viral and anti-fungal drug in honey was not reported till that time, in fact, the activities of honey have been proved as an anti-biotic, anti-viral and anti-fungal agent. They mentioned honey as a potent anti-oxidant, anti-inflammatory, and anti-cancerous substance. It was found that honey is effective in protecting the liver.

Nur et al. (2018) studied the protective effects of honey against the metabolic syndrome. A cluster of diseases comprising of dyslipidemia, diabetes mellitus, obesity, and hypertension is known as the metabolic syndrome (MetS). The numerous studies were reported the shielding potential of honey against MetS. It was reported that though honey is a nutritional food but it is low in glycemic index. Thus consumption of honey reduces the level of blood sugar and helpful in preventing excessive weight gain. The lipid metabolism is increased due to honey as it reduces TC (total cholesterol), TG (triglyceride) and LDL (low-density lipoprotein) as well as increases HDL (high-density lipoprotein) resulting in the decreased risk of atherogenesis. Honey stabilizes the level of blood glucose by enhancing insulin sensitivity. Furthermore, it was stated that oxidative stress reduces due to honey which is the key factor of MetS. They added that vasculature is protected from endothelial remodelling and dysfunction due to honey. Thus it was concluded that

honey is helpful in the management of MetS as a deterrent and add-on restorative agent.

Saranraj and Sivasakthi (2018) reviewed the biochemical and medicinal properties of honey. It was mentioned that honey has been used as a healing agent widely throughout the world. They explored the varied properties of honey as a medicinal substance and food. The wound healing property of honey was reported. It was stated that honey is useful in the treatment of certain diseases like ulcers, bedsores and some skin infections. The high viscosity of honey which provides the barrier to the infection, as well as its antibacterial properties, were reported as the prime reasons behind their wound curing capacity. The composition of honey was also discussed. The antibacterial, antifungal, antiviral and antioxidant activities of the honey were discussed. Medicinal use of honey in hair loss, bladder infection, toothache, cholesterol reduction, colds, stomach disorders, heart diseases, weight loss, and cancer, etc. were explored deeply.

Singh and Singh (2018) explained honey as a sweet and viscous liquid containing monosaccharides which are mainly responsible for its sweet test. It was reported that sugars, water, proteins, enzymes, minerals, and acids are the main constituents of honey. The major causes reported for the deterioration of honey are poor storage conditions and packaging as well as heating at high temperature, high moisture content, and adulteration. The different honey moisture reduction techniques designed by the researchers and beekeepers were discussed.

Siti et al. (2018) studied the long-term effects of Tualang honey on various health-related parameters. They also investigated the effects of honey cocktail on the cardiovascular parameters as well as on the anthropometric measurements of the women after their menopause. The same dose of honey and honey cocktail was fed to the groups of 100 women between age 45-65 years to assessed the said parameters. The diastolic blood pressure was observed with decreased values in the honey fed group as compared to the cocktail group. Fasting blood sugar was also found to be decreased in the honey group in 12 months. The BMI (body mass index) was affected positively in the group receiving honey cocktail.

Waheed et al. (2018) studied the relationship between the anti-cancer activity of honey and the mechanism responsible for this activity by reviewing various articles. It was stated that the antioxidant and apoptotic activity of honey, estrogenic, anti-inflammatory, anti-proliferative, and immunomodulatory effects of honey ingredients like flavonoids and phenolic acids, are chiefly responsible for the anti-cancer activity of honey.

Zaida et al. (2018) determined the effect of the supplementation of honey on the safety profiles of patients with postmenopausal breast cancer. The stage I, II, and III breast cancer patients from Malaysia. The patients were divided into two groups randomly. The control group was on the regular medicine and the experimental group was supplemented with honey dose in addition to the medicine. It was concluded from the findings of the experiment that supplementation of 20 g/day of Tualang honey is safe among the patients suffering from postmenopausal breast cancer.

Joshna et al. (2019) characterized the phytochemicals and total phenolic contents as well as the physicochemical properties of samples of bitter honey. The phytochemical screening and the determination of physicochemical parameters were done by using the standard methods. The experimental data thus obtained was analyzed by applying a statistical technique ANOVA. It was claimed that the characterization of bitter honey from Nilgiris was done the first time. The bitter honey samples were found to be the rich sources of phytochemicals and having a pharmacological significance.

Ota et al. (2019) experimentally evaluated chemical properties and immunostimulatory effects of honey after heating. It was reported that in Chinese medicine sometimes the medicines were roasted with honey in order to stimulate the immunostimulatory activities of the medicine. It was concluded that after heating the immunostimulatory activity of honey showed both in vitro and in vivo in support of the scientific shreds of evidence of the TCM theory.

Yelin and Kuntadi (2019) carried out the identification of the phytochemicals of honey from Java and Sumbawa. Standard phytochemical screening techniques

were used for the identification. It was reported that the phytochemicals in honey are responsible for the antioxidant and antimicrobial potential of honey. The presence of alkaloids, triterpenoids, steroids, flavonoids, tannins, and saponins were identified qualitatively. The result indicated that the honey samples identified with phytochemicals. More research work in this field was expected.

2.3 HONEY BASED PRODUCTS

Subramanian et al. (2007) studied the processing of honey using different methods. They reported that the microorganisms responsible for the spoilage of honey were eliminated by the processing of honey by heat treatment. As an alternative to the conventional heat oriented method, the other methods such as infrared heating, Microwave heating, membrane processing, and ultra-sound processing are also used for the processing of honey. Among all methods, Microwave heating reported as a most rapid method for reducing the yeast level to the desired amount with minimum thermal damage and it also increases the shelf life. Compare to microwave heating, Infrared heating was not found that much rapid but the desired results were achieved in more little duration in comparison to thermal processing. Membrane processing was reported to be a very effective method for the complete removal of yeast cells from honey. Microfiltration and ultra-filtration were useful to manufacture enzyme-enriched honey. Lastly, they suggested a need for more research in the area of processing of honey by microwave and infrared heating technique.

Hebbar (2008) reviewed the characteristics of some dried and intermediate moisture honey items. They discussed various processing techniques used for the production. The spray-dried powder of honey has increased demand in bakeries and confectionaries. But it is reported that during the drying of sugar-rich products like honey, Stickiness is the major problem occurred while processing which is related to a glass transition temperature and the sticky point temperature. They also discussed some additives which were used to avoid such a problem. The use of honey, by replacing part of the sugar in fruit spreads enhances the nutritional and sensory characteristics of the product. The flavor of honey was retained due to the co-crystallization of honey with sucrose. These diversified products using honey seen to be given more satisfaction to consumers due to better taste and nutrition.

Ozdemir (2008) weighed up the use of some alternative sweeteners instead of sugar in the preparation of ice cream. The effects on the quality of ice cream in terms of different parameters were measured. Sucrose was replaced by GS (glucose syrup), honey, HFCS (high fructose corn syrup), sucrose and honey, sucrose and HFCS, and sucrose and GS for the preparation of different ice creams. The acidity was lowest in the ice cream prepared with sucrose and GS. The viscosity of sugar and honey mixed sample was highest. It was stated that the use of various sweeteners in ice cream affects the parameters. The HFCS, honey, and Gs were not found satisfactory results on ice cream parameters but their combination with sucrose found good.

Hosny (2009) studied the processing of probiotic yogurt prepared by using honey as one of the ingredients. A total of 25 honey samples of three uni-floral varieties were subjected to the study to find out the nutritional composition and the microbiological quality. Acidity, pH, total nitrogen, moisture, and total sugars were the parameters detected. Color intensity and bacterial flora were also determined. The data were analyzed and compared. The honey Yoghurt was prepared by using probiotic bacteria and subjected to the sensory evaluation. The yogurts were studied for the storage capacity also.

Hategekimana et al. (2011) studied the properties of a drink prepared by using honey and lemon. The formation of cream in this tea and the effects of various constituents of honey, as well as the environmental factors on the formation of cream, were investigated. It was observed that the cream formation in the honey lemon tea was influenced by many factors. It was observed that total solids in honey, protein content, and polyphenols positively affect the amount of cream formed. Calcium and magnesium were involved in the process of cream formation while Iron involved in coloration.

Seth and Mishra (2011) prepared the candy from honey and standardized the recipe by using RSM (Response Surface Methodology). Skim milk powder, butter, edible starch, and pectin were the ingredients used other than honey. Hardness, yellowness index, and moisture content were the responses under examination. The products were subjected to physicochemical analysis. It was found that with the

increase in the amount of honey the moisture content increased and hardness decreased. The yellowness index also increased with honey level. It was concluded that honey can be used in confectionery effectively and provides functional benefits.

Khaliduzzaman (2012) developed the ice cream using honey as a sweetener. The acceptability of honey was studied by conducting the sensory evaluation. The effect of honey and sugar on the freezing point of ice cream was also studied. The physicochemical and microbiological parameters were determined. Skimmed milk powder, vegetable fat, emulsifier and stabilizer, food color and flavor, and sweeteners were used for the formulation of ice cream. It was reported that ice cream with 3.5 % honey and 13.5 % sugar was most acceptable.

Greenbaum and Aryana (2013) evaluated the effect of honey on some parameters of probiotic culture containing frozen dessert. The probiotic ice cream was prepared by using the probiotic *Lactobacillus acidophilus* culture and honey was used as a sweetening agent. They assessed the effect of light to dark-colored honey, on the bacterial count as well as the quality factors of ice cream. 50 g frozen culture concentrate of *Lactobacillus acidophilus* were added per 7.75 liters of mix and honey of light, amber, and dark color was added separately. Meltdown, pH, apparent viscosity, and *Lactobacillus acidophilus* counts were measured for quality assessment. The products were subjected to sensory evaluation also. It was observed that the bacterial count and viscosity were increased with the addition of honey as compared to the control or without honey ice cream. On the other hand, the pH and meltdown volume was decreased. The ice cream with light color honey scored well in sensory evaluation. In conclusion, the use of light honey in frozen products was recommended.

Rana and Katare (2013) made a traditional Indian sweet dish (sweet role) by using different sweeteners. It was prepared by using sugar, jaggery, and honey. The products were checked organoleptically. The benefit of honey over other sweeteners was evaluated on the basis of the glycemic index. It was concluded that honey has no adverse effect on glycemic response and it can be a better alternative to sugar for better health.

Bakr et al. (2015) studied the quality and the characteristics of the bio yogurt prepared by fortifying with fennel honey. Bio-yoghurt was prepared by the standard method with the addition of fennel honey at varied concentrations. The probiotic culture of a combination of *Lactobacillus acidophilus*, *Bifidobacterium bifidum*, and *Streptococcus thermophilus* (ABT-5) was used at an amount of 3% for the fermentation of milk. Various parameters were determined for the analysis of the product. It was observed that the titrable acidity and total solids were increased with the increase in the concentration of fennel honey. On the other hand, the parameters such as protein, fat, and ash were decreased. The bio yogurt produced by adding fennel honey at the rate of 5% was on top with the overall highest score.

Glusac et al. (2015) studied the quality of yogurt enriched by whey protein and honey concentrate. The activities of *Lactobacillus delbrueckii s b* and *Streptococcus thermophilus* through the growth and viability were detected. It was reported that the yogurt thus prepared by fortifying with honey and whey protein concentrate has the potential to facilitate the growth and activity of species of lactic acid bacteria. The activities were observed for the 21 days storage. It was concluded that the addition of whey protein concentrate and honey promote the fermentation by improving the growth of lactic acid bacteria and the stability of yogurt also increases.

Hamad (2017) evaluated the effects of blending the goat's milk with Tamr and Honey. The chemical composition, rheological properties and the activity of starter were studied for this blending product. Various combinations of the amount of honey and Tamr were used to fortify the goat's milk for this investigation. Goat's milk without any fortification was used as a control to compare the parameters such as total solids, total protein, redox potential, fat content, some organoleptic characteristics. It was suggested that the fermented products from the goat's milk with the addition of honey and Tamr can be prepared.

Khupse et al. (2017) utilized honey in cow milk Lassi, as a sweetening agent. Lassi is a sweetened indigenous drink prepared by churning curd and water in varied proportions as per the requirement. Usually, sugar is added as a sweetener while churning. The standardize cow milk was used for the preparation of dahi (curd). Lassi

was prepared by using sugar and honey at a different amount. The lassi samples were analyzed to determine various parameters like protein, fat, moisture, ash content, total solids, and titratable acidity. Sensory characteristics and the cost were also determined. The percentage of fat, protein, moisture, ash, and acidity were found to be decreased with the increased amount of honey added. The lassi with 12 % of honey was highest in body and texture, flavor, color and appearance, and overall acceptability scores. With an increase in honey percentage, the cost was observed to be increased.

Abou-Dobara et al. (2018) studied the nutritional and health properties of honey added bio- milk prepared from peanut milk, cow milk and the mixture of both kinds of milk. A total of six samples were prepared with and without adding honey. As per the results reported highest acidity and total solids were found in the cow milk rayeb, while peanut milk rayeb had found the highest percentage of fat. There was an increase in unsaturated fatty acid value and a decrease in saturated fatty acids in the mix milk rayeb. The most important result was that the omega-6 and omega-9 fatty acids, as well as antioxidant properties, were reported at a higher level in the rayeb with cow milk, peanut milk and honey mixture. In conclusion, they recommended that the mix rayeb milk was overall good in all the health and nutritional benefits.

Cianciosi et al. (2018) reviewed the health benefits of honey associated with the phenolic compounds present in honey. It was reported that the phenolic acids and the flavonoids of honey are the compounds that have a very crucial role in maintaining human health. The antioxidant and anti-inflammatory properties of these phenolic compounds and flavonoids are responsible for its medicinal properties. They tried to explore the mechanism behind the antimicrobial and anticancer nature of honey. The antidiabetic nature of honey was also highlighted in this article. Besides these health benefits of honey, they also studied the possible toxicity of honey due to some compounds.

Goswami et al. (2018) prepared herbal shrikhand, a traditional Indian sweet dish prepared from curd, sugar and some condiments, with the incorporation of turmeric powder and tulsi. They replaced sugar with honey in this product. In

conclusion, they reported that the herbal shrikhand was with low calorie, had antioxidant and antifungal properties, useful in all seasons and can have a potential of success commercial. The product might have been beneficial for persons with diabetes as well as high blood pressure.

Januario et al. (2018) incorporated a new ice-cream recipe from kefir. Kefir is a kind of milk produced by fermenting the milk with kefir grains. The natural substances like fruits and honey were used for flavor and sweetening. The banana, guava, and lemon ice-cream with honey were analyzed to determine the physical and chemical characteristics as well as the acceptance. The results were compared with the commercially available pineapple ice-cream. From results, It was indicated that all the ice-creams were comparable with the commercial one with slight suggestions. It was possible to develop the fruit-flavored ice-creams commercially from kefir.

Magdy et al. (2018) studied the properties of rayeb milk fortified with Tamr and honey for its quality assessment. Rayeb milk is the special functional beverage in Arab countries, made from yogurt by using probiotic bacteria for fermentation. Tamr is the name of dried dates. They used goat milk for making Rayeb. It was found that the concentration of saturated fatty acids was decreased due to the use of honey and Tamr while levels of many beneficial nutrients such as omega-3, omega-6, omega-9 fatty acids, and antioxidants activity were higher than the control.

Ojha et al. (2018) studied the processing of herbal shrikhand with the incorporation of tulsi and turmeric powder. Honey was used as a sweetening agent in shrikhand instead of sugar. Protein, moisture, fat, lactic acid and the organoleptic characters were checked for quality assessment. The herbal shrikhand was found to have good nutritional value and the overall acceptability was also found good.

Pande and Jude (2019) compared the various brands of honey for the physicochemical parameters. Three brands were analyzed for their quality assessment. Ash value, chemical tests, viscosity, loss on drying, and macroscopic evaluation were the parameters examined by the researchers. All the brands assessed were found complies with the standard value of Indian Pharmacopeia (1996) for macroscopic

parameters. Two brands were found to fail in the physical assessment. As per the chemical evaluation concerns, all brands reach the standards prescribed.

2.4 KUTKI

Gomez and Gupta (2003) wrote the information about little millet (*Panicum sumatrense*) or *kutki*. *Kutki* is a cereal cultivated widely in India, Nepal, and Western Myanmar. It is an important part of tribal agriculture. It is a self-pollinated crop. The grains after removal of husk were cooked and consumed as rice. It can withstand adverse conditions of climate and give good yield.

Sivakumar et al. (2006) studied the cloning and cloning of the Indian little millet. The prolamine storage proteins that accumulate in the endosperm, called zeins, were studied by cloning of genes codes. For this purpose, RT-PCR was performed. Indian little millet (*Panicum sumatrense*) i.e. *kutki* was studied.

Jaybhave et al. (2014) studied the processing technology of some food products made from millet. In this review article, the nutritional importance of millets and their products is discussed. The millet-based ready-to-eat food products and the development status is discussed. Overview of milling of millets, production technology of puffed/flaked millets was taken. It was reported that the millets have the potential to use wider and to produce value-added products that may become popular in the market.

Kesic et al. (2014) investigated the effect of floral origin and aging of honey on its HMF content. Sixty honey samples from Bosnia and Herzegovina were evaluated for the study. HMF in the honey was estimated using the spectrophotometric method. The amount of glucose and fructose in the samples was also analyzed. It was concluded that the formation of HMF in the honey samples was correlated with all three factors such as the age of honey, fructose to glucose ratio, and the botanical origin. The highest value of HMF was recorded up to 52.44% more than the fresh one in 4-year-old honey.

Padulosi et al. (2015) studies minor millets such as foxtail millet, little millet, barnyard millet, and finger millet. It was reported that minor millets were ignored in cultivation but can play a key job in the improvement of many dimensions in livelihoods of the rural people. The income, nutritional status and the empowerment of the rural people especially women can be improved by the cultivation of these millets. It is stated that the minor millets can withstand marginal growing circumstances where the other popular cereals such as wheat, rice, and corn are comparatively unsuccessful. These minor millets were also found more nutritious compared to other popular cereals.

Sarita and Singh (2016) studied the nutritional composition and health importance of millets to find out the nutritional potential of millets. It was stated that millets are proved to have excellent performance in terms of yield during drought or water scarcity also. It was reported that the millets have remarkable edible and nutritive values. They are easy to processing and for the preparation of various food products. Millets are gluten-free grains. The oils extracted from millet are found to be good sources of linoleic acid and tocopherols. They are rich sources of phytochemicals and some micronutrients which are proved to be important for enhancing the body's immune system. They are reported to have antioxidant properties hence useful in the prevention of certain diseases. Millets are alkaline-forming food which is recommended for good health.

Vetriventhan and Upadhyaya (2016) have stated that little millet (*panicum sumatrense*) is India's native cereal crop. It can be cultivated in the varied conditions of soil and the environment. This is the short duration crop having the capacity to produce good yield with limited water supply. The study was carried out to study the grain and biomass yield potential. There were large variations observed in the days to flowering, height of plant, dry matter yield, and grain yield concerning the variance in the types. Due to high biomass yield and short duration of little millet, it can be proved as the crop of high potential of providing food and fodder as well as bioenergy.

Rao et al. (2017) wrote the nutritional and health benefits of millets in their book. It was mentioned that the millets are needed to promote as they offer nutritional security due to high and diverse nutritive value. The usage of millets as direct food has declined considerably in India. *Kutki* is very rich in many micro and micronutrients. The dietary fibers which were once termed as the anti-nutrients and now are known as nutraceuticals are found abundant in *kutki*. The dietary fibers are helpful in the prevention of constipation, during digestion it lowers the release of glucose to the bloodstream as well as helpful in lowering of blood cholesterol. The regular millet consumers were reported at a lower risk of cardiovascular diseases, duodenal ulcer, and hyperglycemia (diabetes).

Carlos et al. (2018) assessed the Mexican honey microbiologically. They collected a total of 1920 samples from eight honey-growing states of Mexico and examined. Among these samples, 40.5 % of samples were not found to comply with the NMX-036-NORMEX-2006 specifications and 45% did not act in accordance with the mesophilic aerobic microorganism specification. The samples contained 3 NMP/g of coliform bacteria. It was suggested that contamination should be avoided. It was stated that for the therapeutic use of these honey the samples were necessary to comply with the specifications and the pathogens must be removed.

Wikipedia (2019), *kutki* is known as little millet in English. It is a species of millet and family Poaceae. The botanical name is *Panicum sumatrense*. The other names of *kutki* in Indian languages are, in Hindi Moraiyo & Shavan and Marathi it is known as Sava, Halvi, and Vari. The nutritive value of *kutki* per 100 g is reported as follows; Energy-341 kcal, Carbohydrates-67 g, Dietary fiber-7.6 g, Fat-4.7 g, Protein-7.7 g, Calcium 17 mg, Iron-9.3 mg, and Phosphorus-220 mg. It is rich in iron and calcium as compared to other cereals. It is also reported that the little millets were found to be cultivated in the Indus Valley Civilization. *Kutki* can withstand both drought and waterlogging.

2.5 LADOO

Kumari and Singh (2005) developed the nutritional *ladoo*, especially for pregnant women. The nutritional composition and acceptability were tested. Maize

containing quality protein was used in combination with gingelly seeds, amaranths, green gram, ragi, and jaggery for this preparation. The maize with quality protein was procured from Rajendra Agricultural University. Ash, fiber, fat, carbohydrates, and crude proteins were the proximate parameters checked. Iron and calcium content was also determined. The *laddoos* were checked for acceptability using the nine-point hedonic scale method of sensory evaluation. It was reported that the *laddoos* were accepted by pregnant women with an average score of 6.

Katara and Rana (2013) prepared the traditional Indian sweet laddoo by using cane sugar and honey. The products were tested organoleptically. The glycemic response and glycemic index were measured in the individuals. For the results of the study, the researchers have suggested the use of honey instead of sugar in sweet dishes. It was mentioned that honey has found a lower glycemic index and response as compared to sugar. The presence of plenty of nutrients and bioactive compounds makes honey the best alternative to sugar.

Naidu et al. (2013) prepared multigrain *laddoo* which were galactagogue as well as protein-rich. In addition to the multigrain flours, dink (edible gum) was used in the preparation of these *laddoos*, as dink is a galactagogue material that helps to increase breast milk production in lactating women. The flours of various cereals and pulses, nuts, ghee, and of course dink were used to prepare the nutritious *laddoo*. The sensory attributes like texture, taste, color, aroma, and overall acceptability were measured. Packing, nutritional labeling, marketing, and budget are the other parameters that were studied.

Sanap and Jadhav (2014) prepared poha (flattened rice) *laddoo*. The *laddoo* were provided as supplementary food to the anemic tribal adolescent girls of the Gond-Madia community of the Gadchiroli district of Maharashtra. One 100 g poha *laddoo* was given to the girls daily for three months. The Hb level was measured before and after the period. The Hb level was found to be highest in the girls provided with the *laddoo* as compared to the control group girls (with normal diet) and the group of girls kept on the recommended iron-rich diet. Thus the poha supplemented diet was found most effective to increase the iron level.

Pandey and Sangwan (2016) studied the quality of wheat flour *laddoos* blended with sorghum and soybean. The *laddoos* made from various combinations of wheat, soybean, and sorghum flours were got higher scores in sensory evaluation when compared to control *laddoos* which were made from wheat flour only. The acceptability of all *laddoos* was within the range of 90 days. Up to 45 days the microbial count of *laddoos* was under the permissible limit. It was concluded that the *laddoo* made from coarse cereals like sorghum and locally available soybean were of low cost and highly nutritious.

Savla et al. (2017) prepared the nutritious *laddoo* using dried dates, dry coconut, jaggery, garden cress seeds, dink (edible gum), and ghee. The consumer acceptance and the shelf life were evaluated for these *laddoos*. The sensory attributes determined were texture, sweetness, taste, and the overall acceptability of the products. The aspects of marketing, packaging, making a nutritional label, and budgeting was also taken into consideration in this study. The *laddoos* were recommended for all individuals including the lactating women and diabetic persons.

Sharma and Goyal (2017) evaluated the organoleptic properties of multigrain flour *laddoos* blended with flax seeds at different combinations. The need for the development of new nutritious food recipes was taken into consideration. It was said that the *laddoos* made with a blending of flaxseed might be beneficial for lowering the fat level which might be beneficial for better health of the heart. The *laddoo* samples with different combinations of multigrain flour and flax seeds were subjected for sensory evaluation to determine the score based on flavor, stickiness, texture, color, and overall acceptability.

Singh and Mehra (2017) prepared *laddoo* by taking different combinations of pearl millet flour and *besan* (Bengal gram flour). The acceptance was determined by sensory evaluation on a nine-point hedonic scale. The use of pearl millet flour more than 50 % amount in *laddoo* was least accepted by the panel. The darkness in color and slightly bitter taste were the main reasons behind the less acceptability of these *laddoos*. The *laddoo* prepared by taking the combination of pearl millet flour and Bengal gram flour at the ration of 25:75 was equally acceptable with the control formula

(without the pearl millet flour). As the pearl millets have a good nutritional value, especially the iron content is good, it was suggested that the use of pearl millet flour in *besan ladoo* might be beneficial as a nutritional point of view.

Bukya et al. (2018) standardized the recipe of dry dates, coconut, and jaggery *ladoo* and studied its storage capacity. The study was carried out as a remedy for the problem of lacking calcium and iron in the people especially children. The ingredients coconut, jaggery, and dates were rich sources of iron, calcium, and fiber. Different proportions of the ingredients were tried with the addition of other nuts to finalize the recipe. The results of sensory evaluation suggested that the *ladoos* with a combination of 32:30:28:10 of coconut, jaggery, dates, and other nuts were most acceptable.

Indu and Awasthi (2018) studied the quality of *ladoo* developed from cereals and legumes with the incorporation of a medicinal herb *ashwagandha* (*Withania somnifera*). The *ladoos* were prepared by taking a different proportion of cereals and legumes with the addition of *ashwagandha* root powder at various levels. The sensory acceptability of the *ladoos* was determined and compared with the control *ladoo* i.e. without *ashwagandha* powder. It was reported that the value addition could be achieved by incorporating up to 5% *ashwagandha* root powder to increase the nutritional content.

Sharma et al. (2018) prepared the *ladoo* from protein-rich soybean and *poha* (flattened rice) to overcome the problem of malnutrition in the pre-school students in the rural area of Ratlam district of MP. The soy-*poha ladoos* were given as supplementary food to the forty malnourished children from five Anganwadi. The carbohydrate, protein, fat, and energy content of these products was evaluated. The study was conducted for three years. It was reported that the highest height, weight, and BMI were recorded in the children supplemented with soy-*poha ladoo*. The study gave a positive indication of supplementation of the *ladoo* made from locally available food sources.

Sharma et al. (2019) evaluated the nutritional quality of *ladoo* from rice bean flour blended with Bengal gram flour at different combinations. The development

process, shelf life, and nutritional quality were assessed. Moisture content, ash, carbohydrates, protein, fat, fiber, and mineral contents were estimated. The sensory evaluation was carried out on the nine-point hedonic scale. The products were acceptable significantly.

Shekhar et al. (2019) prepared the calpro *laddos* and studied the shelf life and acceptability. The term calpro used as a representative of calcium providers. The main ingredient used to make this *ladoo* is Ragi, which is rich in calcium. It was reported that in addition to calcium the calpro *ladoo* was good sources of protein, fat, phosphorus, iron, and fiber. The organoleptic properties were studied on a five-point scale by evaluating the color, odor, taste, and texture. Shelf life, budget, marketing, and packaging were some other parameters that were studied.

2.6 KHEER

Shivakumar et al. (2014) finished an effort to prepare *kheer* by incorporating the foxtail millet flour and finger millet flour at various amounts in the paneer *kheer*. The paneer *kheer* thus prepared with different amounts of foxtail millet flour was subjected to the sensory evaluation. Foxtail millet (*Setaria italica*) flour was blended at 2, 3, and 4% levels. While finger millet (*Eleusine coracana*) flour was blended at 0.5, 1.0 and 1.5% level to the paneer *kheer* mix. *Kheer* blended with 2% foxtail millet flour and 1% finger millet flour was accepted mostly with better sensory scores. The paneer *kheer* incorporated with millet flour at optimized levels was reported to show better textural properties and consistency. The nutty flavor obtained was well accepted. The crude fiber content was found significantly higher in both the samples.

Battalwar and Shah (2015) incorporated the chia seeds in various products such as *kheer*, fruit punch, and smoothie. The sensory evaluation of these products was carried out to determine their quality. It was mentioned that the chia seeds are rich in many essential nutrients such as dietary fiber, omega-3 fatty acids, bone nutrients, proteins, and antioxidants. It was concluded that the incorporation of chia seeds in all the products was tolerated within the limit and for *kheer*, it was 4 grams.

Dadge et al. (2015) evaluated the physicochemical properties of *kheer* prepared by adding the sweet potato paste at different levels. It was mentioned that *kheer* is the sweet dish of India made from rice and milk also known as 'Payas'. The rice was partially replaced by sweet potato paste at different levels. The parameters such as viscosity, pH, moisture, ash, total solids, and protein were the parameters estimated to evaluate the quality of products. The results indicated that there are small changes in the values of the parameters under consideration when compared with the control *kheer* sample. The *kheer* prepared using rice i.e. control was found significantly superior to the sweet potato *kheer* samples.

Pariskar et al. (2015) studied the chemical composition of *kheer* prepared by using a mixture of buffalo and soymilk. The *kheer* was prepared from buffalo milk by adding various compositions of soymilk keeping a constant amount of sugar. It was observed that with an increase in the amount of soymilk in the blend, the content of protein, moisture, and titrable acidity was found to be increased. The cost was also reduced as the amount of soymilk increased. It was reported that the *kheer* prepared by taking buffalo and soy milk in the ratio 80:20 with 2.5 % rice and 8 % sugar was found more suitable due to its low cost, high protein content and less amount of fat.

Salunkhe et al. (2015) prepared the *kheer* fortified with carrot shreds. The milk and carrot shreds were taken with four combinations i.e. 90:10, 85:15, 80:20, and 75:25 for the preparation of *kheer*. Fat, protein, and moisture content was observed to be decreased with the increasing amount of carrot shreds. The total solid and ash content was increased. The products were subjected to sensory evaluation. The *kheer* prepared with 85% milk and 15% carrot shreds was highly accepted with maximum sensory score. The cost was increased with the amount of carrot shreds.

Shrimali et al. (2015) optimized the process for the preparation of *kheer mohan*, a traditional dish of Rajasthan, by using the response surface methodology. It was reported that the traditional method for the preparation of *kheer mohan* is highly time-consuming with the utilization of a lot of energy as well as labor. The innovative method of response surface was employed for the large scale production of *kheer*

mohan. The sensorial attributes were studied by changing the values of variables such as cooking time, weight of *chhana*, semolina, and sugar syrup concentration.

Kavimani (2016) investigated the textural and sensory characteristics of the traditional Indian sweet *Kheer* at the different levels of total solid content. The *kheer* prepared from milk and Basmati rice was subjected for the examination. The samples of *kheer* at varying levels of total solid contents were compared. The results were analyzed statistically by ANOVA technique. The score of the sensory evaluation was found to be highest for the *kheer* prepared at total solid content 28.1%.

Shrimali et al. (2016) studied the *kheer mohan*, a traditional sweet of Rajasthan, for the changes during storage. It was reported that the *kheer mohan* is a very popular sweet of eastern Rajasthan and has very short (six days) shelf life when stored at room temperature. In this study, the researchers studied various packaging methods for increasing the shelf life of the product. The product was studied for the suitability of packaging methods such as normal, vacuum, and nitrogen packaging, etc. The product was evaluated for its quality during storage by determining the sensory properties with free fatty acid content, pH, and microbial counts. It was concluded that nitrogen packaging is most suitable for the *kheer mohan*.

Barela and Shelke (2017) studied *Kheer* preparation from cow milk blended with coconut milk. The utilization of coconut milk with cow milk was promoted in this study for nutritional enhancement. The blendings of kinds of milk were taken at different combinations. The samples thus prepared were subjected for the analysis of fat, protein, ash, and sensory attributes. Statistical technique Randomized Block Design (RBD) was applied for the analysis of data. The cost was found to be increased with an increase in the coconut milk percentage. The *kheer* prepared by blending 20 % coconut milk and 80 % cow milk was accepted mostly.

Deshmukh et al. (2017) studied the process of preparation of *kheer* prepared by using standardized milk (4 % fat) with rice and poppy seeds. The different combinations of rice and poppy seeds were taken. Other ingredients like milk and sugar were added at a constant amount. Physico-chemical characteristics such as total

solids, protein, fat, moisture, and ash contents were estimated. The preparations were also subjected to sensory evaluation. The unit cost was also calculated. It was reported that with the increase in the level of poppy seeds in the *kheer* the cost was increased with an increase in the amount of protein, fat, total solids, and ash. Though the *kheer* with poppy seeds high in cost it was found to be more nutritious.

Shaikh et al. (2017) prepared the *kheer* with pumpkin and the characteristics were studied. The pumpkin powder was used as an additional agent at various amounts and the *kheer* was reconstituted from the dry *kheer* mix. Other ingredients such as rice, hydrogenated fat, sugar, cardamom, and nuts were used for the preparation of *kheer*. Fat, protein, reducing sugar and total sugar, acidity, ash, and moisture in the products were examined. It was concluded that the increase in the level of pumpkin powder resulted with decrease in protein and moisture. Other parameters were not changed significantly. Viscosity, some nutritional attributes, and overall acceptability were found to be good for the *kheer* with pumpkin powder.

Singh et al. (2018) optimized the process for the preparation of chhana *kheer*. They used an artificial sweetener aspartame for sweetening purposes. Chhana is a solid product of milk prepared by coagulating the milk by acid and removing the liquid part known as whey. They used artificial sweetener so that the *kheer* could also be used by diabetic persons. The *kheer* prepared by the lowest amount of aspartame was accepted mostly. The cost was found reduced with an increased amount of aspartame.

2.7 OTHERS

Birdi et al. (2014) discussed the possible reasons behind the problem of malnutrition in the tribal region *Melghat* of Maharashtra. *Melghat* is an area situated in the Amravati district. It was mentioned that many best practices are there in the *Melghat* to prevent malnutrition including public distribution system, Anganwadi services, food provisioning, kitchen garden, propagation of hygiene and sanitation among the tribal people. The major cause of malnutrition was reported that the faulty practices of childcare. Less consumption of green leafy vegetables might lead to the

deficiency of micronutrients. The need for nutrition education was also mentioned.

Gupta (2013) analyzed the some dye yielding medicinal plants for the determination of pharmacological and phytochemicals values both qualitatively and quantitatively. The chloroform and pet ether extracts were prepared for the experimentation. The standard methods were used for the analysis.

Kaur et al. (2013) prepared various extracts of some honey bee products. The preliminary studies were carried out on these extracts. The extracts of bee propolis, pollen, and honey were made and studied. The constituents were analyzed. The greater numbers of components were detected in propolis and pollen as compared to honey. The motive of the study was also to find out the best useful solvent for preparing the extracts. Water was found to be most effectual solvent for the withdrawal of maximum constituents of honey.

Ping et al. (2019) studied the effect of honey and black seed extracts on the breast cancer. The methanolic and aqueous extracts were prepared for the investigation. 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging assay was used for determining the antioxidant properties. MCF-7 breast cancer cell line was used to evaluate the anticancer properties. It was reported that the bioactive compounds present in honey were assumed to be contributing the high cytotoxic activity of honey. It was suggested that the use of honey and black seed mixture should be considered as the health supplement for the anticancer and antioxidant benefits.

Wagay et al. (2019) studied the plant species of *the Melghat* region, which are extensively used as medicine by the people of the native *Korku* tribe. These plants are used as food as well as medicine. The ethnobotanical knowledge of the tribe was helpful for this study. The family of these plants, with their botanical name, Voucher specimen, flowering period, date of collection, GPS location and other details were discussed and recorded during this study. The data was collected through questionnaires, observations during actual field visits, and interviews. The data were found very useful and the need for more study was suggested by the researchers.

CHAPTER 3 MATERIALS AND METHODS

3.1 RESEARCH METHODOLOGY

The theoretical over and above the systematic analysis that was applied to all the methods involved in the current study in a particular field is termed as research methodology. The structural research was carried out during the present study. It was the action type of research that included the experimental work as well as comparisons. It might also be termed as a quantitative type of research. The various research methodologies are there to approach a particular goal. The following methods were applied for this research.

3.1.1 RESEARCH APPROACH AND DESIGN

Evaluative approach was adopted for the present study. The design chosen for this study was based on the experimental work, collection of literature data and their comparative study. The data were generated in the laboratory through the qualitative and quantitative experiments and those were then compared with the published data.

3.1.2 PROCEDURE OF EXECUTION:

The study was gone through various steps throughout its journey. Following are the steps that involved in the current research work. The steps were arranged systematically in such a way to reach to the goal within the stipulated frame of time and with the desired results.

3.1.2.1 STEP I: COLLECTION OF RAW MATERIALS

The raw materials that needed for the analysis as well as for the development of the products with process optimization were collected first. For the present study honey, milk, and *kutki* or little millet (*Panicum sumatrense*) were the prime raw materials incorporated. Forest honeys were collected from the diverse locations of the *Melghat* forest region and stored with the due precautions taken regarding the storage place and facilities. The *kutki* grains (little millet) were procured from the local weekly market of *Chikhaldara*. It was also stored with proper care regarding its storage conditions. Milk was procured freshly from the nearby villages at the time of its use.

3.1.2.2 STEP II:- ANALYSIS OF THE RAW MATERIALS

The honey samples and *kutki* thus procured were analyzed for the evaluation of their properties. For honey their physicochemical, nutritional, phytochemical, in addition antibacterial properties against some selected bacterial species were detected. In case of *kutki* the physical, functional, and nutritional parameters of it were detected. The phytochemical profile of the honey was also found out qualitatively by using the simple screening tests. All the experiments were carried out at the laboratory of food science of Arts, Science and Commerce College, *Chikhaldara*. The chemicals, glass wares, as well as the equipments that were used are of standard quality. The chemicals were analytical grade.

3.1.2.3 STEP III :- DEVELOPMENT OF VALUE-ADDED PRODUCTS

Further, an attempt was made for the formulation of some value-added products by incorporating the honey and *kutki* in the standardized recipes. Here two Indian traditional and most popular sweet recipes i.e. *ladoo* and *kheer* were selected for this study. *Kutki ladoo* were made from *kutki* flour and sugar with honey and the recipe was standardized. *Ladoo* is an Indian traditional sweet dish used extensively in almost all types of traditional or religious programs. The *ladoo* are made in India using the varied number of raw materials. In one of the category, the *ladoo* are made by using wheat flour or *besan* (chickpea/ horse gram flour) with sugar and *ghee*. The *kutki* flour was used as an innovation instead of wheat flour or *besan* for the making of *ladoo*. Instead of using only sugar that is used in the traditional recipe, honey was used as a sweetening agent in addition to sugar for the development of the product.

Another product selected for the current study was *kheer*. It is also an ancient traditional dessert prepared and used in almost all the parts as well as communities in India. It is basically a milk-based sweet dish. In addition to milk, the other ingredients used for making the *kheer* are sugar and a kind of cereal in the various forms such as flour, broken grains, or whole grains. In general rice, semolina, and vermicelli, etc. are used for the preparation of *kheer*. Other food substances such as coconut, carrot, etc are also used in *kheer* making. Here for this study the kind of millet, *kutki*, also known as little millet was used for the preparation of *kheer*. In the *kheer* preparation, with sugar, which is a traditional sweetener incorporated, honey was also used for sweetening purpose. All the products were prepared and the recipes were standardized

at the laboratory of Food Science, ASC College, Chikhaldara. The recipes were standardized by including the *kutki* and honey at different amounts.

3.1.2.4 STEP IV :-SENSORY EVALUATION

The sensory evaluation of the newly developed products was done by applying the nine-point hedonic scale method. For this purpose, the five sensory attributes such as Color, Texture, Taste, Appearance, and Overall acceptability were selected and the evaluation was done by the panel of selected and semitrained judges.

3.2 ANALYSIS OF HONEY

Honey is readily and abundantly available in the *Melghat* forest region. It is one of the prime jungle produce collected by the tribal people of this area. As the *Melghat* forest is having rich biodiversity in its flora, the wide honey collected by the tribal people from the forest must possess plenty of medicinal and nutritional properties. The honey from the *Melghat* may be proved as one of the premier quality honey, and it may get the global recognition.

Keeping these facts in mind honey was selected as a principal material of investigation in the current research. All the honey samples under research were obtained only from the *Melghat* region. It was assumed that the honey collected was produced by one the wild species of honey bees i.e. *Apis dorsata* and *Apis cerana indica*. There was very little research found to be done on the analysis as well as the assessment of the properties of the *Melghat* honeys. Perhaps it could be assumed that the *Melghat* honey was still untouched as concerned with the research point of view. The attempt was made in this research to explore the qualitative properties of the *Melghat* honey in addition to develop some products by using the honey so that there might be a success in developing the brand *Melghat* in the honey sector.

3.2.1 INTRODUCTION

Honey is a crucial and especially a natural substance obtained from the hives of the honey bee. It is one of the highly nutritious produce generated by honey bees from the nectar of the flowers. The nectar is collected and transformed by the honey bees in to the golden liquid i.e. honey. Looking back on human history it is found that honey might be considered as a prime substance used as a sweetener by the ancient man.

Though honey has been recognized and used by the people for years and years the researchers diverted towards the study of honey and its properties very recently. The overall increase in the consumption of honey throughout the world may be the reason behind the interest of researchers to study honey. People are now fascinating more and more towards the consumption of natural foods like honey due to their numerous nutritional and health-enhancing properties.

We may define this golden liquid i.e. honey as a natural product, which may be termed as the supersaturated solution of sugars. The nectar gathered from the flora and various secretions of bees are brought together to initialize the process of manufacturing of honey. Honey sac, an essential and modified organ of honey bees, is used for carrying the raw material from flowers to the hives. The liquid raw material is used repeatedly by the bees when transferred to each other using the mouths.

During the transfer of liquid, the secretions are mixed which carry out the necessary changes in the process of conversion of the liquid to honey. There is a decrease in the water content of the liquid found. The mixture thus obtained is good in the protein and it is stored in the honey cells of honeycomb and left for the ripening. Moisture plays an important role in the process of making honey. Moisture content strongly affects the quality of honey, since it is important in deciding the storage capacity as well as plenty of properties of honey.

The water content is maintained by the honey bees during the ripening period by using their wings for fanning the honeycomb, in order to fasten the process of evaporation of excess water. It is necessary to complete the process of maturation to get the real honey. The well-matured honey possesses all the properties which the honey is famous for. The abundant functional properties of honey useful in the food preparation over and above its curative and health-related uses gave it recognition as a food.

3.2.2 PROCUREMENT OF HONEY SAMPLES

The honey samples that might be produced by the wild variety of honey bees were collected from the dissimilar locations of the *Melghat* region. From each location four samples were collected. The honey samples were collected by the tribal people. With a smaller extent of processing, they sell the honey in the local market. Filtration is the only processing attempt made by them on the honey before selling.

Any impurities such as traces of pollen grains, body parts of honey bees, small or large particles of wax, and any such foreign materials are removed in this process.

Since there is hardly any beekeeper in the *Melghat* who keeps the honey bees for commercial beekeeping, all the samples collected were assumed to be produced by the wild honeybee's species *Apis dorsata* and *Apis cerana indica*. The honey samples were designated with the code names H₁, H₂, H₃, and H₄ as per the locations.

3.2.3 PHYSICOCHEMICAL ANALYSIS OF HONEY

Honey is graded commercially according to its quality. The market rate and usefulness of honey strongly depend upon the physical as well as chemical characteristics of honey since the quality of honey affected robustly by these characteristics.

Honey widely varies in its color as well as properties. The varied colors of honey are also the result of variation in its composition. The floral, as well as locational variations in the source of honey have a clear influence on the color and the taste of honey.

Recognizing the importance of physical as well as chemical properties of honey and their values, all the worldwide agencies dealing with the food and food products, set some quality standards for the honey. The importance of physicochemical parameters of honey can be revealed from the fact that without following some optimum values (range of values) of standards one cannot sell his honey commercially in the market. Thus the composition of honey is very important for its trade value.

Thus while studying the *Melghat* honey, the evaluation of its physicochemical properties was the main objective set for this study. Most of the important characteristics, as prescribed by the standards deciding agencies were included for the determination and study of the *Melghat* honey. The physicochemical parameters of the honey samples were examined by using the standard procedures prescribed for the analysis of Indian standards for extracted honey. Slight modifications were made in the procedures. Bureau of Indian Standards (BIS, 1994-2000) published the standard specifications for the extracted honey in the Indian context.

The draft of these standards was decided by the AISC (Apiary Industry Sectional Committee). Then it was permitted by the Divisional Council regarding Food and Agriculture. This approved draft was then adopted by the BIS (Bureau of

Indian Standards). It was published in the name "Indian standard for extracted honey specifications".

The referred standard was a second revision, which was published in 1974. The very first edition was published in the year 1968. A new modified definition of honey was incorporated in the second revision as well as the process for the determination of HMF was changed.

In addition to this, existing common honey trading practices were taken into consideration before finalizing the draft. The standards given in the Agricultural Produce Act, published in 1937, were as well studied for deciding and describing the grades of honey.

The rules given in the Prevention of Food Adulteration (PFA) Act, published in 1954, were also taken into consideration for the framing of the existing set of standards. According to these standards honey was classified under three grades as

- **STANDARD GRADE**
- **A GRADE**
- **SPECIAL GRADE**

Apart from the physicochemical parameters, some other requirements were also specified for the honey in the publication. As per the given specifications, some bullet points are as follows.

- The honey should be natural and well-ripened.
- The appearance must be clear and it must be extracted using the extractor.
- The objectionable flavor/ taste should not be there in the honey which may be generated due to the smoke, overheating, or other chemical reactions like fermentation.
- It should be strained clear at a temperature below 70°C, when passed through the 150 microns cheesecloth taken in a double layer.
- In addition to this, if the honey is inspected visually, it should appear clear that means it should be without the foreign materials, for instance, scum, mould, dirt, fragments of bees, large particles of bee wax, insects or any of other foreign matters.
- It was recommended in the specifications that the color of honey may vary from light amber to dark brown, but it should be uniform throughout.
- The presence of any type of additives such as color, minerals, vitamins, or sweetening agents is not permitted in the regulation.

The standard procedures are prescribed for the determination of various parameters in the publications. The procedures used for the physicochemical analysis of honey samples are given below.

3.2.3.1 COLOR OBSERVATIONS OF HONEY

Liquid honey varies in color starting almost from colorless just like water to dark amber resembles to black. The color of honey depends upon a variety of factors such as, its botanical source, ecological and other conditions under which the honey is accumulated, age of honey etc. The color of honey is strongly responsible in order to settle on its market value. Usually the honeys with lighter color are used for the direct consumption in household use while the dark color honeys are used for the industrial purpose.

TABLE 3.1: SCALE FOR COLOR ANALYSIS (Krell, 1996)

S.N.	COLOR STANDARDS (USDA)	Pfund SCALE (IN MM)
1	White (as water)	0 to 8
2	Extra white	From 9 to 17
3	White	From 18 to 34
4	light amber (extra)	From 35 to 50
5	Light amber	From 51 to 85
6	Amber	From 86 to 114
7	Dark amber	Above 115

The color of honey is given generally in the Pfund scale measured in millimeters as given in the table. Here the colors of the honey samples were observed visually by referring the chart (Krell, 1996). The colors were identified and the data was recorded.

HONEY SAMPLE PREPARATION:

All the honey samples taken for the study were prepared for analysis as per the procedure given in the FSSAI manual (fssai, 2015).

The honey samples were mixed thoroughly with stirring using a magnetic stirrer. The samples were kept in the water bath on temperature 50°C with constant stirring keeping the aim in mind of dissolving the crystals present if any. The honey

samples then strained by using cheesecloth. The samples were then stored in the airtight plastic containers and stored in a cool and dry place. The samples were labeled properly with the purpose of avoiding any mess and proper examination.

Each time when the samples have to use proper precautions were taken in order to avoid any contamination.

3.2.3.2 MEASUREMENT OF SPECIFIC GRAVITY (BIS, 1994-2000)

Specific gravity may also be called as relative density. It is defined as the ratio of the densities of two different compounds. Among these substances, one compound is essentially a sample substance while another is the reference substance. In general, the density of the substance is always compared with the density of water. Thus on the whole for the calculation of specific gravity, the reference material brings into play is water.

Since specific gravity is a ratio of two same physical quantities i.e. densities, it is simply a number and thus it is a unitless quantity. The value of specific gravity less than one indicates that the substance is less dense than water.

On the other hand, the value of specific gravity greater than one is an indication that the substance is denser than the reference substance (water). Temperature and pressure greatly affect the value of specific gravity. Thus it is suggested that the values of temperature and pressure should also be specified while giving the value of specific gravity.

The specific gravity of honey has a characteristic value. The specific gravity is related with the water content of honey. The specific gravity also serves as an indication of detecting the maturity of honey. It tells whether the honey is ripe or not.

PROCEDURE

A specific gravity bottle was used for the determination. In the beginning the bottle was rinsed and dried thoroughly. The weight of an empty bottle was recorded (X). Then the density bottle was filled up with the boiled and cooled distilled water up to the mark. The temperature of the water was already maintained at 27°C. The weight of the bottle with water was noted down. It is termed as Z.

Then the bottle was emptied and dried once again. One of the honey samples (H_1) which was already maintained at the same temperature as of water was taken in the same bottle. The sample was filled up to the mark. The weight of the bottle with the honey sample was taken and recorded (Y).

Specific gravity of the honey sample (H₁) at 27°C temperature was calculated by using the given formula.

FORMULA FOR CALCULATIONS:

$$\text{SPECIFIC GRAVITY} = \frac{(Y-X)}{(Z-X)}$$

Where

X = mass of empty specific gravity bottle (in gram)

Y = mass of bottle with honey sample (in gram)

Z = mass of bottle with distilled water (in gram)

Using the same procedure the specific gravities of the remaining three honey samples (H₂, H₃, and H₄) were calculated.

3.2.3.3 DETERMINATION OF ASH CONTENT (BIS, 1994-2000)

Ash content of any material in particular of the food material is a representation of the inorganic substances present in that food item. It is the residue that leftovers after the entire demolition of the organic materials. It should not be considered as an equivalent to the mineral content as there may be some changes due to the interaction of constituents in between.

The high value of ash content than the expected figure may be sometimes considered as a result of the consequences of adulteration. The presence of adulterants may also be affecting the ash value of the honey. The loss found in the ash determination due to volatilization during the process of ignition can be overcome by watering the substances before calcinations.

The ash in any of the substances divided in to the following types

- a. **Water Soluble and Insoluble Ash:** Ash mostly contents metals, metal oxides, and other inorganic materials. Most of the part of ash is insoluble in water. The only part of ash which is soluble in water is generally potash i.e. potassium carbonates.
- b. **Acid Insoluble Ash:** The acid-insoluble matter of ash is mostly composed of sand as well as other siliceous matter.

PROCEDURE

Five grams of each honey samples were weighed accurately and taken in separate silica crucibles. The silica crucibles were cleaned and dried carefully before

use. Few drops of oil were added for the prevention of spattering. The crucibles were then heated over a low flame in order to cease the swelling of honey.

Thus the honey samples prepared were ignited by putting them in a muffle furnace at the temperature around 600°C for the preparation of ash. The samples were kept in a furnace until they converted completely into white ash. The crucibles were kept in desiccators for cooling. Proper desiccants were added to the desiccators.

After proper cooling, the weights of crucibles were measured on an electronic balance and recorded for the calculations. The samples were incinerated again, cooled and weighed until there was no change in the weights and constant readings were obtained. The percentage of ash in a given sample was calculated using the following formula.

FORMULA FOR CALCULATIONS

$$\text{ASH CONTENT (Mass \%)} = \frac{100 (M3 - M1)}{(M2 - M1)}$$

Where

M1 = Mass of empty crucible

M2 = Mass of crucible with the honey sample

M3 = Final reading of mass of crucible with ash

All the observations of weights were in gram.

The ash content of other honey samples was calculated by using the same procedure and formula.

3.2.3.4 DETERMINATION OF MOISTURE (BIS, 1994-2000)

Water may content in almost every type of food. Water is an essential part of the food. It may be present previously or may be added during processing. Water may be added or removed or kept constant as per the requirement of that product. Water in a food item gives it tenderness, juiciness, as well as texture. The keeping quality of any food material depends on its moisture content.

The water in food may occur in the following form.

a. Free Water

The water present as a solvent or a dispersing medium for the crystalloids or colloids of the food.

b. Cellular Water

It is the adsorbed water on the particles of the cell walls, protoplasm, and on the constituents of the cell such as cellulose, starches, and proteins.

c. Bound Water

It is the water present in the food in the form of chemical combinations. The bonds are formed for the hydration of some substances such as salts or carbohydrates. The bounded water may be of the following type

- Occlude Water
- Osmotic Water
- Capillary Water
- Chemically Bound Water
- Colloidal Water

Measurement of moisture content is very important in the analysis of the food material. The moisture content of the food is directly related with its quality because many quality parameters are strongly affected by its water percentage. The following characteristics are depending on the moisture content of the food.

- Storability
- Antimicrobial potential or the stability of food against microbial activity
- Viscosity
- Content of dry substances
- Grade of the food
- Nutritional value
- Standards prescribed by the statutory bodies

Thus the overall quality of the food is depending on its moisture content. In the quality assessment of honey, water percentage is one of the major criteria. All the standard agencies prescribed some particular value of moisture for the honey. It is a very crucial property of honey. The high moisture content of honey may result in to the fermentation as well as deterioration of honey. The honey above 22% moisture is not good in quality.

PROCEDURE

Moisture in the honeys was estimated by using the oven drying method. The prepared sand which was passed through the sifter of 500 microns, as described in the standard procedure was taken for the experiments. It was digested with concentrated

HCl (Hydrochloric acid). The sand was then washed with water to remove the chloride residues. After drying properly, the sand was then ignited.

Twenty grams of the prepared sand was taken in the Petri dishes. The heat was applied by keeping the dishes in an oven at an appropriate temperature for a period of one hour. After heating the dishes were removed from the oven and the sand in the dishes was cooled by keeping them in the desiccators.

Two grams of honey sample was taken in one of the sands containing dish. In this way, all the honey samples were taken in a sand containing separate dish. The dishes were tarred before adding the samples. Five milliliters of distilled water was added to each dish.

The sand, water, and honey sample of every dish were mixed with the glass rod. The mixtures were spread evenly. The dishes were firstly heated on a boiling water bath for half an hour in order to remove the excess moisture if any present. After heating, the dishes were put in to the oven which was kept on the temperature around 70-80°C.

The samples were dried for 2 hours in the oven and then removed from the oven. Immediately the samples were kept for cooling in the desiccators with precautions. After proper cooling, the weights of the dishes were recorded on the digital balance.

The dishes were again transferred to the oven for another session of heating. The materials were again heated at the same temperature for an hour. The dishes were cooled again in the desiccators and weighed on the balance. The readings were recorded. The process of heating the dishes in the oven, cooling in desiccators and then weighing was repeated after each hour until there was no reduction in the mass observed.

The content of moisture in the given samples in terms of mass percentage was calculated using the following formula.

FORMULA FOR CALCULATIONS

$$\text{MOISTURE CONTENT (mass \%)} = \frac{100 \times (M_2 - M_3)}{(M_2 - M_1)}$$

Where

M1 = Mass of (dish + glass rod + sand)

M2 = Mass of (dish + glass rod + sand + sample) before drying

M3 = Mass of (dish + glass rod + sand + sample) after drying

All observations of masses were in gram. With the help of the above formula, the moisture content of each honey sample was calculated.

3.2.3.5 DETERMINATION OF SUGARS IN A HONEY SAMPLE (BIS, 1994-2000)

Carbohydrates are the prime constituents of many food materials. The carbohydrates in food generally present as polysaccharides such as starch or mono and disaccharides such as glucose, fructose, lactose, as well as sucrose, etc. Collectively sugars containing all the mono and disaccharides of the food are responsible for numerous properties.

Sugars are divided into reducing and non-reducing sugars. The sugars that containing one or more reducing group are called as the reducing sugars. Generally, all the mono and disaccharides except sucrose are reducing sugars. Honey is a substance which is mainly a sugar solution. Glucose and fructose are the prime ingredients of honey. The various properties of honey are only due to its sugar profile.

3.2.3.5.1 DETERMINATION OF TOTAL REDUCING SUGAR

Reducing sugars are the sugars with having at least one reducing group in its structure, which can reduce the metal compounds. As the metal compounds reduced by the reducing sugar the amount of the reducing sugar can be detected by titrating the compounds with the sugar solutions. The method used for determining the reducing sugars is

LANE AND EYNON METHOD

Here in the current study, Lane and Eynon method was used for the determination of reducing sugar. The method uses the principle of reduction of Fehling's solution by reducing sugar. Fehling's solution is a combination of Rochelle salt (potassium sodium tartarate) and copper sulphate. The cupric hydroxide formed is reduced to cuprous oxide, which is insoluble and red in color, by the reducing group present in the sugar. Usually, methylene blue indicator is used for the determination of end point.

REAGENTS

The following reagents were used for the estimation of reducing sugar. The reagents were prepared freshly for the experiments.

a. Fehling's solution (A)

Accurately 34.639 g of copper sulphate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) crystals were weighed on the electronic balance. The crystals were then dissolved in some distilled water (about 100 ml) taken in a 500 ml volumetric flask. After dissolving the crystals completely, the volume of the solution was made up. The solution was filtered using glass wool before use.

The prepared copper sulphate solution was then standardized with the already prepared standard sugar solution. The standardization was done to calculate the quantity of invert sugar which is required for the reduction of copper sulphate solution. For this process standard invert sugar solution was used for the titration. Methylene blue was used as an indicator.

b. Fehling's solution (B)

346 g of Rochelle salt i.e. potassium sodium tartrate as well as 100 g of sodium hydroxide were weighed accurately and then transferred in to an one liter volumetric flask. The reagents were made to dissolve in some water as per the requirement. Then the volume was made up. This is the Fehling's solution B. The Fehling's solution B thus prepared was kept for a day and then filtered before use.

c. Solution of invert sugar (standard)

Exactly 0.95 g of sucrose was weighed and it was dissolved in 500 ml distilled water. Concentrated hydrochloric acid was added at an amount of 2 ml to the sucrose solution for the inversion. The solution was boiled for thirty minutes and was allowed to keep aside for 24 hours.

It was neutralized by using the solution of sodium carbonate. Lastly, the contents were transferred to 1000 ml volumetric flask and volume was made up by distilled water. This is the standard sugar solution that was used for further titrations. The solution contains 0.1 g of invert sugar per 100 ml of solution.

d. Methylene blue indicator

A freshly prepared methylene blue indicator was used for the experiment.

PROCEDURE

One gram of honey sample was taken (H_1). It was added to the empty 250 ml volumetric flask. Approximately one hundred and fifty milliliters of water was added to the flask and the honey was properly dissolved in the water. After thorough mixing, the volume was made up to 250 ml with distilled water. This is the sample solution of honey.

Five milliliters of both Fehling's solution A and B were taken by using separate pipettes in a porcelain dish. The burette was kept ready by filling with the sample honey solution prepared in the above paragraph. 12 ml of this solution was added to the porcelain dish from the burette at ones and immediately the contents were heated to boiling. Asbestos gauze was used for heating in order to avoid direct heating.

In the next step, three to four drops of methylene blue indicator were added to the content. The titration with the honey solution was continued by keeping the solution in the porcelain dish in boiling condition.

There was a color change from blue to red (reduction of copper sulphate to cuprous oxide) which indicates the end-point of the titration. The volume of honey solution used for completion of the titration was observed and recorded. The percentage of reducing sugar in honey solution was calculated as per the given formula.

FORMULA FOR CALCULATIONS

$$\text{Total reducing sugar in a given sample (mass \%)(RS)} = \frac{S \times 250 \times 100}{M \times V_1}$$

Where

V_1 = Volume of honey solution (burette reading)

S = Strength of the CuSO_4 solution

M = Mass of honey in gram

3.2.3.5.2 DETERMINATION OF TOTAL AND NON-REDUCING SUGAR (SUCROSE)

For determining non-reducing sugar and total sugar, the non-reducing sugar has to be converted into the reducing sugar. In order to do this conversion an inverted sugar solution was prepared. 100 ml of honey solution which was prepared earlier was

taken. 1 ml of concentrated hydrochloric acid was added and the solution was heated up to boiling. The solution was kept for overnight for inversion of sugar.

PROCEDURE

The solution of inverted honey was then neutralized by using sodium carbonate solution and titrated with Fehling's solution to determine the reducing sugar by following the procedure same as described previously for the estimation of the reducing sugars.

The amount of total sugar and the non-reducing sugar of honey i.e. sucrose was calculated by the given formula.

FORMULA FOR CALCULATIONS

$$\text{Total sugar in a given sample (mass \%)(TS)} = \frac{S \times 250 \times 100}{M \times V_2}$$

Where

V_2 = Volume of honey solution (burette reading) (inverted solution)

S = Strength of the CuSO_4 solution

M = Mass of honey in gram

Non-reducing sugar (sucrose)(NRS)(mass %)

$$= \left[\frac{(\text{amount of total sugar}) - (\text{amount of reducing sugar})}{(\text{amount of reducing sugar})} \right] \times 0.95$$

3.2.3.5.3 DETERMINATION OF FRUCTOSE TO GLUCOSE RATIO

Fructose to glucose ration is an important characteristic of honey which is useful in deciding the quality as well as the grade of the honey. The sugar in honey is mostly comprised of glucose and fructose. The amount of fructose is expected to be high than that of glucose. Thus the fructose to glucose ration is expected to be above one.

REAGENTS

- 0.05 N Iodine solution
- Conc. H_2SO_4 (sulphuric acid)
- 0.1 N NaOH (Sodium hydroxide) solution
- 0.05 N Sodium thiosulphate solution (standard)

PROCEDURE

The honey solution already prepared for the determination of sugar content was used for this experiment. In a 250 ml conical flask attached with a stopper, accurately 50 ml of honey solution was taken carefully by using the pipette. To this honey solution, 25 ml of the solution of sodium hydroxide and 40 ml of iodine solution were added. The flask was then closed tightly with a stopper. The contents were allowed to react by keeping the flask in a dark place for about twenty minutes. During this time the iodine in the solution reacts with the glucose in the solution.

Then the solution was acidified by using five milliliters of concentrated sulphuric acid. Immediately the contents were titrated with the sodium thiosulphate solution which was already taken in the burette. The excess iodine solution was reacted with the solution of sodium thiosulphate. The same procedure was repeated again for the blank reading. In which water was taken in place of sample solution of honey. The burette readings i.e. the volume of sodium thiosulphate required to complete the titrations were recorded correctly. The fructose to glucose ratio was calculated using the following formulae.

FORMULAE FOR THE CALCULATIONS

- a. Amount of glucose in the given honey solution (approximate) (mass %)

$$\text{Amount of glucose (Approx) (g)} = \frac{100 \times (\text{B-S}) \times 0.004502}{M}$$

Where

B = milliliter of thiosulphate solution (blank)

S = milliliter of thiosulphate solution (honey sample)

M = Mass of honey in the honey solution

- b. Amount of fructose in the given honey solution (approximate) (f) (mass %)

$$\text{Amount of fructose (Approx)(f)} = \frac{(\text{Approx}) \text{ total reducing sugars} - g}{0.925}$$

- c. Amount of true glucose (x) (mass %)

$$\text{Amount of true glucose (x)} = g - (0.012 \times f)$$

d. Amount of true fructose (y) (mass %)

$$\text{Amount of true fructose (y)} = \frac{\text{Approximate reducing sugars} - x}{0.925}$$

e. Amount of reducing sugar (true) = x + y

f. Fructose to glucose ratio = $\frac{y}{x}$

The same procedure was repeated for other honey samples and then using the same formulae all other parameters regarding the sugar content were calculated.

3.2.3.6 DETERMINATION OF FREE ACIDITY (International Honey Commission, 2009)

The titrable acidity is determined which is an indicator of the presence of free acids in the honey sample. The titrable acidity was determined by using the standard procedure given by international honey commission.

PRINCIPLE

All the free acids present in the honey that are expressed in meq/kg of honey is called as the free acidity of honey (m_{eq} = milliequivalents). In this method the honey samples that dissolved in water are titrated with the 0.1 N solution of sodium hydroxide. pH is used as an indicator.

REAGENTS AND EQUIPMENTS

1. pH meter
2. Magnetic stirrer
3. Carbon dioxide free distilled water
4. Buffer tablets (solutions) with pH 4 and 9 for calibration of pH meter
5. 0.1 N accurately standardized NaOH solution
6. Burettes, pipettes, beakers, etc.

POCEDURE

- a. The pH meter was calibrated by using the solutions of pH 3, 7, and 9
- b. The prepared honey sample was used for the experiment.
- c. 0.1 N solution of NaOH was prepared and then standardized accurately with oxalic acid.

- d. Exactly 10 gm of honey sample was weighed and taken in a previously cleaned and dried beaker.
- e. 75 ml of CO₂ free distilled water was added to the beaker and the honey sample was made to dissolve properly in the water by using magnetic stirrer.
- f. PH electrode was immersed in the solution and the pH was recorded.
- g. The solution was then titrated quickly with 0.1 N NaOH solution until the pH reached to 8.3.
- h. The reading was recorded correctly

FORMULA FOR CALCULATIONS

$$\text{FREE ACIDITY} = V \times 10 \text{ meq/kg}$$

Where

V = Volume of 0.1M NaOH required for the titration in ml

The free acidity was expressed as milliequivalents acid/kg honey. Using the same method the free acidity of other honey samples was calculated.

3.2.3.7 DETERMINATION OF OPTICAL ACTIVITY (BIS, 1994-2000)

Two grams of the honey sample, subjected for the examination, was weighed accurately and taken in to a small beaker. Then the honey was dissolved in a small amount of distilled water. By using a measuring cylinder the volume of honey solution was made up to ten milliliter with distilled water.

The cuvette of the colorimeter was filled with distilled water. The colorimeter reading was then adjusted at 100 percent transmittance or '0' absorbance at 660 nm wavelength. The water was removed from the cuvette and it was filled with the prepared honey solution. The absorbance or the percent transmittance was measured at the same wavelength.

As the apparatus has been available with only the transmittance scale, the optical density was calculated by using the following formula.

FORMULA FOR CALCULATIONS

$$\text{Optical Density} = 2 - \text{Log Percent Transmittance}$$

In the same way the optical densities of other honey samples were determined.

3.2.3.8 ESTIMATION OF TOTAL PROTEIN CONTENT (Ranganna, 2007)

The micro-Kjeldahl method as given by Ranganna (2007) was used for the estimation of the amount of nitrogen in food material. The value was multiplied by some appropriate factor to convert it from the nitrogen content of the value of protein content. The method was adopted as a standard method for the protein estimation by the Indian standard institute i.e. ISI.

The principle of the method includes oxidation of the sample with sulphuric acid and then converting the nitrogen-containing compounds in to another nitrogen-containing substance ammonium sulphate. When some alkali is added to the ammonium sulphate solution ammonia gets free and was collected by the distillation process in to the known quantity of suitable acid. The amount of acid remained unused was measured by titrating the content with a standard alkali solution.

REAGENTS

- a. Sulphuric acid (concentrated) (96 % pure)
- b. Mercuric oxide
- c. Sodium hydroxide flakes
- d. Potassium sulphate
- e. thiosulphate solution
- f. standardized solution of sulphuric acid - 0.5 N
- g. Methyl red indicator
- h. sodium hydroxide solution – 0.1 N

PREPARATION OF SAMPLE

Honey sample was prepared as described in the previous sugar estimation experiment.

PROCEDURE

a. DIGESTION

Two grams of accurately weighed honey sample under consideration was taken in a borosil digestion flask. The little amount of mercuric oxide (0.7 g) as well as 15 g potassium sulphate (in powdered form), and 25 milliliters of sulphuric acid (concentrated) were inserted into the same digestion flask containing the sample.

The flask was heated on the heater by placing it in an inclined position. The contents were gently heated up to the level where the formation of foaming was stopped. The solution was then boiled vigorously until the solution appears clear. After this stage, the boiling was continued for another 2 hours.

b. DISTILLATION AND TITRATION

The digested contents were cooled to the room temperature and 0.2 liters of distilled water was added to the solution. Thiosulphate solution (20 ml) was added and stirred well to get the precipitate of mercury. After that Sodium hydroxide (25 g) was added in order to get a strongly alkaline solution. Some zinc granules were added to avoid bumping.

The flask was connected to the distillation assembly. Another end of the condenser was immersed in the previously measured standard acid solution (sulphuric acid). The solution was straight away heated steadily to carry out the distillation of ammonia. It was heated carefully until the complete distillation of ammonia takes place. The ammonia was reacted with the acid and neutralized. The excess acid that was not reacted with ammonia was titrated back with the solution of NaOH, by taking it in to the burette. Blank titration was also performed by taking all the reagents without adding the sample. The total content of protein in the sample was calculated as per the following formulae.

FORMULAE FOR CALCULATIONS

a. Nitrogen content

$$\text{Quantity of nitrogen (N) (in gram)} = (w - 0.2x) - (y - 0.2z) \times 0.007$$

Where

- w = volume of acid taken for distillation in ml (0.5 N)
- x = volume of sodium hydroxide solution used for back titration in ml (0.1 ml)
- y = volume of acid taken for the distillation in ml (for blank)
- z = volume of NaOH used for back titration (for blank)

b. Total protein content

$$\text{Protein content (mass \%)} = \frac{100 \times N \times \text{Conversion factor}}{W}$$

Where

N = quantity of nitrogen (gram)

W = mass of sample

Same procedure was repeated to calculate the total protein content of each honey sample under examination.

3.2.3.9 FIEHE'S TEST (IS: 4941: 1994)

It is a test used for the detection of the presence of hydroxymethylfurfural in the given honey sample. The test is also used for detecting adulteration in honey. If the given honey sample have an added invert sugar or simply it is adulterated with invert sugar then the test will show positive results. But it cannot be considered reliable as the test based on the detection of HMF and the HMF may be formed due to the storage of honey or due to treating honey with temperature. Thus it can be used for the detection of HMF content only.

PRINCIPLE

When the honey is mixed thoroughly with ether solution the HMF of honey will be dissolved in honey. The HMF of honey which is now isolated when treated with resorcinol solution it gives the pink or cherry red color.

CHEMICALS

- a. Resorcinol solution: 1 g of resorcinol was dissolved in HCl
- b. Ether solution

PROCEDURE

Five grams of honey was weighed accurately on the electronic balance. The honey sample was then transferred to the mortar. Ten milliliters of ether was added to the mortar. The ether solution and honey were blended thoroughly using the pestle. It was observed that honey did not dissolve in the ether.

After integrating both the materials properly the ether extract was decanted carefully and was then collected into a dish made up of porcelain. The process of extraction of HMF from honey to ether by mixing in pestle and mortar was repeated for a second time by following the same method. The second extract was as well collected in the same dish.

From the decanted solution, ether was allowed to evaporate by keeping the porcelain dish in the free atmosphere at room temperature. The solution was blown with the intention to accomplish the complete evaporation of ether.

Resorcinol solution which was put in order, freshly added to the contents of the dish. Only two to three drops were added. The formation of the cherry red color was pointed toward confirmation of the test. The formation of color was observed to check the verification of the test.

3.2.3.10 HMF CONTENT DETERMINATION (BIS, 1994-2000)

Hydroxymethylfurfural (HMF) and some of its derivatives are sometimes responsible for the development of toxicity in honey samples. During the browning reaction (enzymatic), which is a characteristics reaction related to sugar degradation, HMF is produced.

It is a cyclic aldehyde and a furan complex that formed during the processing and production of sugar-containing compounds or maybe during the long storage of honey. The technical name of HMF as given in chemistry is 5-(hydroxymethyl) 2-furan carboxaldehyde.

The presence of HMF is reported in many sugars containing food items such as Tomato pastes and kinds of ketchup, honey, Jams and jellies, citrus juices, bread and bakery items, and syrups as an indication of heat stress, adulteration, or spoilage. In honey the production of HMF may be accelerated due to the presence of simple sugars (invert sugars), some acids over and above some minerals.

HMF is basically not in attendance in freshly harvested honey, but it is produced little by little during storage. Thus HMF is strongly related to the quality and freshness honey. The HMF content of honey is an indication of its long storage.

The storage temperature is, in addition, one of the parameters enhancing the development of HMF. The employ of metallic containers for the keeping of honey as well as the botanical origin of honey besides critically influence the HMF formation and its level. The BIS thus sets the maximum limit of HMF that can be comprised of honey at a maximum of 80 mg per kilogram of honey. (Shapla U M, et.al., 2018; Zein S et.al., 2009)

PRINCIPLE

The international commission of honey (IHC) suggested three methods for the estimation of HMF in honey. Two of the three methods are based on spectrophotometry and one of the methods is based on HPLC. The former two methods are used extensively for the analysis.

Here in this study, the spectrophotometric method as prescribed by BIS was used for the estimation of HMF in the honey samples. This method was suggested by the Winkler, in which the UV absorbance of the solution of honey was measured. The solution of *p*-toluidine and barbituric acid were added.

CHEMICALS

- a. **Solution of barbituric acid:** 500 mg of accurately weighed barbituric acid was taken in a 100 ml volumetric flask. Seventy milliliter of water was added to the flask and it was then kept in a water bath for heating with the purpose of dissolving the contents. After complete dissolving of barbituric acid the contents were cooled and the volume was made up to the mark.
- b. **Solution of *p*-Toluidine:** 25 g of *p*-toluidine was weighed out accurately and then it was dissolved in about 125 milliliter of iso propanol. The contents were warmed gently for enhancing the process of dissolving. The contents were then transferred to the 250 milliliter graduated flask. 25 ml acetic acid (glacial) was added and the volume was made up with isopropanol after proper cooling. The solution was then kept in the dry and dark place for 24 hours.
- c. Distilled water

PROCEDURE

Test sample preparation

Twenty grams of the sample of honey were taken and it was dissolved in 40 ml of distilled water (without oxygen) essentially without heating. The contents were then transferred to the 100 ml volumetric flask already cleaned and dried thoroughly. The volume in the flask was made up with the DW.

The testing experiments were started immediately without delay of time in order to avoid any formation of fresh HMF. This is the honey solution prepared for testing.

SPECTROPHOTOMETRIC DETERMINATION OF SAMPLES

Two dried test tubes were taken after proper cleaning. To each test tube honey solution, 2 ml and p-toluidine solution 5 ml were added. In one of the test tubes, one ml water was added as well as in another test tube one ml solution of barbituric acid was added and the contents were mixed in a good manner. The test tube with water was treated as a blank.

All the procedures were done quickly within a period of approximately two minutes. The samples were then observed in the spectrophotometer for the detection, at the 550 nm wavelength. Cells of one-centimeter size were used.

The HMF content was found by using the following formula for calculations

FORMULA FOR CALCULATIONS

$$\text{HMF content mg per 100 gram of sample} = \frac{\text{Absorbance} \times 19.2}{\text{Thickness of layer}}$$

The same procedure was repeated for all the honey samples. The HMF content determined was compared with the standard values

3.2.3.11 ESTIMATION OF IRON IN THE HONEY SAMPLE BY COLORIMETRIC METHOD (fssai manual, 2016)

The minerals which are essential for the body functioning are divided into two groups as major minerals and trace minerals. Iron included among the trace minerals.

Iron is a trace mineral found in many food materials such as protein-rich foods, green leafy vegetables, etc. Iron helps the intake of protein as well as act as a carrier of oxygen in the body. Iron appears in the body in two forms heme and non-heme iron. Anemia is a disease that may be caused because of the deficiency of iron. It is found most abundant in animals.

PRINCIPLE

The solution containing ash is reduced by hydroxylamine hydrochloride. The iron is determined by using the spectrophotometry technique as a color complex produced by reduction. The color complex is produced due to reaction with α - α -dipyridyl. The absorption is observed at 510 nm wavelength.

REAGENTS

- a. Solution of magnesium nitrate [$\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$] (50%)
- b. Hydroxylamine hydrochloride solution [$\text{H}_2\text{NOH} \cdot \text{HCl}$] (10 %)
- c. Buffer solution of acetate: 12 ml of glacial acetic acid was added in 8.3 g anhydrous sodium acetate and the contents were diluted to 100 ml with distilled water
- d. Concentrated HCl
- e. Standard iron solution (0.01 mg/ml): 0.3512 g of $\text{Fe}(\text{NH}_4)_2(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$ solution was dissolved in water and diluted to 100 ml with water.
- f. 1 ml of above iron solution was diluted to 100 ml
- g. Solution of Orthophenanthroline (0.1 % w/v): 0.1 g of substance was dissolved in eighty milliliter of water (temperature 80°C), cooled and diluted to 100 ml by using distilled water. It was stored in dark and cool place
- h. Solution of α - α - dipyridyl (0.1 % w/v): aqueous solution was prepared by dissolving 0.1 g of the substance in water and diluted to 100 ml.

SAMPLE PREPARATION

The accurately weighed sample was well homogenized in pestle and mortar. The sample was then transferred in to a tarred and cleaned silica dish. The sample was heated on a low flame to remove the volatile substances and till the smoking stopped.

The silica crucible was transferred to the muffle furnace and the temperature was increased gradually to 450°C . The heating was continued up to the formation of carbon-free white ash. The dish was removed from the muffle furnace and kept for cooling in desiccators.

Five milliliters of concentrated HCl was added to the ash and then it was dried using a water bath. 2 ml of acid (HCl) was added to the residue and the residue was dissolved in HCl. Heated for five minutes by covering with a watch glass. The contents were dissolved in to the water and transferred to a 100 ml volumetric flask. The volume was made up to 100 ml with water.

STANDARD CURVE CALIBRATION

Seven volumetric flasks were used and numbered as 1, 2, 3, 4, 5, 6, 7, and 8. The standard iron solution (solution f) was added in to the beakers in an amount 4 ml, 3 ml, 2.5 ml, 2 ml, 1.5 ml, 1 ml, 0.5 ml in the beakers serially. The eighth beaker was kept blank without adding the iron solution.

0.2 ml of concentrated HCl was added in all the seven beakers. All the solutions were measured carefully by using the pipettes. The contents of each beaker were diluted with 10 ml water. 1 ml of hydroxylamine hydrochloride was added to each of them. After five minutes 1 ml O-phenanthroline, 2 ml dipyrldyl, and 5 ml buffer solution were added to each flask after. The absorbance of each solution was measured at a wavelength of 510 nm.

The graph of absorbance was plotted against the amount of iron (in mg) to get a standard curve. The iron content was calculated using the following formulae.

FORMULA FOR CALCULATIONS

$$\text{Iron content (mg/100 g sample)} = \frac{F1 \times V \times 100}{F2 \times W}$$

Where

F1 = amount of Fe in sample (graph value)

F2 = amount of ash solution taken for determination

V = Volume of the solution of ash

W = Weight of honey sample

3.2.3.12 ESTIMATION OF CALCIUM (Ranganna, 2007)

Calcium is one of the very important minerals essential for the excellent nutrition. The ninety percent of overall calcium present in the body is as a building material of the structure of bones and teeth. The basic structure of body i.e. skeleton is primarily made up of calcium.

Honey is reported to be a considerable source of minerals including calcium.

PRINCIPLE

The principle of this technique is based on the precipitation of calcium as calcium oxalate. The precipitate of CaC_2O_4 thus prepared was dissolved in heated dilute sulphuric acid. The dissolved contents were titrated by using the standard solution of potassium permanganate.

REAGENTS

- a. Dilute H_2SO_4
- b. Saturated solution of Ammonium Oxalate

- c. Diluted solution of acetic acid
- d. Diluted solution of ammonium hydroxide
- e. KMnO_4 solution (0.1 N)
- f. Working KMnO_4 solution (0.01 N)- The 0.1 N solution was diluted 10 fold times freshly for the experimentation
- g. Indicator (Methyl red)

PROCEDURE

Ash solution was prepared and 20 ml aliquot was taken in a 250 ml beaker. 10 ml of water, 10 ml of ammonium oxalate solution as well as 2-3 drops of the indicator were added. The solution was firstly made alkaline by adding dilute ammonia. Some drops of acetic acid were added until the color was changed to a faint pink.

The contents were heated to boiling and then allowed to place overnight. The precipitate was observed to form. The solution was filtered with washing using water till oxalate free filtrate was remained.

At first, the precipitate was washed with hot and then with dilute acid (H_2SO_4). Lastly, it was again washed with hot water. The hot contents were titrated with potassium permanganate solution. The pink color was obtained as an indication of the endpoint.

The amount of calcium in a given sample was calculated by using the following formula

FORMULA FOR CALCULATIONS

$$\text{Calcium (mg/100 g sample)} = \frac{T \times V \times 100 \times 0.2}{v \times W}$$

Where

V = ash solution (total volume)

v = ash solution (volume taken for estimation)

T = Titer volume

W = Weight of honey sample

3.2.4 DETECTION OF ANTIBACTERIAL POTENTIAL OF HONEY SAMPLES

It was reported very firstly in 1982 that the honey shows antimicrobial properties. Till the date, numerous research papers were published showing the antimicrobial capacity of honey. Some kinds of honey for an instance, Manuka honey, showed its activity against more than 60 species of bacteria including both aerobic as well as anaerobic. The honey shows its activity against Gram-negative and Gram-positive bacteria also.

Malaysian honey, Egyptian honey as well as other plentiful varieties of honey throughout the world including India, have shown its potential against a variety of microbial as well as viral species. The honey from the *Melghat* was produced from the different nectaries of an assortment of flowers. It is assumed that the honey from the *Melghat* must possess antimicrobial potential. The potential of honey against some selected bacterial species was determined here in this study. The standard methods were applied for the detection of antimicrobial activities of the *Melghat* honey. (Khan et. al., 2018)

3.2.4.1 INTRODUCTION

There were many mechanisms proposed for the justification of the reason for antibacterial activities shown by the honey though it is not entirely unspoken till the date. Some of the factors which are supposed to be accountable for the antimicrobial potential of honey are; generation of hydrogen peroxide, high concentration of sugars, presence of phenolic compounds, presence of compounds that are proteinaceous over and above some physical characteristics such as low pH of honey, its low water activity due to less moisture content, the osmolarity of honey, presence of the enzymes, as well as the presence of some other unidentified compounds (Khan et. al., 2018).

Here in this study, six species of bacteria, three from Gram-positive and three from Gram-negative were chosen for studying the antibacterial potential of the honey samples under examination. The microorganisms selected were

- a. Gram-positive bacteria
 - *Staphylococcus aureus*
 - *Bacillus subtilis*
 - *Bacillus cereus*

- b. Gram-negative bacteria
 - *Escherichia coli*
 - *Salmonella typhi*
 - *Pseudomonas fluorescens*

3.2.4.2 CLAIRO COMBI DISC DIFFUSION METHOD

The antibacterial activities of the honey samples under investigation were detected by using CLAIRO COMBI discs. These are the combined microbial sensitivity discs. The discs are found to be very useful for the evaluation of the *in vitro* potential of the materials which may show their activities against some fast-growing bacteria. The antibacterial activities of several difficult species can also be determined using these discs by diffusing it in agar media.

The *in vitro* diffusion method was applied for the determination of the potential of the honey samples to show the antibacterial activity against the honey samples taken for investigation for this study. The test discs were used are the combined microbial susceptibility equipments. The method was designed by referring to the standard procedure published by 'WHO' (World Health Organization).

The discs used for the experiments i.e. CLAIRO COMBI discs were made by using the sterile and special grade filter paper. The paper possessed fourteen projected arms. The tip of each projection arm was carefully soaked into the stipulated amount of chemotherapeutic sample. Later the paper was dried carefully.

PRINCIPLE

The method is based on the simple truth that, for any antibiotic substance, the range of the inhibition zone created by the substance is inversely related with the Minimum Inhibitory Concentration (MIC) of the strain, which is estimated by the dilution method provided that the test conditions must be same.

PROCEDURE

The following procedure was followed for the determination of antibacterial potential of honey against some bacterial species.

a. PLATE PREPARATION

Mueller-Hinton agar solution was used for the experiment. The agar solution maintained on pH 7.3 was taken into the Petri plates with a depth of approximately 4

millimeters. The precaution was taken to keep the plates on the leveled surface. The plates with solidified media were dried for some time in order to eliminate the excess moisture which was gathered on the surface of media.

b. INOCULUMS PREPARATION

- Pure cultures were used for the detection of antibacterial activities of honey samples. Before the preparation of inoculums, the gram staining was carried out.
- Some colonies of similar species were transferred to the trypticase soy broth containing a test tube. The sterilized wire loop was used for the transfer of colonies.
- The broth culture was kept in an incubator for five hours, maintained at temperatures between 35 to 37 degrees. The solution was become turbid at some level.
- The turbidity was adjusted to the McFarland standard level of 0.5 by adding a solution of $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$ and H_2SO_4 as well as sterile broth.
- The plates were inoculated immediately with the prepared dilute solution.
- Excess inoculums were removed using the sterile cotton swab.
- With the use of another cotton swab, the culture was spread evenly over the disc surface in three directions.
- The lid was kept on the Petri dish and the dish was kept on room temperature for ten minutes.

c. COMBI DISC APPLICATION

The forceps were flamed to sterilized and using the same forceps the combi disc was taken from the container and then it was placed over the surface of the medium in the dish carefully with the help of flamed forceps.

The disc was pressed by applying little pressure in order to have complete contact with the medium. After some time the plates were kept for incubation for a period of seventeen hours at the temperature 36°C ($\pm 1^\circ\text{C}$). The zones of inhibition were appeared showing the extent of inhibition.

d. ZONE READING

The zones were found out by determining the diameter of the zone developed at the end of the incubation period. The zones' diameter was measured carefully by taking the precaution.

3.2.5 PHYTOCHEMICAL ANALYSIS OF THE HONEY SAMPLES

Analysis of the phytochemicals was a very important aspect of the research of any natural material that may be food or medicine, provided that, the natural materials should have been originated from the plants only.

Phytochemicals are the chemical compounds formed during the various metabolic processes and essential for the growth of plants. These compounds are also termed as secondary metabolites, and they include substances such as polysaccharides, gums, alkaloids, tannins, terpenoids, tri-terpenoids, terpenes, flavonoids, coumarins, phenols, and glycosides, etc. (Ezeonu and Ejikeme, 2016).

The entirely natural and plant-based medicines used in any curative therapies were found prosperous in the content of secondary metabolites of plants i.e. phytochemicals. It is guessed that the phytochemicals present in honey are mainly responsible for its amazing properties including its medicinal use.

In this study, the qualitative detection of phytochemicals in the honey samples was carried out by the standard methods prescribed in the various research articles published in the reputed journals with slight modifications. The phytochemicals such as saponins, alkaloids, phenolic compounds, tannins, glycosides, tri-terpenoids, and flavonoids were detected to evaluate the functional and medicinal properties of the honey samples under investigation (Ajuru et al., 2017).

PREPARATION OF THE EXTRACTS (Kaur et al., 2013)

It was reported that most of the constituents of honey were extracted by using water as a solvent. For the preparation of aqueous extract of honey twenty grams of honey was taken in a glass test tube. Fifty milliliters of distilled water was added with constant shaking. The mixture was then centrifuged for ten minutes at the speed of 3000 rpm. After settling, the supernatant was collected and used for the screening tests of the phytochemical.

3.2.5.1 TESTS FOR GLYCOSIDES

Glycosides may be defined as the molecules or the compounds that contain sugar bounded to some functional group with the help of glycosidic bonds. These are very important compounds of living organisms with a crucial role in the maintenance of health. The functional groups attached to sugar releases whenever in use, and serves as a medicinal substance. The glycosides isolated from some particular plants

possess the property of strengthening the working of the myocardium, known as cardiac glycosides (Vardanyan and Hruby, 2006).

Glycosides may be classified as

- Depending upon the type of glycone group present i.e. glucose or fructose etc.
- Depending upon the type of glycosidic bond present. e.g. the bond is 'below' or 'above' with reference to the plane of sugar molecule, is it α - or β -glycosides, and according to the linkages, whether it is C-linkage, O-linkage, N-linkage, or S-linkage
- Depending upon the chemical character of aglycone (Wikipedia)

3.2.5.1.1 TEST 1 (Keller-Kiliani Test):

4 ml of glacial acetic acid solution was taken in a test tube. 1-2 drops of FeCl_3 solution with a concentration of 2% was added. This blend was then mixed with the 10 ml honey sample extract as well as Conc. H_2SO_4 solution at a volume of 1 ml.

A brown ring was observed across the boundary of two immiscible liquids as an indication of the presence of glycosides in the honey sample (Nandagoapalan et al., 2016).

3.2.5.1.2 TEST 2 (Salkowski's Test):

Exactly two milliliters of H_2SO_4 solution was added to the 10 ml of extract. The solution was shaken well. Formation of the reddish-brown color is an indication of the presence of glycosides in the sample under examination (Jaradat et al., 2015).

3.2.5.2 TESTS FOR ALKALOIDS

Alkaloids are the secondary metabolites synthesized by the plants. These compounds are the derivatives of amino acids and proved to be very important substances in living organisms. They tend to show positive effects in the human when taken in small doses. They showed biological advantages as anticancer substances, pain-relieving agents, with antimicrobial and antifungal characteristics, and many other numerous properties especially an anti-inflammatory effect. (Kurek, 2019)

3.2.5.2.1 TEST 1 (Wagner's Test)

Wagner's reagent was prepared by following the standard procedure. Five milliliters of the extract was taken in a test tube. One milliliter of Wagner's reagent and same amount of HCl were added to the extract in a test tube.

If the reddish brown color is taken by the solution in the test tube, then it will be a sign of the occurrence of alkaloids in the sample (Nandagoapalan et al., 2016).

3.2.5.2.2 TEST 2 (Dragendorff's Test)

To detect the alkaloids by this test, Dragendorff's reagent was prepared as per the given method. Five milliliters of the extract was taken in a test tube. Exactly two milliliters of the Dragendorff's reagent and some drops of HCl were added to the test tube.

The formation of precipitate with a color, orange or red will be the indication of the presence of alkaloids in the given sample (Thilagavathi et al., 2015).

3.2.5.3 TESTS FOR SAPONINS

In plants, some defense mechanisms exist with the intention to protect them from herbivores, microorganisms as well as insects or any such kinds of elements. Saponin is one group of such compounds. In other words, they also termed natural detergents having a capacity to produce foam. The Latin word 'Sapo', from which the name saponin came to existence, means soap.

Soap is the substance having properties of emulsifying and foaming. Saponins said to have exhibit plenty of biological activities important in the human body. Saponins show antioxidant as well as anti-inflammatory properties and have a capacity to strengthen the immune system of human (Kregiel et. al., 2017).

3.2.5.3.1 FOAM TEST

In a test tube, nine milliliters of distilled water and one milliliter of the extract were taken. The mixture was mixed for 15 seconds with vigorous shaking. Then it was allowed to stand for 10 minutes.

The positivity of the test was detected by observing the formation of stable foam. The height of the foam was measured to draw the results (Thilagavathi et al., 2015).

3.2.5.4 TESTS FOR TANNINS AND PHENOLIC COMPOUNDS

Tannins are the phenolic compounds having very massive values of molecular weights ranging from 500 to 20000 Da. They are having very different structures with a lot of diversity. It was reported that more than 8000 varieties of tannins were identified until the date.

Proanthocyanidins, ellagitannins, gallotannins, and complex tannins are the major groups in which the tannins divided. Tannins show numerous biological activities including antitumor potential, antibacterial, antioxidant, over and above antifungal effect, etc.

The bioactivity of the tannins is strappingly determined by its aromatic rings in addition to hydroxyl radicals. The capacity of tannins to form high degree polymers is responsible for its antioxidant prospective (Cuong et al., 2019).

3.2.5.4.1 TEST 1 (Lead acetate test)

This test is a screening test used to find out the presence of tannins and phenolic compounds in the given sample. 2 ml of the extract was taken in a test tube and two milliliters of accurately prepared 10% solution of lead acetate was added in the same test tube carefully.

The formation of white precipitate shows the appearance of tannins and phenolic compounds (Thilagavathi et al., 2015).

3.2.5.4.2 TEST 2 (Ferric chloride test)

Another test was used for the detection of the tannins and phenolic compounds in the honey samples under examination. In this detection technique, 3 drops of 2 % FeCl_2 solution, as well as 5 ml of the extracts, were taken together in the same test tube. The contents were mixed thoroughly after addition.

The formation of the blackish blue or brownish green color indicates the presence of the phenolic compounds and tannins in the sample (Jaradat et al., 2015)

3.2.5.5 TESTS FOR STEROIDS (Ring test)

For the execution of this test chloroform, concentrated H_2SO_4 , and Acetic anhydride were used for the detection of steroids in the sample. One milliliter of acetic anhydride, 10 ml of chloroform, and 2 ml of the extract were taken in a test tube and the mixture was shaken. After a while, two milliliters of concentrated sulphuric acid was added in the mixture slowly along the side of the test tube by little slanting the test tube.

The observations were recorded as the formation of the ring at the junction (Thilagavathi et al., 2015).

3.2.5.6 TESTS FOR TRI-TERPENOIDS

It is a common test used for the screening of tri-terpenoids. For the execution of this test sulphuric acid, solution of anhydrous acetate, and methanol solution was used. Honey was diluted three fold times with water and two milliliters of this solution was taken in a test tube. One milliliter of methanol was added. 4-5 drops of this mixture were taken in a spot plate and then titrated with 2-3 drops of anhydrous acetate and concentrated sulphuric acid.

The formation of the red color was an indication of the presence of tri-terpenoids in the given honey sample (Yelin & Kuntadi, 2019).

3.2.5.7 TESTS FOR PROTEINS (Ninhydrin test)

Five milliliter of the honey extract was taken in a test tube. To the extract two milliliters of 0.2% solution of ninhydrin was added. The contents were boiled. The appearance of violet color was an indication of the presence of proteins in the given sample (Jaradat et al., 2015).

3.2.5.8 TESTS FOR FLAVONOIDS (Shinoda Test)

Five milliliters of extract was taken in a test tube. Some pieces of magnesium ribbon as well as 2-3 milliliters of concentrated Hydrochloric acid were added to the test tube. The contents were kept for some time. The formation of reddish pink color gave the indication of presence of flavonoids (Jaradat et al., 2015).

3.2.5.9 TESTS FOR CARBOHYDRATES

Carbohydrates are the polyhydroxy-aldehyde or polyhydroxy-ketones, or the compounds which reduce to them. The common carbohydrates are i.e. glucose and fructose etc. (monosaccharide), maltose and sucrose, etc. (disaccharide), as well as starch, pectins, etc (polysaccharides). They play a very crucial role in human health.

Following tests were carried out for detection of carbohydrates (Jaradat et al., 2015).

3.2.5.9.1 TEST 1 (Fehling's test)

The extracts were taken in a test tube. The contents were hydrolyzed by using dilute HCl solution and then it was neutralized with the alkali. Fehling's solutions A and B were added to the test tube in an equal amount. The contents were heated.

The formation of the red precipitate is the indication of the presence of reducing sugars in the sample extract.

3.2.5.9.2 TEST 2 (Benedict's test)

Test solution i.e. extract was taken in a test tube. Few drops of Benedict's reagent were added. The contents were heated to boiling in a water bath. The formation of the reddish brown precipitate of metal oxide is an indication of the presence of carbohydrates in the sample.

3.3 ANALYSIS OF KUTKI (*PANICUM SUMATRENSE*)

Another prime material that was chosen for the study was *kutki*, a cereal crop of the *Melghat* area. The *Melghat* region is suffering from the problem of malnutrition for decades. There may be some interesting findings that will be come to existence after the study of *kutki*. The novel recipes prepared from *kutki* may be useful to find some solution towards the way of solving the problem of malnutrition.

3.3.1 INTRODUCTION

Kutki is a kind of minor millet and commonly known as little millet. *Kutki* is a local as well as Hindi name of little millet. The botanical name of this millet is '*Panicum sumatrense*'. The most important thing to be mentioned about little millet is, it is a kind of crop that can endure water logging and drought more and over can grow in adverse conditions of environment as compare to the other common crops like rice, wheat, etc. *Kutki* was one of the major crops grown in the *Melghat* area, the area of our research.

The cultivation of *kutki* was now decreasing constantly due to various reasons. It was observed that very little research was done on little millets. Especially the variety of little millet grown in the *Melghat* i.e. *kutki* was yet not studied by any researcher. The research on *kutki* may open the new dimensions of study and nutrition which may be found beneficial for the progress of the region as well as the people.

3.3.2 PROCUREMENT OF KUTKI SAMPLE

Kutki was purchased from the local market. It was first examined visually for the selection. The *kutki* thus purchased was cleaned. Foreign materials present in the grains if any were separated by the application of simple unit operations. There is a considerable reduction in the number of cultivars of *kutki* in the *Melghat* region. The *kutki* is available rarely in the market. As the people are now getting aware to

consume traditional grains, the demand of *kutki* grains is somewhat increasing. So it is sold at high rates as compared to other cereals.

FIGURE 3.1: KUTKI (LITTLE MILLET) (indiamart.com & i.ytimg.com, 2020)



3.3.3 REMOVAL OF REFRACTIONS

The refractions were removed from the grains. Refractions may be defined as the materials present in the grains. These materials are different from normal food grains in many dimensions. Refractions include other food grains, broken grains as well as grains that are damaged, etc.

The refractions were identified as per the definitions mentioned in the Regulation of Food Safety and standards (2011). The refractions also include any type of objectionable substances present in the grains and produced by insects, birds or rodents. They are termed as filth (heavy and light). The filth was removed by using sieves.

Other foreign materials such as pieces of clay, stones were removed by the agitation process. The cleaned grains were taken for the physicochemical analysis and product development

3.3.4 PHYSICOCHEMICAL AND FUNCTIONAL PROPERTIES ANALYSIS OF KUTKI

The indigenous crop millets are cultivated in India from ancient times more than ever little millet. It is also called as *kutki* in Indian national language 'Hindi'. The botanical name of *kutki* is 'Panicum sumatrense'. Though the cultivation of millets reduced in India, still in many areas it is cultivated extensively.

There are major millets such as jowar and maize which are more popular among the consumers over and above cultivators, but the minor millets such as little millet, kodo millet, common millet, barnyard millet, etc. are also under cultivation in some regions especially in the hilly or water logging areas.

As per as the notional composition concerns, millets are found to be very rich in all types of nutrients even they are known as Nutri-cereals. Along with the abundant amount of major nutrients, millets are having a splendid profile of mineral and vitamin contents. In addition to this, millets have an excellent possibility to serve as medicine due to its therapeutic properties owing to the presence of many nutraceuticals.

Little millet or *kutki*, one of the prime crop of the *Melghat*, is not that much famous among the general people as well as researchers. Here in this study the little millet or *kutki* is taken for the research and for the development of products. The physicochemical analysis of *kutki* may help to explore the new area of research

towards little millets. Grain weight, grain volume, bulk density, hydration capacity, and swelling capacity were measured by following the method given by Kamatar et al., 2013; Reddy et al., 2019.

3.3.4.1 1000 GRAIN WEIGHT

It is a weight of randomly selected 1000 grains of little millet. One thousand grains of the millet were selected randomly. The weight of the grains was then measured on the electronic balance for accurate and constant reading. The reading was recorded.

3.3.4.2 GRAIN VOLUME

It is the volume of the randomly selected 1000 grains. For this purpose the known volume of water was taken in a measuring cylinder. Carefully counted one thousand grains were poured in to the water carefully. The increase in volume was calculated by subtracting elevated volume from original volume.

3.3.4.3 BULK DENSITY

Bulk density of the little millet was estimated by using the following formula

$$\text{Bulk Density} = \frac{\text{Weight or 1000 grains (W)}}{\text{Volume of thousand grains (V)}}$$

3.3.4.4 HYDRATION CAPACITY AND HYDRATION INDEX

Hundred grams of grains were weighed accurately. The grains were then subjected for soaking in water for 24 hours. The excess water was drained off and the weight of the soaked grains was measured. The percent gain of weight by the grains is its hydration capacity. It was calculated by subtracting the original mass of grains from the mass of soaked grain. It was expressed in weight percent. It was calculated using the following formula.

$$\text{Hydration Capacity} = \frac{(W_2 - W_1)}{W_1} \times 100$$

Where

W1 = Weight of dry grains

W2 = Weight of soaked grains

$$\text{Hydration Index} = \frac{\text{Hydration Capacity of 1000 grains}}{\text{Dry weight of 1000 grains}} \times 100$$

3.3.4.5 SWELLING CAPACITY AND SWELLING INDEX

The volume of soaked grains was measured. The swelling capacity of the little millet was calculated by subtracting the original volume of grains from the volume of soaked grains. It was mentioned as the volume per hundred grams.

$$\text{Swelling Capacity} = \frac{(V2 - V1)}{W} \times 100$$

Where

V1 = Volume of dry grains

V2 = Volume of soaked grains

W = Weight of the dry grains

$$\text{Swelling Index} = \frac{\text{Swelling Capacity of 1000 grains}}{\text{Seed volume}} \times 100$$

3.3.4.6 DETERMINATION OF MOISTURE (FSSAI Manual for cereals, 2016)

Water is a principal content of almost each and every food item, provided that the quantity may be deferent. Sometime it may be added during the processing or may be removed as per the item. The water in a food material may occur as a

- free water
- cellular water and
- bound water

The measurement of moisture content in the foodstuff is very important as it affects the quality and the consumer value of that food material. The keeping potential or shelf life, the susceptibility of the product to any type of spoilage, may be chemical or biological, are strongly dependent on the moisture content. Thus the measurement of moisture content is one of the important criteria followed for the quality assessment.

Though the grains of millets appear to be dried still there is some water present inside. Thus the water content of *kutki* grains was measured using a simple oven drying method.

APPARATUS

- a. Household Grinding Mills
- b. Simple Electric Oven
- c. Petre Dishes
- d. Desiccators
- e. Electronic balance

PROCEDURE

The grains were ground firstly by using the grinding mill. The care was taken in order to avoid too fine or too coarse flour of *kutki*. The flour sample was selected by passing through the sieve of 1 mm size.

Five grams of ground sample was taken in the dish. The dish was tarred and dried before adding the sample. The sample was spread evenly. The dish was put in to the oven for two hours that was kept on the temperature around 130°C in order to remove the free water. After two hours the sample was allowed to cool in the desiccators. It was then weighed by using the electronic balance.

The dish containing the sample was again kept in the heated oven for thirty minutes and weighed after cooling to room temperature. The process was repeated to get constant reading as an indication of no further loss of water. After each heating session, the sample was cooled properly before weighing.

The formula used for the calculations was

FORMULA FOR CALCULATIONS

$$\text{Amount of moisture in a given sample (mass \%)} = \frac{100 \times (M1 - M2)}{(M1 - M)}$$

Where

M = Mass of empty dish

M1 = Mass of (dish + sample) before drying

M2 = Mass of (dish + sample) after drying

3.3.5 NUTRITIONAL AND CHEMICAL COMPOSITION OF *KUTKI*

Milletts are highly nutritious food materials. There is range of types of millets available. Here in this study the *kutki* sample from the *Melghat* was analyzed for the analysis of some of their nutritional and chemical properties. Here the proximate

parameters such as carbohydrates, fats, and protein as well as dietary fibers and some minerals were determined.

3.3.5.1 ESTIMATION OF TOTAL FAT BY SOXHLET APPARATUS

(Ranganna, 2007)

Cereals and millets are low in fat content. Thus it is also reported from the previous study that little millet does not contain fat in a large amount too. Though the fat content is low little millets are very good sources of some essential fatty acids as well as such as PUFA i.e. polyunsaturated fatty acids.

The total crude fat content of *kutki* was determined by using the Soxhlet apparatus. It is an apparatus used for the estimation of total or crude fat contained in the food material. The technique is based on the principle of solvent extraction. The suitable organic solvent was used for the extraction.

APPARATUS

- a. Soxhlet Apparatus
- b. Electronic Digital Balance
- c. Beakers
- d. Water bath

PROCEDURE

The dried sample remained after the estimation of moisture was used for the estimation of total fats. The sample was shifted to a thimble. The thimble was plugged at the top with cotton. Fat-free cotton was used for this purpose. The thimble was then put in the Soxhlet apparatus extraction tube.

The Soxhlet assembly was arranged as per the directions. Anhydrous ether was used for the extraction process. The sample was extracted for 18 hours continuously. The water bath was used for heating instead of giving the heat with direct flame. The flame was adjusted frequently in order to avoid any losses of solvent due to extra heating.

After the completion of extraction, the assembly was allowed to cool properly at normal temperature. A beaker was taken for the collection of ether. The beaker was cleaned, dried, as well as tarred before use. Ether was collected carefully into the beaker. The apparatus was washed with a small quantity of ether in order to collect all residues.

The ether was then evaporated gently at low temperatures. The residue was weighed after removal of all traces of ether. The amount of total fat was calculated by using the following formula

FORMULA FOR CALCULATIONS

$$\text{Total fat (\%)} = \frac{(W_2 - W_1) \times 100}{W}$$

Where

W₁ = Weight of empty beaker

W₂ = Weight of beaker + extract

W = Weight of sample

3.3.5.2 ESTIMATION OF TOTAL PROTEINS (Ranganna, 2007)

The micro-Kjeldahl method was used to find out the amount of nitrogen in the sample. The amount of protein was obtained by multiplying the nitrogen value by some factor. The method was also adopted by ISI as a standard method for protein estimation. In this method, the sample was treated with sulphuric acid for oxidation, which leads it to the compound with nitrogen i.e. ammonium sulphate.

Ammonia was liberated from ammonium sulphate solution which was collected into the known quantity of suitable acid. The remaining acid was estimated by titrating with a standard alkali solution. The reagents as described previously were used.

DIGESTION

Five grams of sample was weighed accurately and it was then taken in the digestion flask made up of borosil material. Some mercuric oxide and potassium sulphate were added. Fifty milliliters of concentrated sulphuric acid was also added for the digestion. The contents were heated gently up to the formation of foaming was stopped.

In the next stage of heating, the contents were heated vigorously up to a clear solution was obtained. The solution was boiled for another 2-3 hours.

DISTILLATION OF SAMPLE AND TITRATION

The contents that were digested previously were taken in a flask after cooling and diluted with water. The mercury was precipitated by adding a thiosulphate solution. The contents were made alkaline with sodium hydroxide and then distilled

by using the distillation assembly for getting ammonia. The ammonia that was distilled out was neutralized with acid and the excess acid was estimated by titrating with sodium hydroxide solution.

The same process was repeated for the sample without a sample (blank). The protein content was calculated as

CALCULATIONS

a. Estimation of Nitrogen content

$$\text{Amount of nitrogen (A)} = (V_1 - 0.2V_2) - (V_3 - 0.2V_4) \times 0.007$$

Where

V_1 = volume of acid initially taken for distillation (sample)

V_2 = volume of sodium hydroxide required (titration of sample)

V_3 = volume of acid taken for the distillation (blank)

V_4 = volume of NaOH required for titration (blank)

b. Amount of protein

$$\text{Protein (mass \%)} = \frac{100 \times A \times Cf}{M}$$

Where

A = Amount of nitrogen

M = Weight of sample

3.3.5.3 DETECTION OF ASH VALUE (Ranganna, 2007)

The ash is a residue that surplus after the complete burning of the organic bits and pieces. The value of ash content is not exactly similar to that of the content of minerals in the food as there may be a number of changes in the quantity by reason of the interaction of internal components.

Ash value is related to the minerals, inorganic materials, and some time with the adulteration. Water was used before igniting the *kutki* sample in order to avoid the losses that may occur in its value.

PROCEDURE

Ash content was estimated by the simple method of incineration of the material in the muffle furnace until you get complete white ash. The procedure applied for determining the ash was repeated as it was used for the determination of

the content of ash for the honey sample previously. The separate crucible with proper washing, cleaning, and drying was used. The temperature applied was also the same. The content of ash was carried out by using the following formula

FORMULA FOR CALCULATIONS

$$\text{Ash percentage} = \frac{100 \times (M3 - M1)}{(M2 - M1)}$$

Where

M1 = Mass of empty crucible

M2 = Mass of crucible with the sample

M3 = Mass of crucible with ash

3.3.5.4 DETERMINATION OF TOTAL CARBOHYDRATES

Total carbohydrates are the sum of all types of saccharides of comprising the given food material. It is the measure of all-together of the sugars as well as the polysaccharides. Generally, little millet contains starch in a large amount. The other carbohydrates may be the dietary fibers and very little amount of sugars.

Total carbohydrates were determined by the simple calculations as explained by the BIS. The carbohydrates were calculated using the following formula. (IS 1656, 2007)

FORMULA FOR CALCULATIONS

$$\text{Amount of total carbohydrates (weight \%)} = 100 - (W+X+Y+Z)$$

Where

W= Moisture (weight %)

X= Total proteins (weight %)

Y= Total fat (weight %)

Z= Ash content (weight %)

3.3.5.5. ESTIMATION OF TOTAL DIETARY FIBERS

Dietary fibers comprise of some carbohydrates which are not digestible. The endogenous secretions produced in the upper portion of the GI tract cannot digest the dietary fibers.

These are the big and complex molecules of carbohydrates such as some polysaccharides in addition to lignin. In addition to the lignin dietary fibers may also

comprise of gums as well as mucilages with some components of other cells such as ester-linked acetic acid, phenols (non-lignin), cell wall, phytic acid, and minerals, etc.

One can define dietary fibers in several ways; it may be as "the lignins, celluloses, as well as hemicelluloses, all together are DF". They may also be defined as "the substances of the plant cells which are not hydrolyzed by the enzymes containing in the human digestive system.

While summarizing the definitions it can be concluded that "dietary fibers are the polymers of carbohydrates with DP (polymerization degree) more than three, and which are not digested over and above absorbed by the small intestine". There are two types of fibers SDF (soluble DF) and IDF (Insoluble DF)

- a. Soluble DF: Lignins, Celluloses, and Hemicelluloses
- b. Insoluble DF: Gums, beta-glucans, mucilages, pectins, and some hemicelluloses

Excluding lignins, all are the polysaccharides without starch. The low consumption of dietary fibers may lead to many chronic diseases such as cardiac disorders, obesity, diabetes, and diseases of the large bowel. Little millet or *kutki* contains a considerable amount of dietary fibers which make them nutritional excellent substances. The moisture free and fat-free sample was taken for the estimation of dietary fibers. The sample was then digested enzymatically for the solubilization of protein and starch.

PROCEDURE

The sample after taking away moisture and lipids were taken for the estimation. Sugars were eradicated by centrifuging 5 grams of the sample with the solution of ethyl alcohol (80%) for five minutes at a speed of 2000 rpm. The supernatant was then disposed of.

Subsequently, the contents were digested with enzyme pepsin. For accelerating the process of digestion the contents were incubated. The insoluble fractions of the dietary fibers were collected by washing (firstly using acetone and later using ether) and drying the residues after digestion.

As well as the soluble part was separated by centrifuging the supernatant and then washing and drying the residue obtained during centrifugation. The total dietary fibers in the sample of *kutki* were calculated by using the following formula

FORMULA FOR CALCULATIONS

$$\text{Total dietary fibers} = \frac{(M1+M2) \times 100}{M}$$

Where,

M1 = Mass of soluble fraction

M2 = Mass of insoluble fraction

M = Mass of sample

3.3.5.6 ESTIMATION OF CALCIUM (Ranganna S, 2007)

Calcium comes among the major minerals that are indispensable for the body to function well. Nutritionally, among all the minerals calcium has a prime importance as it is the chief structural component in the making of teeth and bones.

There is a necessity of intake of calcium in the daily diet to maintain the bones healthy. It also helps in maintaining the smooth movement of muscles in addition to blood pressure. Calcium is required at all stages of age. Millets are the good source of calcium. Little millets are also reported to contain calcium in a considerable amount.

PRINCIPLE

The theory related to this method is based on the precipitation of calcium in the form of its compound calcium oxalate. The precipitated CaC_2O_4 (calcium oxalate) was dissolved in heated water down sulphuric acid. The dissolved substances were titrated with the standard solution of potassium permanganate ($\text{K}_2\text{Cr}_2\text{O}_7$).

REAGENTS

- a. Dilute H_2SO_4
- b. Ammonium Oxalate solution (saturated)
- c. Indicator (Methyl red)
- d. Dilute acetic acid
- e. Dilute ammonium hydroxide
- f. KMnO_4 solution (0.1 N)
- g. Working KMnO_4 solution (0.01 N) - Freshly prepared during experiment

PROCEDURE

The ash prepared from the *kutki* sample was used for calcium detection. Ash solution was prepared as per the instructions and as done in determining the ash content of honey. Acetic acid was added until the color was changed to a faint pink.

The contents were treated as discussed in the calcium estimation of honey. The precipitate obtained was washed by using concentrated H₂SO₄ (cold and hot). The traces of H₂SO₄ were eliminated with hot water. The contents were treated with a KMnO₄ taken in the burette to get the pink color. The calcium was estimated as

FORMULA FOR CALCULATIONS

$$\text{Amount of calcium (mg/100 g sample)} = \frac{V_3 \times V_1 \times 100 \times 0.2}{V_2 \times M}$$

Where

V₁ = Total volume of ash solution

V₂ = Volume of ash solution taken

V₃ = Titer volume

M = Mass of *kutki* sample

3.3.5.7 ESTIMATION OF IRON IN THE *KUTKI* SAMPLE BY COLORIMETRIC METHOD (fssai manual, 2016)

Though iron is required in a very small amount it is equally essential for the smooth functioning of the body. Green leafy vegetables, some protein-rich foods, dates, etc are the good sources of it. Little millet is one of the richest sources of iron among all the cereals and millets. Being a fantastic source of iron, it is very important in the nutritional point of view, and consuming the food prepared from *kutki* may be helpful to conquer malnutrition.

PRINCIPLE

As discussed in 3.2.3.11, the iron content of *kutki* was detected by spectrophotometry. The readings of absorbance were taken at a wavelength of 510 nm.

REAGENTS

All the reagents that are used for the estimation of iron in *kutki* were the same as used for the determination in honey.

SAMPLE PREPARATION

The accurately weighed 5 grams of *kutki* sample was grounded. It was taken in the crucible for preparation of ash as discussed earlier. The contents were heated in a muffle furnace to get a fine white colored and carbon-free ash.

After proper cooling of the ash in desiccators, the ash was treated with 4-5 ml of hydrochloric acid (concentrated), and the sample was prepared by diluting the ash to 100 ml. This is the standard solution.

STANDARD CURVE CALIBRATION

0.5ml, 1 ml, 1.5ml, 2ml, 2.5ml, 3ml, 3.5ml, and 4ml of the standard iron solution were taken in different beakers. One more beaker was prepared for blank. 0.2 milliliters of conc. HCL was mixed in the iron solution of each beaker including blank and then the contents were diluted by using water to ten milliliters.

1-2 drops of hydroxylamine was also added and the contents were allowed to keep for five minutes. The buffer solution was added and readings of absorbance were taken by putting the spectrophotometer at 510 nm

The graph of iron content against the absorbance was plotted. It was the standard curve. The amount of iron in *kutki* was calculated as

FORMULA FOR CALCULATIONS

$$\text{Iron content (mg/100 g sample)} = \frac{\text{Fe1} \times \text{V} \times 100}{\text{Fe2} \times \text{M}}$$

Where

M = Mass of *kutki* sample

Fe1 = amount of Iron (sample)(for calibration)

Fe2 = amount of ash solution (sample)(for determination)

V = Volume of ash solution

3.4 Milk

Milk was another ingredient used for the development of a product *kheer*. As milk is abundantly found in *Melghat*, such a product is chosen for the study which includes milk. Gaoli is the prime community habitat of the *Melghat* region. Keeping the animals for getting milk, and then selling the milk and milk based products in the nearby area is the prime occupation of the Gaoli community. Generally, they use the traditional techniques for the processing and preparation of these products.

The milk from the *Melghat* is not only superior in quality but also well-known for its purity. The *Melghat* milk and milk products such as rabri, khoa, etc are renowned in the surrounding neighborhood.

3.4.1 Introduction

As discussed earlier milk is a primary diet with which the young mammal is fed by its mother. The composition of milk is such that it has all the necessary ingredients required for the growth over and above the sustenance of the suckling. The milk is produced by the mammary glands of all female mammals but the milk of only some of the domestic animals is used by humans for their consumption. Numerous food products and dishes are prepared and consumed throughout the world.

3.4.2 Procurement of milk

As discussed above getting a good quality of milk was not difficult for the study. The good quality of fresh milk was collected from the nearby village. The milkman was instructed to take care of avoiding any avoidable contamination.

While milking the milk, the milkman used gloves as well as the mask. A completely clean and previously sterile pot was taken for getting the milk. The milk was immediately pasteurized and stored in a refrigerator. The milk was collected fresh just before preparing the products so that minimum time should be lapsed in between getting the milk and preparing the products.

When there is a delay in using milk due to some technical reason the milk was pasteurized again and when the gap was too long the new fresh milk was procured.

3.5 DEVELOPMENT OF VALUE ADDED PRODUCTS

The products were selected in such a way that the maximum utilization of the local produce should be possible. Keeping this idea in mind *Ladoo*, and Indian sweet dish, or maybe called as the king of sweets, as well as *Kheer*, the queen of sweets, were selected for this study.

Both products were very famous traditionally in India. They are approved by the people not only as desserts but having religious importance also. In many Indian festivals, *Ladoo* and *Kheer* are having the first preference as 'Prasadam',

The principal ingredients for the preparation of *kheer* are milk, cereal flour or broken grains, and off course sugar without which no sweet product is possible. Here we replaced cereal with the millet *kutki*, and for innovation, honey was added for sweetening, not completely as a replacement of sugar, but as a supplementary sweetener.

Milk, *kutki* and honey, all the three ingredients were procured from the *Melghat* as the local produce. Other ingredients, such as cardamom powder, etc. were used for mainly adding the flavor or as the garnishing agents.

Similarly, for the preparation of *ladoo*, *kutki* flour, ghee, and sugar were used. Same as in the case of *kheer*, honey was used as a supplementary sweetening agent, not completely as a replacement of sugar. Here the ingredients used were also of the local origin. The products were made by using traditional recipes with some modifications.

3.5.1 LADOO

The product is such chosen that it should be delicious as well as popular. In addition to that, the product must be nutritious and made by using the local ingredients. While making it a novel, one thing that should be kept in mind, was it must be a familiar one. *Ladoo* satisfies all the above conditions. Thus *ladoo* was chosen as one of the products for the study.

3.5.1.1 INTRODUCTION

Ladoo is a traditional Indian sweet dish, may be originated from the south region of India. It is a sphere-shaped dessert and got its name from the word 'Lattika', originated from Sanskrit. *Ladoo* may be made from a variety of substances, but traditionally the prime ingredients used in the preparation of *ladoo* are flour, sugar, and ghee/ fat.

Other ingredients which are treated as optional may be added to the *ladoo*, which are cardamom powder, dry fruits, nuts, raisins, etc. *Ladoo* are the essential part of the menu served or prepared during festivals as well as religious occasions. It is said that *Ladoo* is a favorite sweet of many Hindu Gods. The Prasad cannot be completed without *ladoo*.

Traditionally the Indian marriages cannot be fulfilled without giving *ladoo* to the guests'; perhaps the phrase 'giving *ladoo*' (*Laddoo Khilana*) is used as an alternative word for getting married.

For this study, the *ladoo* were made by using *kutki* flour as it is easily available in the area. The nutritional importance of *kutki* was protected by the formulation of *kutki* based *ladoo*. Honey was also used as a sweetening agent in combination with sugar to enhance the nutritional quality of the *ladoo*.

3.5.1.2 FORMULATION OF *LADOO*

Ladoo were made by using the following ingredients.

- *Kutki* flour
- Honey
- Ghee (Desi)
- Sugar

While formulating the *ladoo*, the prime ingredients such as *kutki* flour, ghee, and sugar were taken in the same proportion for all varieties of *ladoo*. Honey was added in different amounts. All four samples of honey were used for the formulation.

According to the types of honey and amount of honey the following varieties were prepared.

3.5.1.2.1 PLAIN *LADOO* (CONTROL)

The control *ladoo* samples were made by using only *kutki* flour, ghee, and sugar. Honey was not added to these samples. The sample was treated by the code number L_{blank}

3.5.1.2.2 *LADOO* BLENDED WITH HONEY (SAMPLES)

Ladoo were prepared by adding the honey in different combinations. In preparing all the varieties the amount of *kutki* flour, ghee, and sugar was kept constant. *Ladoo* prepared by using honey sample 1 (H1) were designated with the code name LH₁.

Further as per the varying amount of honey added per sample four varieties of *ladoo* LH₁ were prepared and were designated with the code name as follows.

- a. LH_{1a} (amount of honey 2%)
- b. LH_{1b} (amount of honey 4%)
- c. LH_{1c} (amount of honey 6%)
- d. LH_{1d} (amount of honey 8%)
- e. LH_{1e} (amount of honey 10%)

In the similar way by using all the four varieties of honey, *ladoo* were prepared. In all the recipes the amount of *kutki* flour, sugar, and ghee were kept constant. Thus by adding the second honey sample, it got five types of *ladoo* with code names LH_{2a}, LH_{2b}, LH_{2c}, LH_{2d}, and LH_{2e}. The procedure for preparing *ladoo* and designating each variety was kept on repeating.

Finally with these formulations total 20 varieties of *ladoo* were prepared by using different combinations as well as different varieties of honey. Honey was added after the preparation of the basic mixture. It will avoid the heating of honey as well as prevents the honey from losing its properties as well as altering the nutritional value. The enzyme activity was also preserved. The varieties of *ladoo* prepared were designated with the codes as mentioned in the table 3.2

TABLE 3.2: CODE NAMES OF *LADOO*

Amount of honey	Code Names				
	Honey Samples Added				
	Sample 1	Sample 2	Sample 3	Sample 4	Without Honey
2 %	LH _{1a}	LH _{2a}	LH _{3a}	LH _{4a}	L _{blank}
4 %	LH _{1b}	LH _{2b}	LH _{3b}	LH _{4b}	
6%	LH _{1c}	LH _{2c}	LH _{3c}	LH _{4c}	
8%	LH _{1d}	LH _{2d}	LH _{3d}	LH _{4d}	
10 %	LH _{1e}	LH _{2e}	LH _{3e}	LH _{4e}	
Total <i>Ladoo</i> Samples Prepared= 21					

3.5.1.3 PREPARATION OF *LADOO*

The traditional procedure was incorporated for the preparation of *kutki* and honey *ladoo*. Firstly blank *ladoo* mixture i.e. without honey was prepared from *kutki* flour, sugar, and ghee. The ghee was used for the purpose of roasting which added the flavor in addition to the increase in the nutritional value of the product.

A. CLEANING OF *KUTKI*

Kutki was cleaned prior to the milling. The foreign material present in the *kutki* was removed by using simple unit operations. Sieving was employed to remove the smaller dust particles and other refractions. The lighter material was removed by agitation. The *kutki* grains were inspected visually, and any remaining insects or other foreign particles were removed by picking up with hands.

B. MILLING OF *KUTKI*

Kutki was milled by using the portable milling machine. The machine was thoroughly cleaned to remove any dust, particles of other grains which were milled in the machine previously.

The precautions were taken in order to get the flour with the even texture of flour. The flour was allowed to cool with proper care to room temperature.

C. ROASTING OF *KUTKI* FLOUR

Five hundred grams of *kutki* flour was taken in an iron pan. Then the flour was roasted on the gas stove on low flame with the addition of ghee (75 g). Care was taken in order to avoid excess roasting or burning. For this, the flour was stirred constantly with the help of flattening spatula. Excessive roasting may add a burning flavor to the flour, which may be unacceptable. The roasting was continued till the flour turns to light pinkish brown. A pleasant aroma also indicated the completion of the roasting process.

D. GRINDING OF SUGAR

Sugar was ground in the mixer grinder to get a fine powder of sugar. While grinding the sugar care was taken in order to avoid melting due to the heat of friction evolved during grinding. For this purpose, the grinder was run in the small intervals of time, in between each session of grinding, instead of grinding continuously in one stroke.

E. PLAIN *LADOO* (CONTROL)

Ladoo were prepared by the indigenous method. The ghee roasted flour of *kutki* and powdered sugar (200 g) were mixed with gentle stirring. Due to the finely ground sugar, the mixture got a very light sticky structure. The mixture was divided in to twenty one parts. One part of this mixture was treated as the plain *ladoo* mix.

The other twenty parts were used for the preparation of *ladoo* with honey. *Ladoo* were made from the plain *ladoo* mix, by rounding in small balls. Thus in the plain *ladoo* mix the ingredients were added with the following proportion.

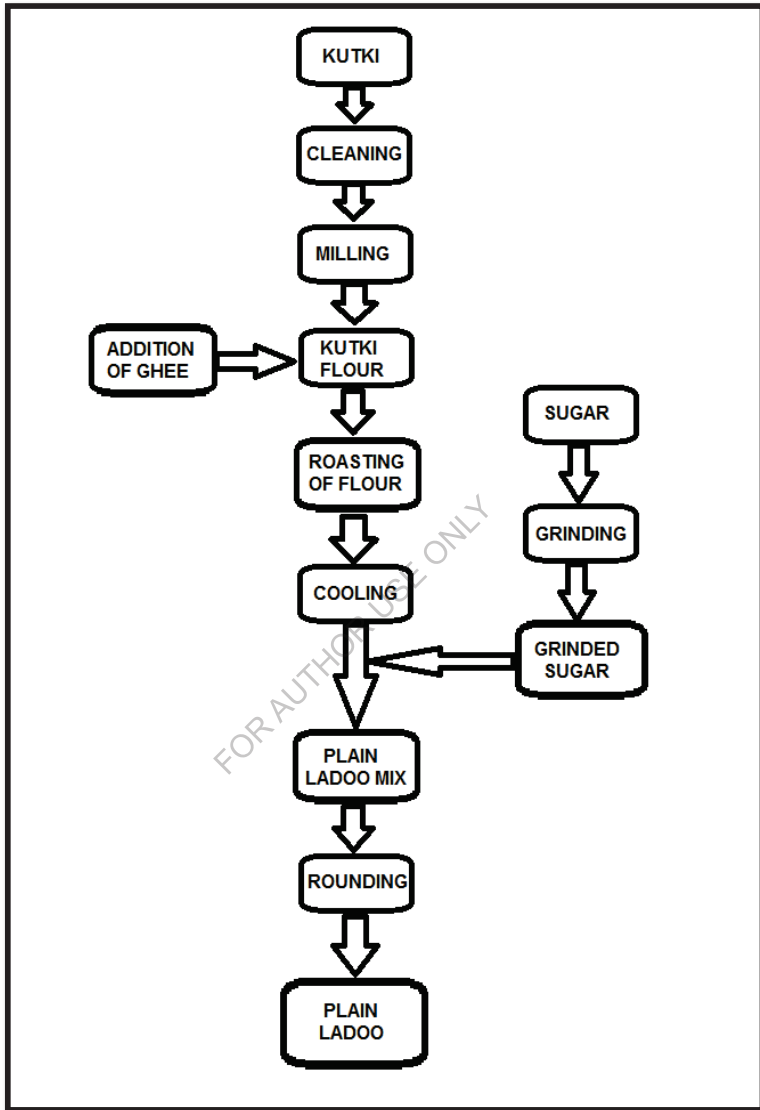
<i>Kutki</i> flour	: 500 g
Ghee	: 75 g
Powdered sugar	: 200 g

The amount of sugar may vary according to taste and amount of honey.

F. *LADOO* BLENDED WITH HONEY

There were twenty parts of plain *ladoo* mix. Honey was added to these parts as per the scheme discussed above.

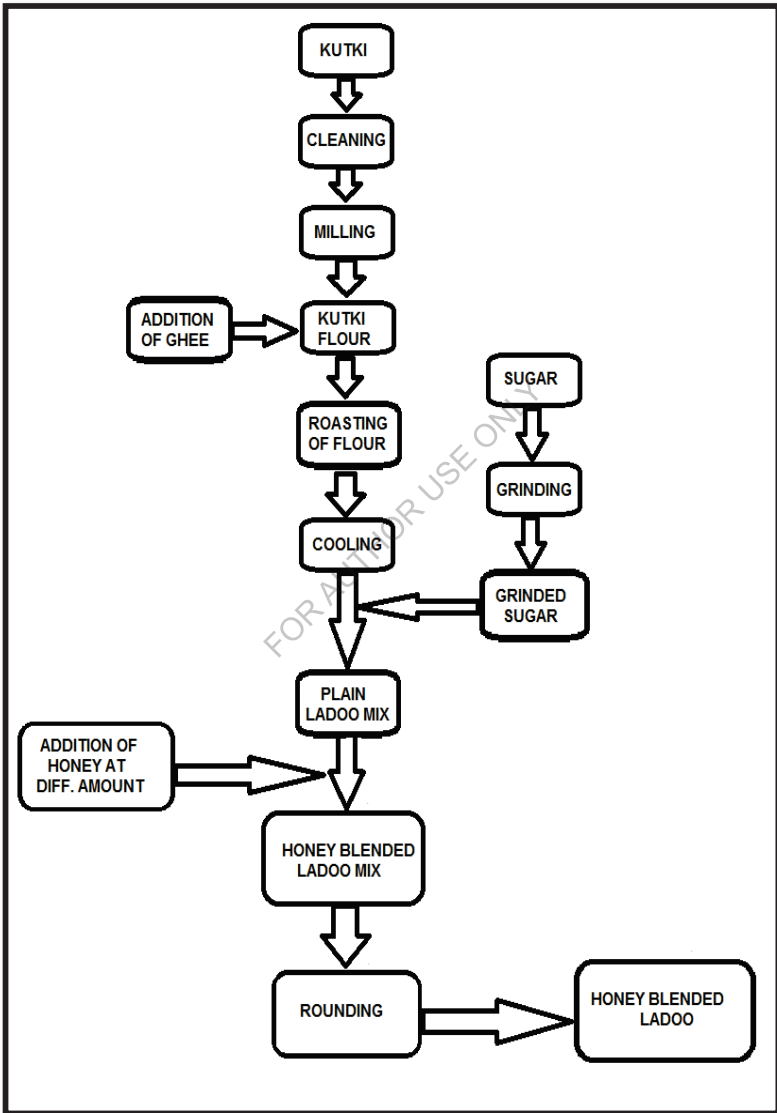
FIGURE 3.2 FLOW CHART FOR PLAIN LADOO



Each type of honey was added at an amount of 2%, 4%, 6%, 8%, and 100%. We had four types of honey samples. Thus twenty types of formulations were obtained from this mix. The flow charts of the preparation of *ladoo* are given

These twenty one kinds of *ladoo* were subjected to the sensory evaluation by the panel of semi-trained judges.

FIGURE 3.3 FLOW CHART FOR HONEY BLENDED *LADOO*



3.5.2 KHEER

Kheer is another product selected for the development of novel recipe from *kutki* and honey. Milk, another raw material available in the *Melghat* was used in the preparation.

3.5.2.1 INTRODUCTION

As already discussed it is well-known that *kheer* is the most popular sweet dish prepared in every part of India and nearby countries. The basic ingredients that are used in its preparation are milk and of course sugar. Generally, there is an addition of some cereal or cereal-based products such as rice, semolina, suji, etc.

In the course of the current study, instead of using rice, broken wheat, or semolina, the coarsely ground *kutki* was used for the preparation of *kheer*. Milk collected from the surrounded villages of the *Melghat* was utilized for this purpose.

3.5.2.2 FORMULATION OF KHEER

Kheer was made by using the ingredients such as *Kutki*, Milk, Honey, and Sugar.

While formulating the *kheer*, the prime ingredients such as *kutki* grains, milk, and sugar were taken in the appropriate proportion. The same proportion was followed for all varieties of *kheer*. Honey was added at the different amounts in all varieties as per the plan. All of the four samples of honey were used for the formulation of *kutki kheer*. According to the types of honey and amount of honey the following varieties were prepared.

3.5.2.2.1 PLAIN KHEER (CONTROL)

The control *kheer* or plain *kheer* was prepared by using only *kutki* grains, milk, and sugar. Honey was not used in the preparation of plain *kheer*. The sample was designated with the code number K_{blank} .

3.5.2.2.2 KHEER BLENDED WITH HONEY

Different kinds of *kheer* were prepared by adding the honey with different combinations to the decided portion of the plain *kheer*. For preparing all the varieties of *kheer* the amount of *kutki* grains, milk, and sugar was kept constant.

Various kinds of *kheer* prepared by using honey sample from location one (H_1) were designated with the code name KH_1 . Further, as per the amount of honey

added in each of the four varieties of *kheer* (KH₁), the samples were prepared and designated with the code name as follows.

The *kheer* samples prepared by adding honey sample 1 at varied amount

- a. KH_{1a} (amount of honey 2%)
- b. KH_{1b} (amount of honey 4%)
- c. KH_{1c} (amount of honey 6%)
- d. KH_{1d} (amount of honey 8%)
- e. KH_{1e} (amount of honey 10%)

In a similar way by using all the four varieties of honey, different kinds of *kheer* were prepared. Thus by adding the second honey sample, it got five types of *kheer* with code names KH_{2a}, KH_{2b}, KH_{2c}, KH_{2d}, and KH_{2e}. The procedure for preparing *kheer* and designating each variety was kept repeating.

Finally with these formulations total 20 varieties of *kheer* were prepared by using different combinations as well as different varieties of honey. The amount of sugar may be adjusted as per the sweetness of added honey. As honey and its properties sensitive to heat, it was added after the preparation of plain *kheer*. It will avoid the heating of honey as well as prevents the honey from losing its properties as well as altering the nutritional value. The enzyme activity was also preserved.

The varieties of *kheer* prepared were designated with the codes as given in the table 3.3.

TABLE 3.3: CODE NAMES OF *KHEER*

Amount of honey	Code Names				
	Honey Samples Added				
	Sample 1	Sample 2	Sample 3	Sample 4	Without Honey
2 %	KH _{1a}	KH _{2a}	KH _{3a}	KH _{4a}	K _{blank}
4 %	KH _{1b}	KH _{2b}	KH _{3b}	KH _{4b}	
6%	KH _{1c}	KH _{2c}	KH _{3c}	KH _{4c}	
8%	KH _{1d}	KH _{2d}	KH _{3d}	KH _{4d}	
10 %	KH _{1e}	KH _{2e}	KH _{3e}	KH _{4e}	
Total <i>Kheer</i> Samples Prepared= 21					

3.5.2.3 PREPARATION OF KUTKI KHEER

The traditional procedure was incorporated for the preparation of *kheer*. Firstly plain *kheer* without the addition of honey was prepared by using *kutki* grains, sugar, and milk. Milk was the prime and bulk ingredient used in the preparation of *kutki*.

For the preparation of *kheer* with honey, the plain *kheer* was used. Honey was added in the plain *kheer* in the specified amount after cooling the plain *kheer* at room temperature in order to avoid any nutritional loss caused by heating the honey.

3.5.2.3.1 PREPARATION OF PLAIN KUTKI KHEER (CONTROL)

Kheer was prepared by following the indigenous household method only instead of other cereal grains such as rice or wheat, *kutki* was used. The prime ingredients were taken in a following proportion

Milk	: 2 kg
<i>Kutki</i>	: 100 g
Sugar	: 300 g

The amount of sugar may vary according to taste.

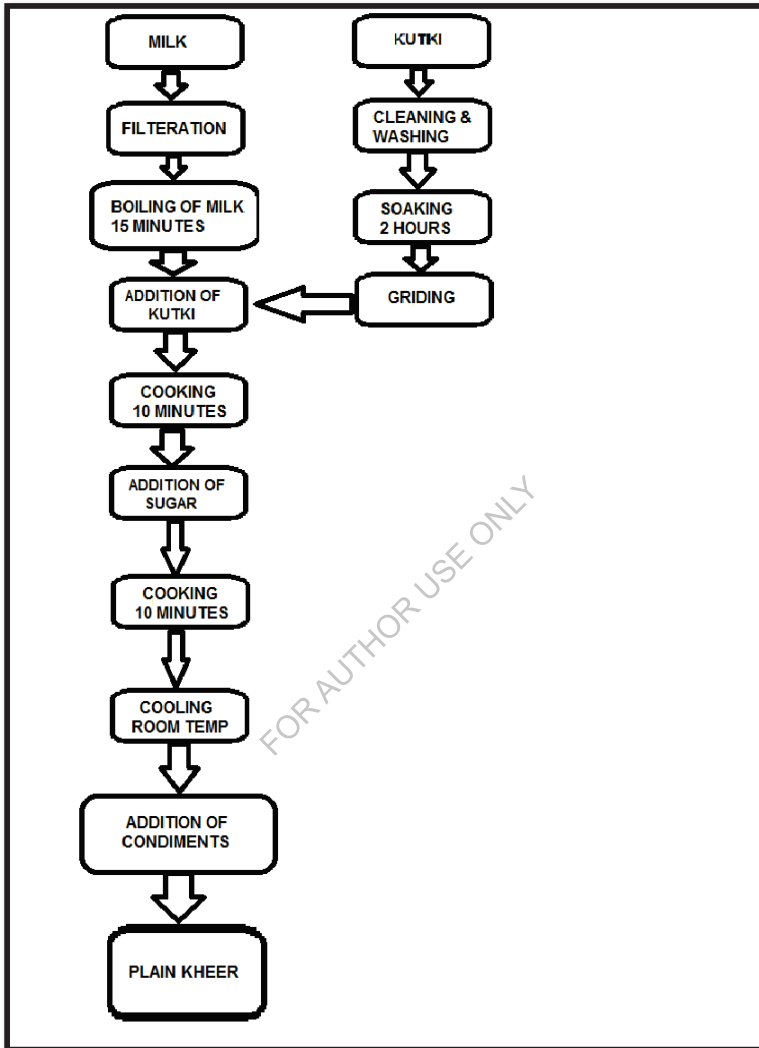
A. Cleaning of *Kutki*: The grains of little millet were inspected for any dirt and cleaned at first. Simple unit operations such as sieving, agitation, handpicking of objectionable material, and washing were applied for this process.

B. Soaking of the *Kutki* grains: After proper washing, the excess water was removed carefully and fresh water was added to the hundred grams of *kutki* grains for soaking. The level of water was maintained in such a way that the grains should be under the water layer for at least one inch. The *kutki* grains were allowed to soak for two hours.

After two hours of soaking the grains were soften. They were ground in a mixer grinder in such a way to get a very coarse paste. The care was taken that the grains were just broken down and should not be converted in to fine particles.

C. Cooking the milk: Two liters of milk was taken in a suitable non-stick pot. The milk was heated gently first to boiling. Then it was kept on low flame and boiled for another fifteen minutes. Continuous stirring was applied while boiling the milk in order to avoid the formation of foam which may overflow the milk out of the pot. It was observed that due to loss of moisture the volume of milk reduced to 1800 milliliters.

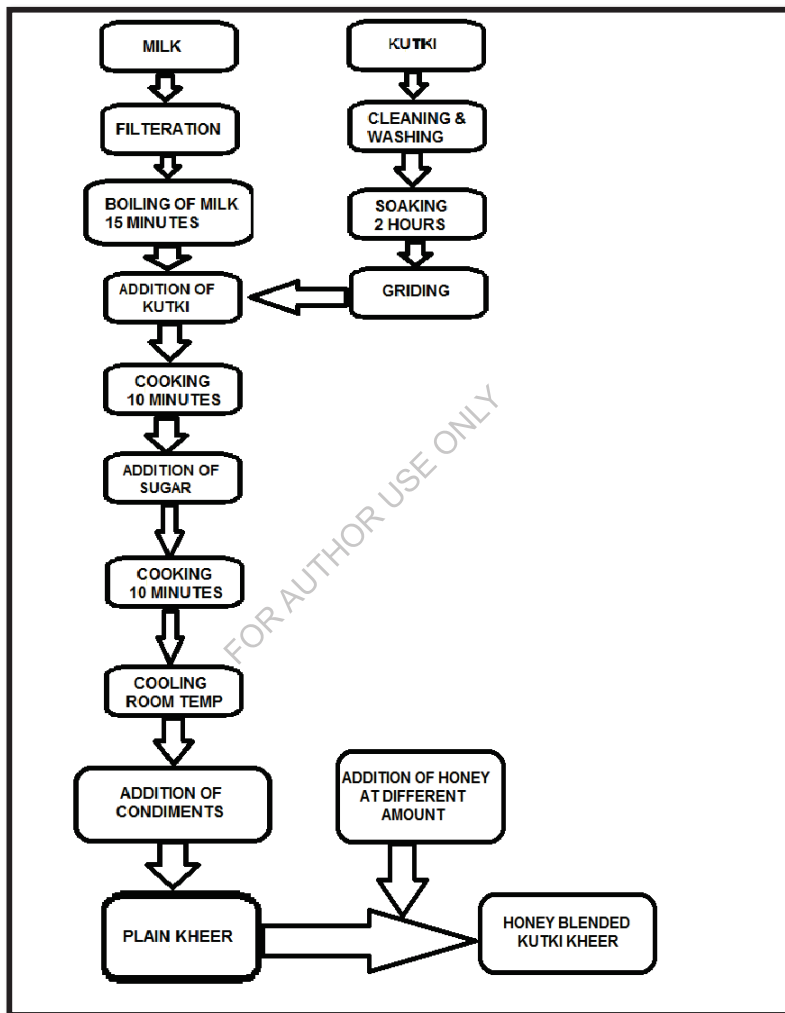
FIGURE 3.4 FLOW CHART FOR PLAIN *KHEER*



D. Addition of the *Kutki* grains: The previously soaked and coarsely ground *kutki* was added to the hot milk without turning off the gas flame. The mixture of milk and the *kutki* were heated together with continuous stirring. The mixture was boiled for another ten minutes. It was sufficient time in order to cook the *kutki* completely. The

coarsely ground grains of *kutki* were softened, which was the indication of completion of cooking of *kutki*.

FIGURE 3.5 FLOW CHART OF HONEY BLENDED *KHEER*



E. Addition of sugar: The decided amount of sugar was added to the above boiled combination of milk and *kutki*. The blend was again heated for 10 minutes. Here the plain *kheer* is ready. Cardamom powder was added to the *kheer* after cooling to room temperature.

3.5.2.3.1 KHEER BLENDED WITH HONEY

There were twenty parts of plain *kheer* taken. Honey was added to these parts as per the scheme discussed above. Each type of honey was added at an amount of 2%, 4%, 6%, 8%, and 10% in separate parts. There were four types of honey samples taken for the research. Thus twenty varied formulations were obtained after the addition of honey.

These twenty one kinds of *kheer* samples (twenty with honey and one plain) were subjected to the sensory evaluation by the panel of the judges.

3.6 SENSORY EVALUATION OF THE PRODUCTS (Ranganna, 2007)

The response of the customer to any product definitely depends on the quality of the food. Quality of a food product is determined by maintaining the various key parameters such as safety, shelf-life, flavor, color, texture, etc. The overall quality of the food product is depended upon the attributes such as nutritional and other parameters, quantity, as well as its sensory quality.

Sensory Quality

It is a parameter with great importance for both the producer as well as the consumer. It is the tool to decide whether the prepared product will be accepted by the user or not. The product should have to satisfy the gustatory as well as the aesthetic sense of the consumer. The sensory quality evaluation is a process of determining the perception about food by eating and observing the appearance and overall feel.

The parameters of appearance e.g. shape, size, defect present if any, color, and uniformity, are evaluated with the help of the sensory organ eyes. Other parameters such as texture, consistency, flavor, taste, odor, and mouth feel are also evaluated during sensory examination. For the evaluation of the prepared products based on honey and *kutki*, the nine-point hedonic test was applied.

3.6.1 NINE POINT HEDONIC TEST

On the basis of pleasurable or un-pleasurable experiences, the above hedonic tests were dependent. The hedonic ranking tests give an idea about the sensory quality of the product from the customer point of view.

Maximum four samples were provided at a time to each of the panel members for the examination in order to avoid confusion. The judges are asked to evaluate the product on the basis of the nine points that are already discussed.

3.6.1.1 PROCEDURE

The laboratory was set up as per the standards. The typical layout was followed for the preparation and judging. The panel of five trained judges was selected for the sensory evaluation exercise. While selecting the panel judges the criteria were applied. The members were of

- Availability of time
- Good physical condition
- Readiness to expend time
- Good concentration and learning level capability
- Sensitivity in average
- Interest as well as inquisitiveness to do the job

The members selected were trained partially for the job through the basic qualifying tests of recognition of odor and taste. The semi-trained five members were selected as a panel of judges.

The suitable numbers of food samples under examination were served to the panel members at one session for the evaluation. The responses were recorded for drawing the conclusions. The responses were recorded by providing a separate score sheet to each panelist.

3.6.1.2 SENSORY EVALUATION OF *LADOO*

For the evaluation of the *ladoo*, the samples were grouped in such a way that the evaluation should be done most effectively. The judges were asked to give the scores in each category by assigning them with the numerical values as per the criteria given in the nine point hedonic scale method.

The five sensory attributes i.e. Color, Texture, Taste, Appearance, and Overall acceptability were evaluated by the panel of selected persons.

The point system was described to them for the sensory evaluation

1. Liked extremely- 9
2. Liked very much -8
3. Liked moderately-7
4. Liked slightly -6
5. Neither liked nor disliked -5
6. Disliked slightly -4
7. Disliked Moderately -3
8. Disliked very much -2
9. Disliked extremely-1

For this purpose, the sheets were prepared as per the given format for every judge separately. Two types of sheets were applied for the evaluation of each product i.e. *ladoo* and *kheer*.

A. Sheet type 1: This type of sheet is for the sensory comparison of *ladoo* samples at varied amount of particular honey sample. Here the *ladoo* prepared by adding particular honey sample (H_1) at different amount were evaluated at once. The blank *ladoo* sample was also given for comparison.

FIGURE 3.6 SENSORY EVALUATION SHEET 1 (FOR LADOO)

SENSORY EVALUATION SHEET						
Name of the Panel Member: -----						
Name of the product : -----						
Sheet No. (type 1) :-----						
Sensory Attributes	Ladoo Sample Code					
	LH _{1a}	LH _{1b}	LH _{1c}	LH _{1d}	LH _{1e}	L _{blank}
Color						
Texture						
Taste						
Appearance						
Overall Acceptability						

In sheet 1 the honey sample of only one type was used. The scores were for the comparison to get the best amount of honey that could be added in order to get the highest acceptability of the product.

Separate Sheet no. 1 is used for the evaluation of *ladoo* prepared by adding particular honey sample. Thus there were four sheets with code number 1 were filled by each judge, as there were four types of honey samples used at varied amount (2%, 4%, 6%, 8%, and 10%), for the preparation of *ladoo*.

B. Sheet type 2: These types of sheets were prepared for the comparison of the *ladoo* samples prepared by adding different honey samples. The *ladoo* prepared by adding the different types of honey but at the same amount were evaluated organoleptically to compare which type of honey sample is more acceptable in *ladoo*.

FIGURE 3.7 SENSORY EVALUATION SHEET 2 (FOR LADOO)

SENSORY EVALUATION SHEET					
Name of the Panel Member: -----					
Name of the product : -----					
Sheet No. (type 2) :-----					
Sensory Attributes	<i>Ladoo</i> Sample Code				
	LH ₁	LH ₂	LH ₃	LH ₄	L _{blank}
Color					
Texture					
Taste					
Appearance					
Overall Acceptability					

3.6.1.3 SENSORY EVALUATION OF *KHEER*

For the evaluation of the *kheer*, the groups of the samples were made to avoid the confusion and the most effective evaluation of the product. The judges were provided with the sheets for assessing the products by following the nine-point hedonic scale method as discussed earlier in the sensory evaluation of *ladoo*. The method and all other parameters used are also the same as for the sensory evaluation

of *ladoo*. Nine point scale from extremely liked to extremely disliked was employed. The sheets were also prepared in an identical manner i.e. separate for each panel member.

C. Sheet type 1: These types of sheets were for the sensory comparison of *kheer* samples at a varied amount of particular honey.

FIGURE 3.8 SENSOTY EVALUATION SHEET 1 (FOR *KHEER*)

SENSORY EVALUATION SHEET						
Name of the Panel Member: -----						
Name of the product : -----						
Sheet No. (type 1) :-----						
Sensory Attributes	<i>Kheer</i> Sample Code					
	KH _{1a}	KH _{1b}	KH _{1c}	KH _{1d}	KH _{1e}	K _{blank}
Color						
Texture						
Taste						
Appearance						
Overall Acceptability						

Here the *kheer* samples prepared by adding particular honey (H₁) at different amounts were evaluated at once. The blank *kheer* sample was also given for comparison.

Sheet number 1 was used for the *kheer* samples prepared by adding only one type of honey sample. Thus a total of four sheets of type 1 were used for the sensory evaluation of *kheer* samples. On each of this type of sheet, the sensory scores for the *kheer* samples prepared with a varied amount of honey were recorded.

D. Sheet type 2: The type 2 sheets were used for the comparison of the *kheer* samples, prepared by adding the same amount of each honey sample. The sensory

scores of the *kheer* samples prepared by adding various types of honey at the same amount were recorded collectively.

FIGURE 3.9 SENSOTY EVALUATION SHEET 2 (FOR *KHEER*)

SENSORY EVALUATION SHEET					
Name of the Panel Member: -----					
Name of the product : -----					
Sheet No. (type 2) :-----					
Sensory Attributes	<i>Kheer</i> Sample Code				
	KH ₁	KH ₂	KH ₃	KH ₄	K _{blank}
Color					
Texture					
Taste					
Appearance					
Overall Acceptability					

Here the most suitable honey for the preparation of *kheer* on the basis of its acceptability was examined. In the same way, as in the sensory evaluation of *ladoo*, this type 2 sheet was used by giving to each panel member.

The judges were provided with the separated isolated facilities for the proper judging. The *kheer* prepared by adding each honey at the same level were served at once with of course the involvement of a blank sample. The data collected from the individual sheet was then jotted down in tabular forms for further analysis.

ANALYSIS OF DATA

The data thus collected were combined and written in the tabulated form. The tables were prepared as per the convenience and the type of data. The data then compared with the values available in the literature or with the values specified by the standard agencies. The data of sensory evaluation is compared by using the statistical method of ANOVA. After analyzing the data by comparing it with the available values the results were drawn with the help of proper discussions. From the results

and the conclusions that were obtained the finding were noted down systematically with the future scopes and opportunities. The recommendations were given at the end.

ANALYSIS OF VARIANCE (ANOVA)

Analysis of variance commonly known as ANOVA is a statistical technique used to test or compare the various means. The experimental observations obtained by various treatments and their relation can be statistically compared by ANOVA.

In the experiments, if the design uses only one factor to compare then it is the one-way ANOVA. On the other hand, if there are two factors then it is two-way ANOVA (Christensen, 1996).

In the current study, the sensory evaluation data obtained for the variety of parameters are compared by using one-way and two-way ANOVA. The mean values obtained for the various parameters in the evaluation of the products (ladoo and kheer) are compared through the one-way ANOVA method. The comparison is done separately for the values of evaluation of products honey type wise and amount wisely. The summary of total scores of sensory evaluation for each product is compared by using the two-way ANOVA method.

The null hypothesis is designed such that 'there is no significant difference between the tabulated values in the rows and columns. F values for respected rows and columns of the table are calculated and the hypothesis is tested by comparing the calculated F-value with F-critical value (at 0.05 level of significance). The distribution is known as F-distribution (In the name of Sir Ronald Fisher) (Christensen, 1996).

CHAPTER 4

RESULTS AND DISCUSSION

4.1 INTRODUCTION

The study was carried out to determine the physicochemical distinctiveness of the *Melghat* honey. *Melghat* honey is the honey that is prepared mostly by the undomesticated or wild species of honey bees i.e. *Apis dorsata*, and *Apis cerana* by collecting the floral liquid from the nectaries of plenty of different flowers that included diversified plants from the prosperous *Melghat* forest. The antibacterial potential in addition to the phytochemical screening of the *Melghat* honey were also detected by using the standard methods. The data in consequence obtained was compared with the standard values published earlier.

'*Kutki*', also known as little millet, was as well examined to evaluate its physicochemical, functional, and nutritional characteristics. The scientific name (botanical name) of *kutki* is *Panicum sumatrense*. It is native of India and one of the most important crops cultivated and consumed mostly by the tribal people of the *Melghat* region. It was mentioned in the literature that *kutki* is found to be affluent in iron, calcium, and some other minerals in addition to vitamins. In this study, the physicochemical properties of *kutki* were examined. Besides the proximate ingredients, some mineral contents were also determined.

4.2 ANALYSIS OF THE MELGHAT HONEY

For the study, the honey samples were collected from the four distinct locations of the *Melghat*. The honey samples collected for the analysis to detect the physicochemical characteristics.

PHYSICOCHEMICAL PROPERTIES

4.2.1 COLOR

Liquid honey varies in color from almost colorless just like water to dark amber that resembles closely to black. It is the color that is the first perceived by the consumer while selecting the honey (Boussaid et al., 2018). The colors of the honey samples were observed visually by using the Pfund color range. The colors were identified with the help of color charts and the data was recorded. The color observations of all the honey samples were summarized in table 4.1

TABLE 4.1: COLOR OBSERVATIONS OF MELGHAT HONEY SAMPLES FROM DIFFERENT LOCATIONS

S N	HONEY SAMPLES		COLOR
	LOCATION	SAMPLE NO.	
1	LOCATION 1 (H ₁)	1	Amber
2		2	Amber
3		3	Light Amber
4		4	Amber
5	LOCATION 2 (H ₂)	1	Light Amber
6		2	Light Amber
7		3	Light Amber
8		4	Extra light Amber
9	LOCATION 3 (H ₃)	1	Light Amber
10		2	Extra light Amber
11		3	Light Amber
12		4	Light Amber
13	LOCATION 4 (H ₄)	1	Dark Amber
14		2	Amber
15		3	Dark Amber
16		4	Dark Amber

DISCUSSION

It was revealed from the data that the samples were ranging from dark to light amber in color. Very lighter colors such as extra light or water white were totally absent in the collected samples. The honey samples from the same locations were having a similarity in their color pattern.

All the four honey samples collected from the first location (H₁) were possessing amber color. The third sample was found to exhibit some lighter amber shade. The honey samples from the second location (H₂) were amber and light amber in color with very little variation. The second location honey samples were lighter in color as compare to the location one honey samples. The honey samples collected

from the location three (H₃) were very much similar in color when compared to that of the samples H₂.

The honey samples collected from the fourth location (H₄) of the *Melghat* forest were found to be the darkest in color among all the honey samples. The color of the second honey sample from the fourth location was somewhat lighter than the remaining three, but it was also darker than rest of the honey samples.

It was observed from the results that the average relative density of the darker samples slightly tended to have greater values in comparison with the lighter sample. There was not any specific relation found between color and other properties.

The variations in the color of honey may be due to an assortment of properties and content such as climatic and agricultural conditions, availability of the types of source flowers, techniques and methods used for the processing, storage conditions including temperature and time, water content, ash content, optical density, and the composition of honey (Khalil et al., 2012; White, 1975; Krell, 1996, Krishna, 2015; Subramanian et al., 2007; DaSilva et al., 2016).

The colors may vary as per the pattern and amount of minerals as well as the content of pigments. It was also added that the color may change during storage depending upon the temperature of storage and the time duration (Shobham et al., 2017). White and Doner, 1980, studied honey and stated that there is a relation between color and flavor of honey, dark-colored honeys have an intense flavor and mild flavored honeys are light in color. The results were in accordance with the study by Sohaimy and the study of Karnataka honey of India. (Sohaimy et al., 2015; Almasi & Basavarajappa, 2019)

All the samples of the *Melghat* honey may have a significant content of phenolic compounds as all are having a range of dark colors. The darker honeys are having high potential to serve as excellent antioxidants (Kaskoniene et al., 2009). Thus the variation in the color range of honeys in this study might be due to the variety in nectar origin, age of honey, storage time and the conditions, the surrounding temperature, and availability of minerals (Kavapurayil et al., 2014).

4.2.2 Ph

The pH of honey is an indication of its acidic or basic nature. It was revealed in plenty of studies that honey is naturally acidic in nature. The locational variations or the differences in the botanical sources cannot change the nature of honey from acidic

to basic (Atul et al., 2018; Manukumar et al., 2013). The pH of the different honey samples under the study was measured using the digital pH meter and was recorded. The data of pH values are as given in table 4.2. The means and standard deviations are calculated.

DISCUSSION

The pH was ranging from 3.39 to 5.07. The low values of standard deviation indicate that there were significant similarities found in the values of the pH of honey samples belonging to the matching locations. If summarized, it was found that all the honey samples collected from the *Melghat* forest were acidic in nature. Location 4 samples (H₄) were comparatively low in pH while the location three samples (H₃) were least acidic with higher pH.

The values were significantly similar to the values of pH detected in the study of honey samples from Madhya Pradesh, India (Rajpoot et al., 2013). The results were also in the range specified by Bagdanov (2011) during his study. It was stated that the values of the pH of honey generally stretch out between 3.5 and 4.5. Though there are not any specifications decided by the standard deciding agencies for the pH of honey, all the honey samples included in the present study were near the range.

Here are some scores obtained by the researchers who studied the pH and its effects on the properties of honey (Adebisi et al., 2004 (3.31- 6.02); Boussaid et al., 2018 (3.67-4.11); Chin & Sowndhararajan, 2019 (3.17- 5.85); Harun et al., 2017 (4.32); Gebru (2015) (2.99- 4.45); Nazarian et al., 2010 (4.45-4.96), Zhou et al., 2013 (6.71). The honey samples from Nigeria, Tunisia, Serbia, Istanbul, Ethiopia, Iran, and China were analyzed in the above studies. Sohaimy et al. (2015) analyzed the Yemeni, Egyptian, Alexandrian, Kashmiri, and Saudi honey samples. There were slight differences found with the current study values.

It was reported that the low down pH of honey is due to the presence of heaps of organic acids that are in the honey naturally. The phosphates, chloride ions in attendance in honey were also responsible for its acidic pH (Bogdanov et al., 2004; Shobham et al., 2017).

The pH of honey is having different values depending upon not only its organic acids profile but also the minerals content, formation of HMF, kind of origin of flowers and pollens, the storage conditions of honey such as temperature and humidity, and consequences of adulteration (Asif et al., 2002; Pande and Jude, 2019;

White & Doner, 1980; Sohaimy et al., 2015). Dimins et al., (2006) stated that the pH of honey determines its quality, as the shelf life of honey is strongly dependent upon its pH.

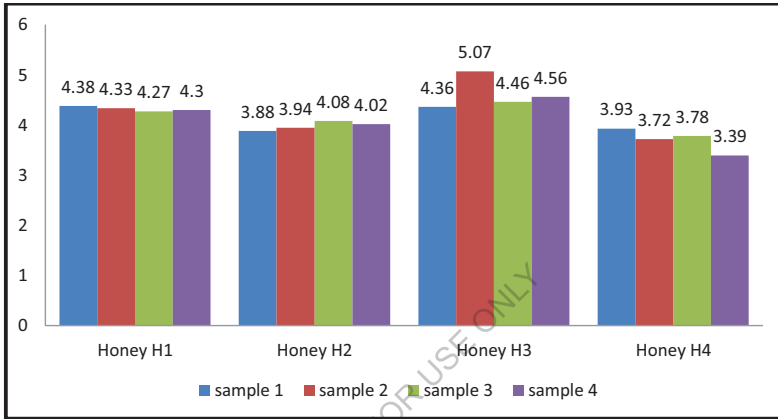
TABLE 4.2: pH OF MELGHAT HONEY SAMPLES FROM DIFFERENT LOCATIONS

S N	HONEY SAMPLES		Ph	MEAN pH	STANDARD DEVIATION (SD)
	LOCATION	SAMPLE NO.			
1	LOCATION 1 (H₁)	1	4.38	4.32	0.04
2		2	4.33		
3		3	4.27		
4		4	4.30		
5	LOCATION 2 (H₂)	1	3.88	3.98	0.08
6		2	3.94		
7		3	4.08		
8		4	4.02		
9	LOCATION 3 (H₃)	1	4.36	4.61	0.27
10		2	5.07		
11		3	4.46		
12		4	4.56		
13	LOCATION 4 (H₄)	1	3.93	3.71	0.20
14		2	3.72		
15		3	3.78		
16		4	3.39		

The flavor over and above the resistive capacity of honey to fight against the microorganisms, responsible for its spoilage to a greater extent affected due to the acidic pH and the presence of organic acids in honey (Da-Silva et al., 2016). The low pH of honey is related to the life of the spoilage creating microorganisms. The growth comes to an end through the prevention of proliferation as the optimum pH for most of the microorganisms is above or near neutrality, so low pH acts as an antimicrobial agent.

The texture, structure, and stability are some parameters affected by the pH. The pH is one of the crucial criteria that help to find out the floral origin of monofloral honeys. The acidic pH of honey boosts its therapeutic potential (Abeshu & Gelata, 2016; Krishnasree & Mary, 2015; Almasi & Basavarajappa, 2019; Manzoor et al., 2013; Islam et al., 2012).

GRAPH 4.1: pH OF THE HONEY SAMPLES



The low values of the pH of the *Melghat* honey samples show that these honeys might have the potential to fight strongly against microorganisms. Thus the *Melghat* honey might have high stability and shelf life. Also the *Melghat* honeys might have tremendous medicinal and therapeutic potential.

4.2.3 SPECIFIC GRAVITY

The specific gravity is one of the measures of the moisture and sugars in the honey. Specific gravity or relative density is remarkably related to the water activity of honey. Water activity is the characteristic that is the cause of many other properties. The specific gravities of the honey samples from the *Melghat* were given in table 4.3

DISCUSSION

The relative density or specific gravity values were found in the range of 1.37 to 1.45. In the current learning, location four samples (H_4) having the lowest specific gravity while location one samples (H_1) were topped the table. It was observed that there were very few variations that appeared in the values of the relative density of all

the honey samples. Likewise, the honey samples collected from the same locations were having almost identical values (low values of SD). For instance, in the case of all the four samples from location four i.e. H₄, the values were 1.42, 1.38, 1.37, and 1.39 with SD 0.02. Except for the first one (SD-0.03), all are very much similar to each other.

The same results have appeared for all the locations with little exceptions. The specific gravity values were found to have relations with pH, the pH values and specific gravities were increasing simultaneously. Moisture and specific gravity have appeared in the inverse relationship.

TABLE 4.3 SPECIFIC GRAVITIES OF MELGHAT HONEY SAMPLES FROM DIFFERENT LOCATIONS

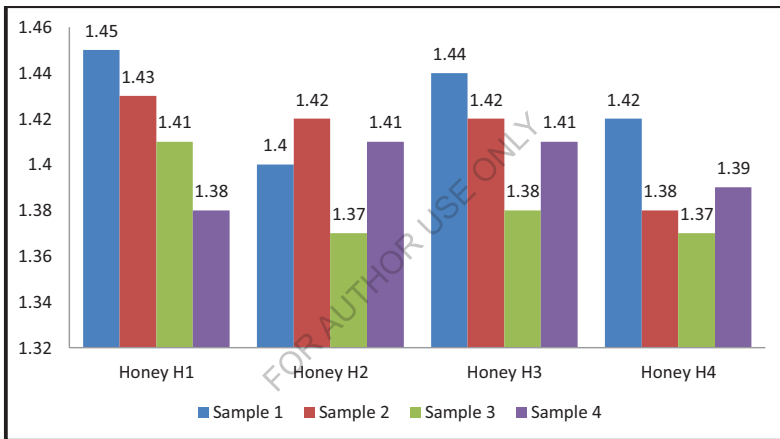
S N	HONEY SAMPLES		SPECIFIC GRAVITY	MEAN	STANDARD DEVIATION (SD)
	LOCATION	SAMPLE NO.			
1	LOCATION 1 (H₁)	1	1.45	1.417	0.03
2		2	1.43		
3		3	1.41		
4		4	1.38		
5	LOCATION 2 (H₂)	1	1.40	1.40	0.02
6		2	1.42		
7		3	1.37		
8		4	1.41		
9	LOCATION 3 (H₃)	1	1.44	1.412	0.02
10		2	1.42		
11		3	1.38		
12		4	1.41		
13	LOCATION 4 (H₄)	1	1.42	1.39	0.02
14		2	1.38		
15		3	1.37		
16		4	1.39		

The results that obtained were showing similarity with Gairola et al., (2013) (1.36-1.42), and Atul et al., (2018) (1.39-1.42). Gairola (2013) had assessed 11

samples from Uttarakhand of India whereas Atul Kumar evaluated the properties of honey samples from North India. Almasi & Basavarajappa (2019) got the values that are very much similar to the current data when they studied the honey samples from Karnataka (1.39 to 1.42). In the study by Kavapurayil et al., (2014), the data obtained was started from a lower range.

No value of specific gravity obtained in this study was below the standard value given by BIS (IS 4941, 2002). All the honey samples from the *Melghat* might be recognized as the graded honey samples as per the limit set by BIS. According to it the minimum specific gravity of honey must be above 1.37 for its grading

GRAPH 4.2: SPECIFIC GRAVITIES OF HONEY SAMPLES



The variation in the specific gravity values might be due to the difference in the water content as well as the overall composition of honey samples.

4.2.4 MOISTURE

The water content of honey is one of the most crucial parameters to determine the quality of honey. In the composition of honey, it is the second most bulk-forming agent both by weight and volume (Krell, 1996). Water is the solvent in which all other constituents of honey were got dissolved or maybe as the suspended particles. The aqueous content of honey may vary tremendously in the kind of honeys depending upon the numerous factors. The current study detected the moisture content of all

samples under investigation. The data thus obtained are tabulated and presented in table 4.4

TABLE 4.4: MOISTURE CONTENT OF MELGHAT HONEY SAMPLES FROM DIFFERENT LOCATIONS

S N	HONEY SAMPLES		MOISTURE (MASS %)	MEAN	STANDARD DEVIATION (SD)
	LOCATION	SAMPLE NO.			
1	LOCATION 1 (H₁)	1	18.38	18.40	0.15
2		2	18.24		
3		3	18.65		
4		4	18.33		
5	LOCATION 2 (H₂)	1	18.35	19.00	0.64
6		2	18.45		
7		3	19.89		
8		4	19.32		
9	LOCATION 3 (H₃)	1	19.51	18.80	0.45
10		2	18.59		
11		3	18.79		
12		4	18.29		
13	LOCATION 4 (H₄)	1	18.88	19.04	0.42
14		2	19.68		
15		3	18.51		
16		4	19.09		

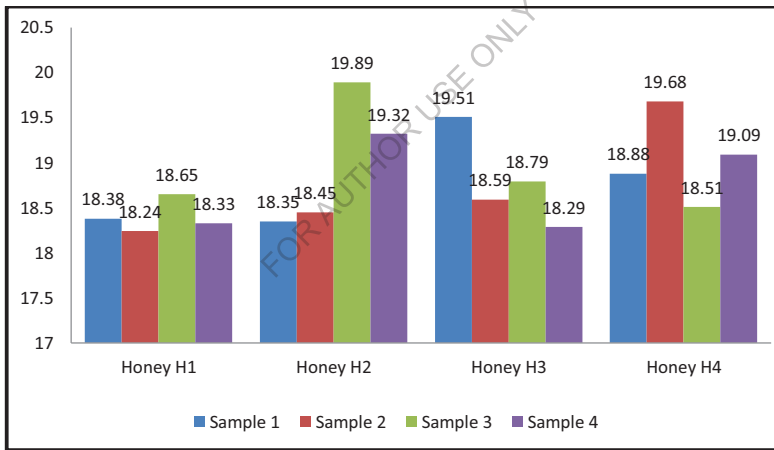
DISCUSSION

It was revealed from the data that the entire samples have the moisture contents below 20%. The values were indicating the fact that all the samples were of special grade samples. According to the standards set by BIS (Bureau of Indian Standards), the special grade honey should have the water content below 20 % (IS 4941, 2002). The water content values in the current study were ranging between 18.24% and 19.89%. The values were also lying bellow the specified standards as given by EU (water content should be below 20%) (Dinins et al., 2006).

In this study, the specific gravity and moisture were found to have an inverse relationship as the honey samples with low water content had been having higher relative density with few exceptions. The honey samples from location one (H₁) were possessed the mean value of water content 18.4% similarly the location 2 (H₂), 3 (H₃), and 4 (H₄) were having the mean values of moisture content 19.0%, 18.8%, and 19.04% respectively.

The results were appeared to be contemporaneous with the results drawn by Pande and Jude (2019), (18% -19.4%); Islam et al. (2012), (17.19% - 19.19%); Bogdanov (2011) (15% - 20%). Harun et al. (2017) studied Istanbul honey and get water content 16.31 % whereas, Sohaimy et al. (2015) investigated honey samples from Egypt (moisture 18.32%), Saudi (15.64%), Yemen (16.28 %), and Kashmir (14.73%).

GRAPH 4.3: MOISTURE CONTENT OF THE HONEY SAMPLES (MASS %)



In addition to this, many researchers have investigated the honey samples of different geographical varieties as well as dissimilar floral origins to evaluate the moisture content. Some of them are Gebru (2015) (17 - 23 %); Bogoviku and Gedeshi (2015) (14.3 - 21%); Krishnasree and Mary (2015) (16.6 %); Kavapurayil et al. (2014) (22.6 - 26.2%); Rajpoot et al. (2013) (18.10 – 23.2%); and Manukumar et al. (2013) (15.69 – 17.23%). All the values investigated by the respective researchers were mentioned in the bracket.

It was observed that, though most of the results were not matching with the current data but with some exceptions all the values were within the stipulated range. The moisture content of the five mono-floral Karnataka honey samples was characterized by Almasi and Basavarajappa (2019), which have shown the results analogous to this study (17.5% to 19.5%).

In the above study, it was observed that the water content of honey may vary due to a range of direct or indirect reasons. The consequence of variations in the moisture content of the investigated samples in the current study might be due to some noteworthy reasons such as the storage conditions (surrounding temperature and humidity), stage of ripening and maturation of honey when it was harvested, botanical origin, environmental and locational factors, types and the condition of hives, and types and implementation of methods during handling and processing, etc.

The current study showed the variations in their values of moisture contents were also might be due to the season or the climatic conditions during the harvesting of honey as well as the geographical and ecological factors.

White and Doner (1980) stated that the natural water content of honey is the remaining water that comes from the nectar collected and taken for the production of honey, after the ripening of honey.

The moisture content of honey can be considered as an important criterion for its grading and for determining its level of maturity since it was observed that the water content of matured honey always found low than that of immature or under-ripened honey. The many of physical parameters of honey such as color, taste, flavor, viscosity, relative density, and solubility were found to be affected strongly due to the variations in its water content (Dimins et al., 2006; Da-Silva et al., 2016; Manzoor et al., 2013).

As the moisture content of the inspected honey samples much low the *Melghat* honey might be a good antimicrobial agent. The susceptibility of these honey samples for fermentation quite low, as it was revealed that the honey samples with high moisture were likely to be ferment due to the yeast present naturally in honey and there might be a growth of molds which may cause spoilage (Amabye, 2017; White & Doner, 1980; Bogdanov et al., 2004).

From the above data, considerations, and discussion regarding the moisture content it can be concluded that the *Melghat* honey would be with high shelf life and

excellent quality. It might have an excellent potential to fight against microorganisms, and with a low risk of fermentation over and above granulation. The honey samples in the current study were having the moisture values absolutely within the range and can be considered as special grade honey as per the BIS standards and could be got the premium value in the honey market.

4.2.5 ASH CONTENT

Ash content of honey was determined as it is also a primitive characteristic of honey useful to evaluate its quality. Many features are there that may affect the ash content of honey. It may be a result of the type of pollens and the source flowers. The soil properties in the harvesting area and the atmospheric conditions might also cover a significant effect on the ash content of honey. As honey mostly comprised of sugars and water, and all other ingredients in honey are in very low quantity especially minerals and other ash forming components, the ash content of honey is practically very low (Bogdanov et al., 2004; Asif et al., 2002).

The ash content of all the *Melghat* honey samples was determined and recorded in table 4.5

DISCUSSION

It was cleared from the data that the ash content of the *Melghat* honeys was much below the specified maximum value given by BIS. According to the BIS for a honey to be sold in an Indian market the maximum amount of ash that can be accommodated in honey is 0.5 g/ 100g of the sample (IS 4941, 2002). It can be witnessed that the ash content of the *Melghat* honey samples was laid below 0.39%. The ash content of some samples was too low to determine.

The maximum average ash content was in the location one samples (H_1) with a value of 0.29% followed by location four (H_4) honey samples. Samples from locations two and three (H_2 and H_3) were very low in ash. There are low values of standard deviation. The ash content of the *Melghat* honeys did not show any relevance with the other factors.

The variations in the ash value of honey samples might be an upshot of ample of reasons. It was reported that the minerals in the honey mostly affect the content of ash. The soil in the area of honey harvesting, as well as the area within the range of the honey bees for honey collection, has an influence on the mineral found in the honey.

TABLE 4.5: ASH CONTENT OF MELGHAT HONEY SAMPLES FROM DIFFERENT LOCATIONS

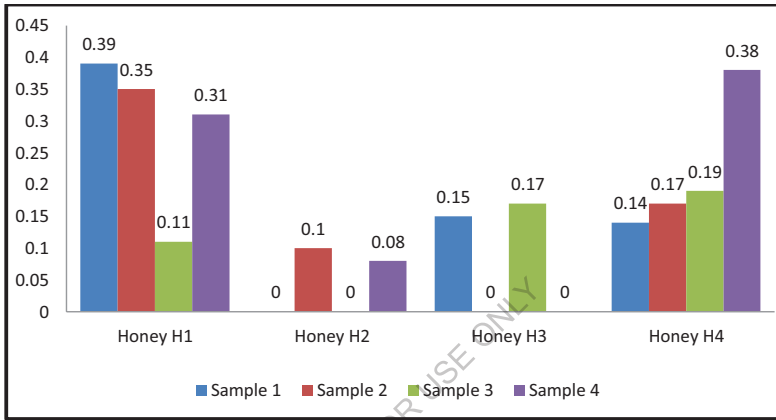
S N	HONEY SAMPLES		ASH CONTENT (MASS %)	MEAN	STANDARD DEVIATION (SD)
	LOCATION	SAMPLE NO			
1	LOCATION 1 (H₁)	1	0.39	0.29	0.11
2		2	0.35		
3		3	0.11		
4		4	0.31		
5	LOCATION 2 (H₂)	1	BLQ	0.04	0.05
6		2	0.10		
7		3	BLQ		
8		4	0.08		
9	LOCATION 3 (H₃)	1	0.15	0.08	0.08
10		2	BLQ		
11		3	0.17		
12		4	BLQ		
13	LOCATION 4 (H₄)	1	0.14	0.22	0.09
14		2	0.17		
15		3	0.19		
16		4	0.38		

The ash content is also related to the color and electrical conductivity of honey. The higher value of ash content was generally observed in the darker colored and strong-flavored honey, as it is also related to its minerals content. Inorganic residues in higher range are also one of the reasons for increased ash content (Da-Silva et al., 2016; Krishnasree & Mary, 2015).

In addition to this, it was affirmed that the content of trace elements also have an effect on the ash value (Amabye, 2017). Atul et al. (2018), after analyzing 100 unprocessed and fresh honey samples collected from Northern India stated that ash content of honey is its important characteristic which can be used for the investigation of the botanical origin of single-flower kinds of honey as well as to differentiate between the blossom and honeydew honey.

The ash value in his study was between 0.09 to 0.49% which is similar to the current figures. Bogoviku and Gedeshi, 2015, who investigated Albanian honey samples suggested that the high ash content in honey might be an indication of honey adulteration, so owing to low ash content, the honey samples investigated in this study, were must be free from adulteration.

GRAPH 4.4: ASH CONTENT OF THE HONEY SAMPLES (MASS %)



Many researchers investigated the honey samples from India and abroad. The data of ash content obtained in this study is significant in accordance with Gebru (2015) (0.09-0.30%); Harun et al., 2017 (0.30%); and Atul et al., 2018 (0.09-0.49%)

4.2.6 OPTICAL DENSITY

Absorbance or optical density of a substance is a logarithm of the proportion of the intensity of light falling on the solution of the substance to the intensity of light that is transmitted through the substance. It is an imperative characteristic used for the assessment of the freshness and color of the honey.

The optical densities of all the honey samples were measured and the data thus obtained was portrayed in the table 4.6

DISCUSSION

All the results were depicted in the table. It was revealed from the results that the optical densities were found within the limit given by BIS. The maximum permitted optical density for all grade honeys by BIS is 0.3. In the current study, the optical densities were ranging between 0.12 and 0.32. The maximum average optical

density was observed in the location four (H₄) honey samples, followed by location two (H₂) and then location one (H₁) honey samples. Whereas the minimum value of average optical density was detected for the location three honey samples (H₃).

It was noted that the significant similarities were found in the values for the honey samples from identical locations with very minute variations, it is also supported from the values of standard deviation. The optical densities were appeared to have in accordance with the colors of the honey samples. The honey samples tend to have darker color shades, were having high values of optical density whereas the lighter color honey samples were showing lower optical density readings. The moisture content of the honeys also appeared to have a significant relationship with optical density.

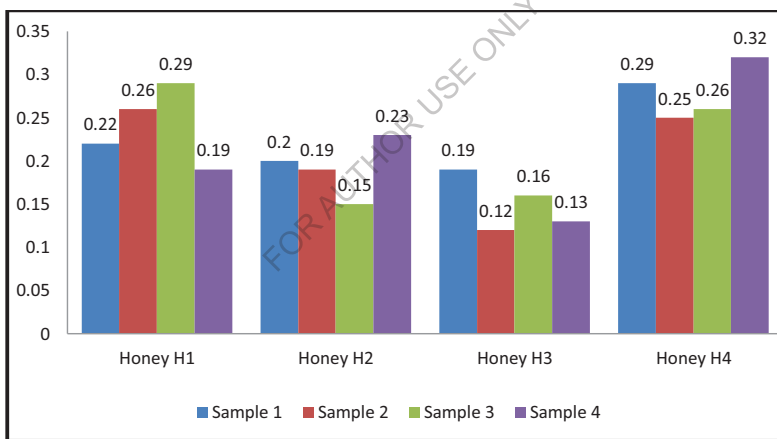
TABLE 4.6: OPTICAL ACTIVITIES OF MELGHAT HONEY SAMPLES FROM DIFFERENT LOCATIONS

S N	HONEY SAMPLES		OPTICAL DENSITY	MEAN	STANDARD DEVIATION (SD)
	LOCATION	SAMPLE NO.			
1	LOCATION 1 (H₁)	1	0.22	0.24	0.04
2		2	0.26		
3		3	0.29		
4		4	0.19		
5	LOCATION 2 (H₂)	1	0.20	0.19	0.03
6		2	0.19		
7		3	0.15		
8		4	0.23		
9	LOCATION 3 (H₃)	1	0.19	0.15	0.03
10		2	0.12		
11		3	0.16		
12		4	0.13		
13	LOCATION 4 (H₄)	1	0.29	0.28	0.03
14		2	0.25		
15		3	0.26		
16		4	0.32		

The slight variations in the optical densities of honey samples from the same locations were might be due to the differences in the color shades. As discussed earlier colors of the honeys may vary due to numerous factors such as the overall composition of honey, differences in the climate of geographical location as well as during harvesting, floral origin, and storage conditions (Boussaid et al., 2018; White & Doner, 1980; Kavapurayil et al., 2014; Shobham et al., 2017). Thus it is concluded that the optical density of the honey samples might be varied due to differences in the above-mentioned factors.

Almasi and Basavarajappa (2019) analyzed five single floral honey samples from Karnataka, got the results similar to the current study. The current study observations were also concurrent with Manzoor et al. (2013), who investigated the physical properties of honey samples from Jammu and Kashmir.

GRAPH 4.5: OPTICAL DENSITIES OF THE HONEY SAMPLES



4.2.7 FIEHE'S TEST

Fiehe's test was employed for all the honey samples from the *Melghat*. Fiehe's test is used as an indication to point out any consequences of adulteration in the given honey sample. During the process, the furfural formed which is an indication of the adulteration by added sugar reacts with the compound resorcinol and shows the formation of instant cherry red color (Umarani et al., 2015). The results of Fiehe's test for all the honey samples under consideration are given in Table 4.7

DISCUSSION

The samples were found to exhibit no any sort of adulterations. Since almost all the samples with some exceptions were showed a negative result for Fiehe's test.

TABLE 4.7: FIEHE'S TEST RESULTS FOR MELGHAT HONEY SAMPLES FROM DIFFERENT LOCATIONS

S N	HONEY SAMPLES		FIEHE'S TEST RESULT
	LOCATION	SAMPLE NO.	
1	LOCATION 1 (H ₁)	1	Negative
2		2	Positive
3		3	Negative
4		4	Negative
5	LOCATION 2 (H ₂)	1	Negative
6		2	Negative
7		3	Positive
8		4	Negative
9	LOCATION 3 (H ₃)	1	Negative
10		2	Negative
11		3	Negative
12		4	Negative
13	LOCATION 4 (H ₄)	1	Positive
14		2	Negative
15		3	Negative
16		4	Positive

All the honey samples from location three (H₃) were totally free from adulteration as per the result of Fiehe's test. It was noted that in the location four honey samples (H₄) two samples were having negative results and the remaining two showed positive results. In location one and two honey samples (H₁ and H₂), only one sample each was with a positive result.

As per the guidelines given by the BIS (IS 4941, 2002) the Fiehe's test should be negative for the grading of honey samples in standard, A, or special grade. Thus four samples failed to qualify Fiehe's test. The positive result of the test indicates the

possibility of adulteration. But it is not always true. In the BIS guidelines, it is also mentioned that if the Fiehe's test is positive then the HMF content must be below 80 mg/kg of honey, and not any of the *Melghat* honey samples were examined under this study showed the value of HMF content above 80 m/kg. Thus the positive result of Fiehe's test did not confirm the consequences of adulteration in the *Melghat* honeys.

It is reported that the positive result of the test in some honey samples might be due to aging, or due to the presence of impurities that appeared during handling, extraction, processing, and storage of honey (Kavapurayil et al., 2014). Borges et al. (2019) examined 30 Brazilian honey samples that showed similar results. About 50 % of the honey samples under examination went positive with Fiehe's test and claimed that it might be due to the poor storage conditions of honey samples. All or most of the honey samples from Riyadh and Lahore were detected in some other studies and also gone positive with Fiehe's test but the average HMF content was under the specified standard limits (Aljohar et al., 2018; Sharif et al., 2018)

4.2.8 ANALYSIS OF CARBOHYDRATES AND SUGARS

Carbohydrates structure the largest part of the honey. Mostly the carbohydrates in attendance in the honey are in the form of sugars and sugars are the most imperative and abundant constituents of honey.

Owing to the largest ingredient most of the physicochemical, as well as restorative properties of honey, are related to the existence and amount of sugars. During this learning, the honey samples were analyzed for the determination of total carbohydrates, sugars (reducing as well as non-reducing), over and above glucose, and fructose. The true values of fructose and glucose, fructose to glucose ratio as well as glucose to water ratio were calculated by using empirical formulae.

As mentioned earlier the standard procedures and methods approved by the authorized agencies in the field of honey analysis were drawn on for executing the experimental work. The results thus obtained were tabulated in the given table 4.8 with the standard deviation.

DISCUSSION

4.2.8.1 TOTAL CARBOHYDRATES AND ENERGY VALUE

Carbohydrates are the nutritionally prime and health pertinent constituents of many foods. Honey has a plentiful amount of carbohydrates contains in it. It was reported that about 95% of the dry material of honey is in the shape of carbohydrates

(Bogdanov et al., 2008). In honey most part of the carbohydrates is found in the form of sugars i.e. monosaccharides and disaccharides. Oligosaccharides are also there in honey comparatively in a slighter amount. The carbohydrates in the honey were determined by using the method prescribed in the manual of BIS (IS 1656, 2007)

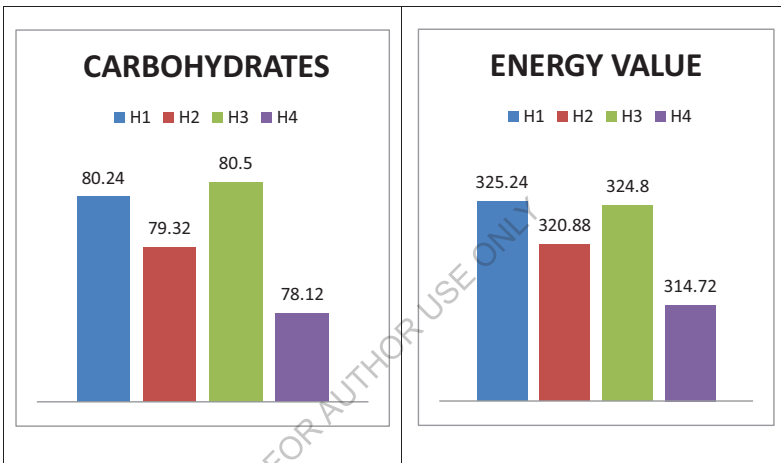
TABLE 4.8: CARBOHYDRATE AND SUGAR PROFILE OF MELGHAT HONEY SAMPLES

S N	PROPERTIES	HONEY SAMPLES				MEAN	SD
		H ₁	H ₂	H ₃	H ₄		
1	Total Carbohydrates (g/100g)	80.24	79.32	80.50	78.12	79.545	0.93
2	Energy Value (Kcal/100g)	325.24	320.88	324.8	314.72	321.41	4.22
3	Total sugar (g/100g)	79.54	74.96	79.27	74.67	77.11	2.30
4	Sucrose (Total N-R Sugar) (g/100g)	3.36	2.62	4.24	2.96	3.295	0.61
5	Total Reducing Sugar (g/100g)	76.18	72.34	75.03	71.71	73.815	1.85
6	Glucose (g/100g)	36.92	35.47	35.12	35.76	35.818	0.68
7	Fructose (g/100g)	38.13	35.93	39.12	34.84	37.005	1.70
8	Fructose : Glucose Ratio	1.03	1.01	1.11	0.97	1.03	0.05
9	Glucose : Water Ratio	2.00	1.87	1.86	1.88	1.903	0.05

The amount of total carbohydrates was found to have the highest in the location three honey sample (H₃) i.e. 80.50% furthermore lowest in the location four honey sample (H₄) i.e. 78.12%. The values obtained were almost the same with very trivial differences (SD 0.93). All the values were stuck between very narrow ranges of 78.12 to 80.50%. The sugars were interrelated positively with the total carbohydrates.

Honey is regarded as an elevated and instant energy food. In view of the fact that the glucose and fructose in honey are rapidly digestible so honey makes available instant energy. Thus the honey can be used as an instant source of energy for the sportspersons and athletes to enhance their performance. The energy value of honey was simply obtained by calculation. The combined amount of carbohydrate and protein was multiplied with the conversion factor 4 kcal/g to obtain its energy values.

GRAPH 4.6: TOTAL CARBOHYDRATE (MASS %) AND ENERGY VALUE (KCAL/100g) OF HONEY SAMPLES



Obviously, honey samples with high carbohydrates must have the highest energy value. But here in this case the location one honey sample (H₁) is with the highest energy value than sample with location three (H₃); it is due to fact that the protein content of the location one honey sample is significantly higher than the location three honey sample. The energy values were ranging from 314.72 to 325.24 Kcal/100g (SD 4.22).

4.2.8.2 TOTAL SUGAR

The total sugar content was ranging between 74.67 and 79.54 g/100g of the honey. The *Melghat* honey samples showed no significant differences in their values of total sugar content as it can be told from the values of standard deviation (SD 2.3). Total sugar encompasses both the reducing and non-reducing sugars. It was reported

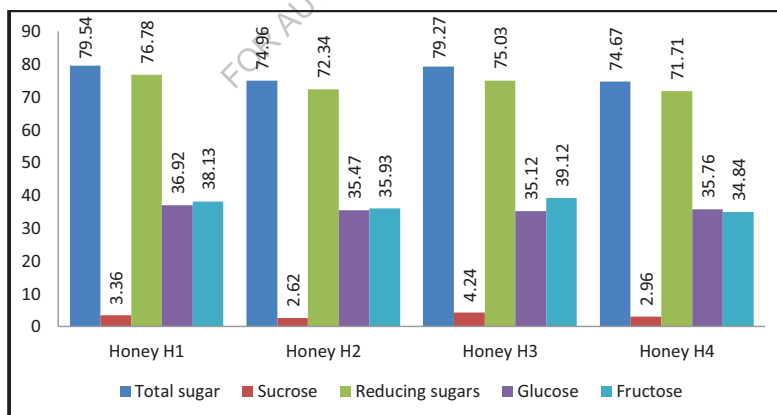
that honey is a saturated solution of at least 22-25 different sugars among which dextrose (glucose) and levulose (fructose) are predominant (White & Doner, 1980).

This represents that apart from glucose and fructose, there were at least 22-25 different sugars were reported (e.g. maltose, rhamnase, maltotriose, iso-maltose, turanose, maltotetraose, etc.) that might be present in honey.

The highest value of total sugar was observed in the honey sample H₁ i.e. 79.54%. The honey sample H₃ was at the second position with a slightly lower value i.e. 79.27%, followed by H₂ (74.96%) and H₄ (74.67%). Samples from location one and three are very close to each other while the samples from location two and four have almost similar values. There was no specified limit suggested by BIS for the content of total sugars, but it appeared to be at an optimum level.

The data showed similarity with the results acquired in the studies done by Bogdanov (2011), and Shobham et al. (2017). The average percentage of total sugar they got was 79.7% and 78.0 – 88.0% respectively. In comparison, the amounts of total sugar in the honey samples investigated by Krishnasree and Mary (2015) (65.21); Islam et al. (2012); and Manukumar et al. (2013) were reported to be at lower levels.

GRAPH 4.7: SUGARS IN THE HONEY SAMPLES (MASS %)



4.2.8.3 SUCROSE (NON-REDUCING SUGAR)

The amount of non-reducing sugar i.e. sucrose was ranging from 2.62 to 4.24% with standard deviation 0.61. The *Melghat* honey sample from the location three (H₃) was found highest in the content of sucrose with value i.e. 4.24%, while the

lowest amount of sucrose was detected in the honey sample from location two i.e. 2.62%. Sample H₁ is on second position with the amount of sucrose 3.36% and sample H₄ was on 2.96%. All the values were within the range specified by BIS (IS 4941, 2002), as the maximum amount of sugar that is allowed in a honey sample for its grading is 5%. Thus as per the criteria by BIS, all the honey samples fall in the special grade category.

It was told that the higher percentage of sucrose sometimes offers an indication of the added sugar or of under-ripened honey as early harvesting of honey does not allow the complete inversion of sucrose (Shobham et al., 2017). Thus all the honey samples under examination might be not adulterated with sucrose.

Lots of researchers investigated various honey samples and found a varied amount of sucrose content. The amount of sucrose obtained in various studies was White and Doner (1980) (0.25-7.57%); Amabye (2017) (1.01-2.57%, wild honey samples from Ethiopia); Sohaimy et al. (2015) (1.34-3.59%, honey samples from Yemen, Kashmir, Saudi, and Egypt); and Atul et al. (2018) (0.74-3.95%, North Indian honey samples).

4.2.8.4 TOTAL REDUCING SUGARS

The reducing sugars of honey are mainly comprised of glucose and fructose. The other reducing sugars are present in a very insignificant amount. The reducing sugars such as dextrose and levulose (i.e. glucose and fructose) are the key sugars present in the honey and both of them are found almost in equal amounts. Thus most of the part of the sugar in the honey has consisted of glucose and fructose. The amounts of total reducing sugar in the present study were ranging from 71.71 to 76.18%, and that of glucose was in the range of 35.12-36.92% (SD 0.68) as well as the amounts of fructose were lying between 34.84 and 39.12% (SD 1.7).

The location four honey sample (H₄) was observed to be lowest in the content of total reducing sugar (71.71%) and fructose (34.84%) but the amount of glucose (35.76%) was somewhat higher than that of location three honey sample i.e. H₃ (35.12%) which was at the lowest position. Location one sample (H₁) was highest in the amount of total reducing sugars (76.18%) and glucose (36.92%) except for fructose (38.13%) instead location two honey sample (H₂) has a maximum amount of fructose in it (39.12%).

All the values of reducing sugars obtained in the investigation were within the range specified by BIS. The minimum amount of total reducing sugars as specified by BIS is a minimum of 70%, 65%, and 65% for special, A, and standard grade honey samples respectively. Thus all the *Melghat* honey samples subjected for examination in the present study fell in the category of special grade.

The data of the amount of fructose and glucose found in *Melghat* honey samples is concurrent with the data obtained in the research done by Boussaid et al. (2018); Gairola et al. (2013); Atul et al. (2018); and Nazarian et al. (2010).

4.2.8.5 FRUCTOSE TO GLUCOSE RATIO (F/G RATIO)

In all the honey samples except the location four sample (H₄) the amount of fructose weighed up was higher than that of glucose. Thus the fructose to glucose ratio was found to exhibit greater than 1 in the remaining three honey samples (H₁, H₂, and H₃).

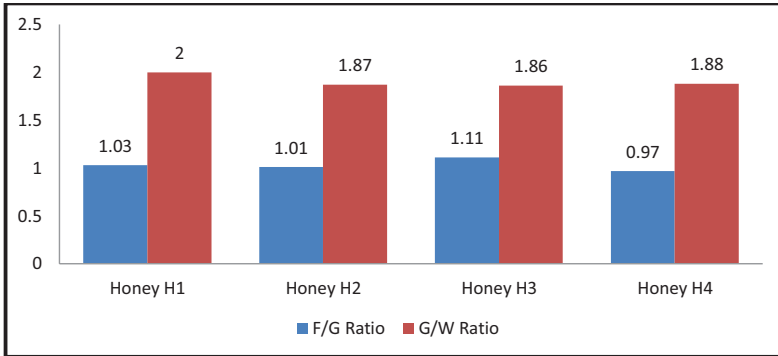
The lowest f/g ratio was observed in location four honey sample i.e. 0.97 and the highest value was obtained for the location three sample i.e. 1.11. As per the BIS standards, it should be a minimum of 1. Thus all the *Melghat* honey samples have fallen into the special grade category. Even the location four honey sample was also very close to the criteria with the f/g ratio 0.97. The standard deviation is very low i.e. 0.05.

The occurrence of fructose to glucose ratio more than that of one is an indication that the amount of fructose is more than that of glucose. Fructose is more soluble than glucose in water. Thus honeys with a higher amount of fructose have fewer tendencies of granulation because, as soon as the amount of water drops below a certain value the glucose if in higher amount starts to crystallize. Thus the honeys with lower glucose are liable to remain liquid for a long and have very fewer chances of granulation.

These honeys are comparably sweeter due to the fact that fructose is sweeter than that of glucose (Boussaid et al., 2018; White & Doner, 1980). The f/g ratio can be used as one of the criteria for the classification of monofloral honeys depending on its floral origin as the ratio of fructose to glucose might be depending on the source of nectar (Bogdanov, 2011; Chin & Sowndhararajan, 2019; Da-Silva et al., 2016).

The results were in accordance with the studies carried out by Gairola et al. (2013) and Nazarian et al. (2010).

GRAPH 4.8: F/G AND G/W RATIO OF HONEY SAMPLES



4.2.8.6 GLUCOSE TO WATER RATIO (G/W RATIO)

The granulation tendency and the granulation index may not be detected to that extent with the help of only fructose to glucose ratio because it is the glucose and its solubility that is responsible for the tendency of granulation. If the amount of water goes below a certain limit the monohydrate crystals of glucose start to form as an initiation of the process of crystallization. The number of crystals, their dimensions & shape, and quality, etc. factors are dependent upon the storage conditions and the composition of honey (Kavapurayil et al., 2014; White & Doner, 1980). The ratio of glucose to the water (g/w) is found to be most useful for forecasting the occurrence of granulation or crystallization in honey.

There is no specific value of g/w ratio given by BIS or any of the similar agencies. But it was reported that the value of g/w ratio less than 1.7 indicates that the honey is non-granulating. On the other hand, if it is more than 2.1 the honey will be susceptible to the rapid granulation. Thus the prediction of crystallization of honey could be a more appropriately indicated by the g/w ratio than the f/g ratio (Gairola et al., 2013; Sohaimy et al., 2015).

Various studies affirm that there are lots of reasons for the varying amount of sugar in honey. The amount of sugar in the honey depends upon the sugar profile of the nectar of origin as well as the enzymes present. The crops in the area of collection of nectar, climatic conditions, storage, as well as geographical location also affect the sugar profile of honey. Initially, in the immature honey, sucrose is present in large amount and due to action of various enzymes glucose and fructose and some other

sugars are formed (Bogoviku & Gedeshi, 2015; Kavapurayil et al., 2014; Almasi & Basavarajappa, 2019)

The concentration of sugars influences an assortment of properties of honey. A high concentration of sugars gives a higher density to honey. It makes the honey more sticky and viscous. The hygroscopic nature of honey that might be responsible for its wound healing capacity is due to its sugar profile.

The presence of sugars in honey makes it immune to spoilage, the growth of microorganisms prevented due to the sugars. H_2O_2 that is formed due to the oxidation of sugars is responsible for most of the therapeutic properties of honey. Honey is an instant and high source of energy as the levulose and dextrose present in honey are capable of digesting quickly and serve as an efficient source of energy (Shobham et al., 2017; Amabye, 2017; Abeshu & Gelata, 2016; Da-Silva et al., 2016; Bogoviku & Gedeshi, 2015; Islam et al., 2012; Manukumar et al., 2013).

Honey is fermentable and sweet due to its sugar profile hence can be used in bakery products comprehensively. It serves as a functional food in many products for enhancement of flavor, color, and shelf life (Krishnasree & Mary, 2015).

Thus the *Melghat* honeys might be used as a food, food ingredient, over and above as a functional food expansively in many products due to its excellent sugar profile. It may be useful as medicine also as it is found that as per as the sugar profile in concert the *Melghat* honeys are definitely fall in the category of special grade specified by BIS.

4.2.9 OTHER CHARACTERISTICS AND NUTRIENTS

Other than moisture and sugars, which are the bulk-forming constituents of honey other nutrients are also present in honey. Though the amount of these constituents is very little in the honey they have significant importance in the quality and properties of honey. Many properties of honey are influenced because of the presence of these materials. In the current study detection of some of these properties and analysis of some other important materials such as total protein content, free acidity, the content of hydroxymethylfurfural (HMF), and detection of mineral-like sodium, iron, and calcium was done. The data obtained are recorded in table 4.9

TABLE 4.9: OTHER CHARACTERISTICS AND NUTRIENT CONTENT OF MELGHAT HONEY SAMPLES

S N	PROPERTIES	HONEY SAMPLES				MEAN	SD
		H ₁	H ₂	H ₃	H ₄		
1	Total Protein (Mass %)	1.07	0.90	0.70	0.56	0.81	0.19
2	Free Acidity (Meq/Kg)	21.21	27.12	20.03	32.17	25.13	4.87
3	HMF (mg/kg)	29.73	08.10	12.56	37.86	22.06	12.18
4	Iron (mg/100g sample)	1.05	0.68	1.84	1.73	1.33	0.48
5	Calcium (mg/100g sample)	11.7	1.38	5.40	6.65	6.28	3.68
6	Sodium (mg/100g sample)	33.82	5.29	17.04	21.34	19.37	10.20

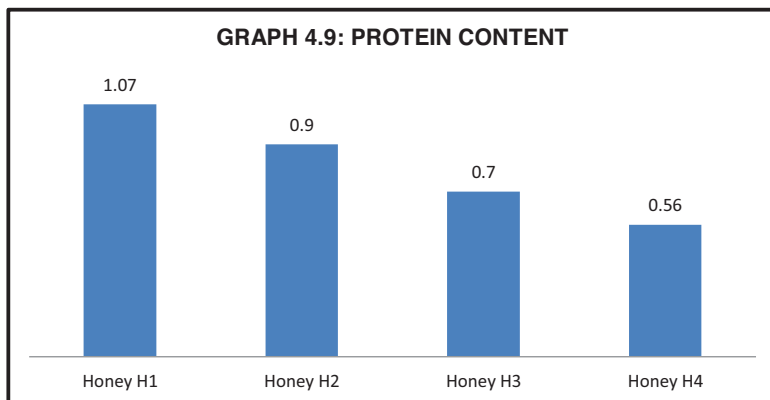
DISCUSSION

4.2.9.1 Total Proteins

The protein content of honeys was calculated by using the micro-Kjeldahl method as given by Ranganna (2007). Proteins contain of honey is in very little amount with standard deviation 0.19. In the *Melghat* honey samples used for the study, the protein was present in a very diminutive amount.

The maximum amount of protein was found in the location one honey sample and it is 1.07 g/100g of the sample. The location four honey sample was having the least value of proteins in it with the value 0.56. There was a gradual decrease found in the amount of protein from sample 1 to sample 4. Sample two was on the second position with 0.9 % proteins followed by sample 3 with 0.7% and lastly sample from location four with 0.56% protein.

The results were similar to the values reported by Amabye (2017), who evaluated the wild honey samples from Ethiopia. Atul et al. (2018), who studied the properties of North Indian honey samples and Nazarian et al. (2010), who evaluated the honey samples from Iron, got similar results for protein content.



Almasi and Basavarajappa (2019); Islam et al. (2012); and Sohaimy et al. (2015) detected the protein content of the honeys subjected for their respective studies, got the values of protein towards some higher side.

Different honey samples are varied in the content of protein due to the variation in plenty of factors such as the type of nectar as well as plant, amount and quality of pollens, and the types of honey bees (Boussaid et al., 2018).

The proteins or the amino acids are initially present in a very infinitesimal amount in the nectar of blossom. The proteins are added in the honey through the natural secretions added by the bees. The pollens are also the strong source of proteinaceous material of honey. 8-11 numbers of proteins are reported to have in honey.

The large part of proteins is in the form of enzymes that may be added to the honey through bees, nectar, pollen, or from the microorganisms (White & Doner, 1980). The prime enzymes that are found in honey are invertase, glucose oxidase, and amylase, or diastase. The diastase activity of honey is used as an indication of the freshness of honey because the diastase activity of honey tends to decrease by aging (Bogdanov, 2011).

Mostly all the amino acids are present in honey but at very trace amount among which proline is present at the highest amount. Proline is responsible mainly for the darkening of color during heating or storage as it reacts with sugar to produce the dark color. Proline might be used for the detection of adulteration of honey with sugar, as it was reported that the value of proline below 180 mg/ Kg of honey is an

indication of adulteration. It was reported that the analysis of the proteins from the pollens might be regarded as the prime criterion for the identification of honey for its naturalness since about one-third of the total protein of honey is originated from the pollens (Nazarian et al., 2010).

Thus the considerable amount of protein in the *Melghat* honey samples indicates its freshness and good quality.

4.2.9.2 Total Acidity

Honeys are always acidic in nature irrespective of its floral source or the geographical difference. It was also observed in this study from the low pH values obtained (Atul et al., 2018; Manukumar et al., 2013). The free acidity of honey is due to the presence of various organic acids as well as inorganic ions like phosphate. It is also a result of the production of gluconic acid from glucose as a result of the action of glucose oxidase enzyme (Sereia et al., 2017).

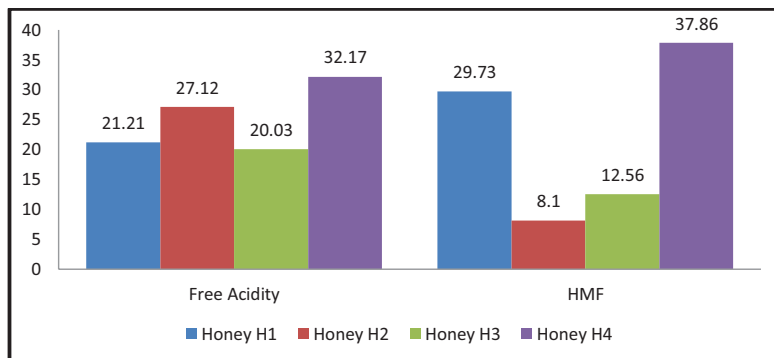
The free acidities of the honey samples in this study were ranging from 20.03 to 32.17 (SD 4.87). The maximum acidity was found in the location 4 honey sample (H₄) (32.17) followed by location 2 (H₂) (27.12) and location 1 (H₁) (21.21). The lowest acidity was found in the location three honey sample (H₃) i.e. 20.03. The values of free acidity were matching with the pH values of the honeys. The lowest average pH honey sample i.e. sample 4 is found with the highest value of free acidity. The pattern is repeated for all the samples. The free acidity of all the *Melghat* honey samples under examination are lying well below the maximum standard values prescribed by the authorizing agencies such as EU standards (free acidity should be < 50 meq/kg) or Agmark, 2008 (free acidity should be < 40 meq/kg).

The results were significantly analogous with the values obtained during the studies done by Harun et al. (2017), (30 meq/kg, for the honey samples from Istanbul); Chin and Sowndhararajan (2019), (7.8-42.7 meq/kg, for Serbian honey); Gebru (2015), (17.33-32.70 meq/kg, Ethiopian honeys); and Atul et al. (2018), (14.17-40.17 North Indian Honeys).

Manukumar et al. (2013), who studied the honey samples from Bihar, Delhi, Sirsi, and Banglore of India, stated that all the honey samples were acidic and the reason may be the process of fermentation. Bogoviku and Gedeshi (2015); Pande and Jude (2019) and Yadata (2014), carried out the experimental works to detect the

acidity of honey samples and got the results with some higher/lower values than that of the present study.

GRAPH 4.10: FREE ACIDITY (Meq/Kg) AND HMF (Mg/Kg) OF HONEY



Shobham et al., 2017 who studied the honey samples from Telengana (free acidity 9.2-41.4 meq/kg) stated that the differences in the value of free acidity of the varied honey samples might be due to the differences in the season of harvesting the honey. It was reported that the honeys with low acidity might be considered as an indication of freshness as due to aging the fermentation occurred in honeys result in the formation of acids and an increase in the acidity. Boussaid et al. (2018) and Abeshu and Gelata (2016) also agreed with these facts and added that the low acidity of honey supports its therapeutic properties.

The *Melghat* honeys are with the acid values well within the specified limits. The differences in the acidity might be due to lots of reasons as discussed. Most of the organic acids that are present in the honey are synthesized from the sugars due to the action of the variety of enzymes present in honey. There are plenty of organic acids present in honey such as formic acid, lactic acid, acetic acid, citric acid, malic acid, maleic acid, succinic acid, pyroglutamic acid, oxalic acid, etc.

The gluconic acid is the prime acid of honey which is derived from dextrose by the enzymes. Though the reactions by the enzymes continuously occur, honey acts as a buffer, and the acidity of honey does not change with a small amount of acid or alkali added or removed. The detection of organic acids might be helpful for finding out the floral source of single floral honeys. The acidity of honey is very important as

it influences the taste, flavor, as well as some physical properties of honey (Bogdanov, 2011; White & Doner, 1980; Balos et al., 2018; Da-Silva et al., 2016).

4.2.9.3 Hydroxymethylfurfural (HMF)

Hydroxymethylfurfural or simply HMF is a cyclic aldehyde compound that is produced due to the degradation of sugars through the non-enzymatic browning reaction. Some minerals, acids as well as mainly sugars are responsible for the reaction. The HMF content of the *Melghat* honey samples was measured by the standardized method prescribed by BIS. The results were tabulated in the table 4.9 and represented graphically in the graph 4.10.

All the honey samples were having a significant amount of HMF in them with standard deviation 12.18. The second sample of honey (H₂) was possessed the lowest amount of HMF i.e. 8.10 followed by location three honey sample (H₃) with HMF content 12.56 then sample from location one (H₁) with the value 29.73 and the highest HMF content was found in the location four honey sample (H₄) and it was 37.86. All the values were expressed in mg/kg of honey.

Though there was a significant difference found in their values, the HMF content was comfortably within the range specified by the standard agencies. The maximum amount of HMF allowed by BIS as well as Agmark is 80 mg/kg of honey (IS 4941: 2002; Agmark, 2008).

The result of Fiehe's test was found significantly in accordance with the values of HMF contents. Among the honey sample from location four two samples showed a positive response to Fiehe's test, the same sample was found highest in the content of HMF. The content of the HMF in honey samples also found to be affected by the color of honey. The darker honey samples were found to exhibit a higher percentage of HMF as compared to the light-colored honey samples. The other properties were not showing any significant relationship with the HMF content.

It was reported that naturally HMF is not present in honey or present in a very trace amount. The amount of HMF content found to increase on the prolonged storage. There are more chances of the formation of HMF in more acidic honeys (Zappala et al., 2005; Bogdanov, 2011). As mentioned earlier HMF is a cyclic aldehyde that is produced during the Maillard reaction. HMF is reported to be responsible for the cytotoxicity toward the skin, mucous membranes, as well as the upper respiratory tract. It might be responsible for mutagenicity, carcinogenicity, etc.

Some benefits of HMF were also reported there such as it was found to exhibit antiallergic, anti sickling, anti hyperuricemic, anti-inflammatory, and antioxidative potential. Various factors were said to be affecting by the formation of HMF in honeys such as the temperature at which the honey is stored, fructose to glucose ratio, physical properties of honey such as water activity, pH, its acidity, etc. The use of the metallic container for storing honey, the thermal stress over and above the moisture content of honey are also responsible for the formation of HMF in honey (Shapla et al., 2018; Da-Silva et al., 2016). The age of honey and fructose to glucose ratio might also be affected by the HMF value of honeys (Kesic et al., 2014).

Many researchers studied the honey samples for the determination of HMF. The data in this study was found to have resembled with Islam et al. (2012) i.e. 3.06-43.81, who studied the Bangladeshi honey samples; Manukumar et al. (2013) i.e. 1.75-27.87, who studied the Indian honey samples; Gairola et al. (2013) i.e. 13.8-36.86, studied the samples from Uttarakhand, India; and Harun et al. (2017) i.e. 1.07-30.69, who experimented on the samples from Istambul. The data obtained in the studies by Bogoviku and Gedeshi (2015) (6-17.1); Krishnasree and Mary (2015) (30.01); Rajpoot et al. (2013) (0.13-1.34); and Kavapurayil et al. (2014) (11.52-203.52), etc. were not matching with the current studies.

4.2.9.4 MINERALS

Plenty of minerals are found in honey at a varied amount. The minerals that are detected in honey are calcium, sodium, iron, potassium, magnesium, phosphorous, manganese, copper, nickel, zinc, Iodine, etc. The minerals in the honey are found generally in very fewer amounts. Among all the minerals potassium is mostly predominant. The mineral content of honey was reported to be useful for assessing the floral source of honey because the mineral content of honey is significantly dependent on its floral source and geographical location (Amabye, 2017).

There are variations found in the relation among the various factors of honey. Though the extrinsic factors for instance heat, pH, etc. affect many other properties of honey, it does not have any effect on the contents of the minerals. On the other hand, the intrinsic factors like EC (electrical conductivity), ash, and color are found to be related with its mineral content (Da-Silva et al., 2016; Abeshu & Gelata, 2016; Atul et

al., 2018; Krishnasree & Mary, 2015). During the current work the content of iron, sodium, and calcium was detected.

The inclusion of minerals from soil and environment by the plants through their expected processes affected the mineral quality of nectar and naturally the mineral profile of honey. The floral basis of the nectar from which the honey is made has a remarkable effect on its mineral profile. The dark-colored honey contains an elevated amount of trace elements than the honey with lighter a color. The geological location of honey also influences its mineral profile moreover the mineral content is used as a tool to discover the geographic location of honey. The wrong handling of honey also resulted in the count of the minerals especially heavy metals which are of anthropogenic origin. The honey from polluted areas is found to have a higher amount of minerals.

Thus the reasons behind the variations in mineral content reflected in the data of secondary researchers might be owing to the discrepancy in floral and geographical origin of the honey. The type of soil in the surrounding area, environmental pollution, and contamination due to the human handling of honey may be the reasons for dissimilarity in the content of minerals of the kinds of honey. (Bogdanov et al., 2007; Mohammed & Babiker, 2009; Dahir & Hemed, 2015; Da-Silva et al., 2016)

IRON

The iron was found in a very diminutive amount in the *Melghat* honeys. It was ranging from 0.68 to 1.84 mg/kg of honey with standard deviation of 0.48. The iron content of the *Melghat* honey samples was showing the similarities with the study carried out for the Tunisian honeys studied by Boussaid et al. (2018) (0.83-3.54) and for the Karnataka honeys studied by Almasi and Basavarajappa (2019) (0.1-1.46). The data of iron in honey reported by Krishnasree and Mary (2015), in the study of Kerala honey was exceptionally very high (284.76 mg/kg).

White and Doner (1980) studied the properties of light and dark-colored honey separately and reported that the iron content in light honey was 2.4 and for dark honey, it was 9.4 mg/kg. Pande and Jude (2019) confirmed the presence of iron in the honeys qualitatively. There was not any value of iron specified by any authorized body but the values of iron content in this study are showing the similarities with the range suggested by Abeshu and Gelata (2016) (1.0-3.4 mg/kg) in their review article.

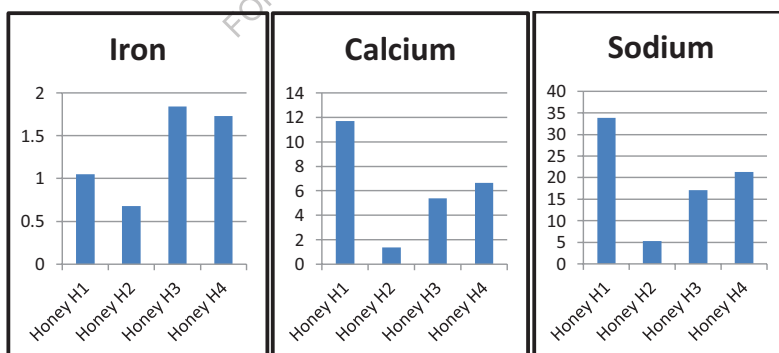
CALCIUM

The calcium content of the *Melghat* honey samples was ranging between 1.38 and 11.7 mg/kg (SD 3.68) of honey. Pande and Jude (2019) had confirmed the presence of calcium in their honey samples by a qualitative test. The values were concurrent with the data reported for the Karnataka honey samples by Almasi and Basavarajappa (2019) (0.61-12.97), and Abeshu and Gelata (2016) (4-30). White and Doner (1980) obtained 49 mg/kg of calcium in light and 51 mg/kg of honey in dark-colored honey. The honeys were also studied for the content of calcium by Boussaid et al. (2018); Krishnasree and Mary (2015) and Zhou et al. (2013); but the data obtained was at higher range i.e. 113.85-221.07, 3600.00, and 97.1-194.2 mg/kg respectively.

SODIUM

Sodium was also found to contain in the *Melghat* honey samples. Pande and Jude (2019) also confirmed the presence of sodium in their honey samples qualitatively. The highest sodium content was observed in the location one honey sample i.e. 33.82 mg/kg, followed by location four sample with 21.34 mg/kg and then location three with 17.04 mg/kg. The value of standard deviation is 10.20. Location two samples showed the lowest content of sodium i.e. 5.29 mg/kg of honey.

GRAPH 4.11: MINERALS IN HONEY



The values were analogous with the values of sodium in honey reported by Abeshu and Gelata (2016) (0.6-40 mg/kg). Boussaid et al. (2018) (251.34-521.22); White and Doner (1980) (18 for light and 76 for dark honey); Almasi and Basavarajappa (2019) (0.25-6.31); and Zhou et al. (2013) (7.79-127.8) were also

studied the honeys for the detection of sodium and got the values written in the brackets which showed significant differences with the values obtained in the present study.

4.3 ANTIBACTERIAL ACTIVITIES OF MELGHAT HONEY

Honey has been recognized as an antioxidant as well as an antimicrobial agent. Due to these properties, it has been extensively used in the treatment of various diseases from ancient times. It was observed that there are several limitations regarding the use of synthetic antibiotics. There are consequences observed of developing the resistance in the pathogenic microorganisms against the antibiotics on frequent use.

In addition to this synthetic antibiotics are having some side effects on the host body. Due to these limitations of antibiotics, the need is now developed towards the re-evaluation of ancient therapies and the use of natural medicinal products which can replace the synthetic antibiotics. Honey is one of these natural substances, which has the potential to work against the pathogens in various diseases. The ancient Indian medicinal therapy 'Ayurveda' has been using honey as a prime ingredient in medicines against many diseases (Chauhan et al., 2010; Bogdanov, 2011; Boussaid et al., 2018).

Honey has reported exhibiting a broad spectrum of inhibition against almost all species of bacteria including Gram-negative, Gram-positive, pathogenic, nonpathogenic, aerobic, and anaerobic bacteria. Honey showed its potential against such bacterial species that developed resistance for some common antibiotics. It was reported that honey showed its potential against almost sixty bacterial species (Kavapurayil et al., 2014; Mohapatra et al., 2011).

In the present study, the antibacterial potential of the *Melghat* honey samples was detected. Gram-negative bacterial species such as *Escherichia coli*, *Salmonella typhi*, and *Pseudomonas fluorescens* over and above Gram-positive bacterial species such as *Staphylococcus aureus*, *Bacillus subtilis*, and *Bacillus cereus* were used for the experimentation. Discs of size 10 mm were used in the estimation. The results obtained after 24 hours of incubation at 37°C temperature were inserted in the following tables.

All the honey samples showed an antibacterial effect against all the bacterial species except *E. coli*. Surprisingly no honey sample showed its potential against the

said bacteria. Thus no zone of inhibition obtained for *E. coli*. The zones of inhibitions were recorded and tabulated.

4.3.1 HONEY SAMPLE (H₁)

The antibacterial activities of the location one honey sample were detected against the said bacteria and the zone of inhibitions are recorded in the table 4.10

DISCUSSION

The honey sample H₁ showed its activities against the five bacterial species out of six. There are no significant differences found in the zones of inhibition for the bacteria. The pattern of the trend of zones observed for Gram-positive and Gram-negative bacterial species were almost similar. The maximum inhibition diameter was found for the Gram-positive species *B. cereus* i.e. 16 mm followed by *S. typhi* (14 mm), *B. subtilis* (13 mm), *Ps. fluorescens* (12 mm), and *S. aureus* (11 mm).

TABLE 4.10: ANTIBACTERIAL ACTIVITY OF LOCATION 1 MELGHAT HONEY SAMPLE (H₁)

S N	TYPE OF BACTERIA	SPECIES	ZONE OF INHIBITION IN MM
1	Gram negative	<i>Escherichia Coli</i>	--
2		<i>Salmonella typhi</i>	14
3		<i>Pseudomonas fluorescens</i>	12
4	Gram positive	<i>Staphylococcus aureus</i>	11
5		<i>Bacillus subtilis</i>	13
6		<i>Bacillus cereus</i>	16

4.3.2 HONEY SAMPLE (H₂)

The antibacterial activities of the location two *Melghat* honey sample were detected against the said bacterial culture and the zone of inhibitions are given in the table 4.11

DISCUSSION

The honey sample H₂ also showed its potential against the five bacterial species out of six similar to sample H₁. There are no significant differences found in the zones of inhibition. The trend of zones was found similar for Gram-positive and Gram-negative species. The maximum inhibition diameter was found for the Gram-

negative species *S. typhi* (16 mm), followed by *B. cereus* (15 mm), then *S. aureus* (14 mm), *B. subtilis* (12 mm), *Ps. Fluorescens* (12 mm), and *S. aureus* (11 mm).

TABLE 4.11: ANTIBACTERIAL ACTIVITIES OF LOCATION 2 MELGHAT HONEY SAMPLE (H₂)

S N	TYPE OF BACTERIA	SPECIES	ZONE OF INHIBITION IN MM
1	Gram negative	<i>Escherichia coli</i>	--
2		<i>Salmonella typhi</i>	16
3		<i>Pseudomonas fluorescens</i>	12
4	Gram positive	<i>Staphylococcus aureus</i>	14
5		<i>Bacillus subtilis</i>	12
6		<i>Bacillus cereus</i>	15

4.3.3 HONEY SAMPLE (H₃)

The antibacterial activities of the location three *Melghat* honey sample were detected against the said bacterial culture as done for location one and two honey samples. The zone of inhibitions are recorded in table 4.12

TABLE 4.12: ANTIBACTERIAL ACTIVITIES OF LOCATION 3 HONEY SAMPLES (H₃)

S N	TYPE OF BACTERIA	SPECIES	ZONE OF INHIBITION IN MM
1	Gram negative	<i>Escherichia coli</i>	--
2		<i>Salmonella typhi</i>	17
3		<i>Pseudomonas fluorescens</i>	14
4	Gram positive	<i>Staphylococcus aureus</i>	12
5		<i>Bacillus subtilis</i>	12
6		<i>Bacillus cereus</i>	14

DISCUSSION

The highest activity of inhibition in the honey sample H₃ was observed against the Gram-negative bacteria *S. typhi*, which showed the inhibition zone of 17 mm, that was the highest zone obtained among all the honey samples for all the bacterial

species. The zones against *Ps. fluorescens* and *B. cerus* were compositely on second position with a value 14 mm. followed by *S. aures* and *B. subtilis* with 12 mm. As similar with the above two honey samples, location 3 honey sample also not showed any activity against bacterial species *E. coli*.

4.3.4 HONEY SAMPLE (H₄)

The antibacterial activities of the location four *Melghat* honey sample were also detected against the said bacterial culture with the similar techniques as done for location one and two honey samples. The data are recorded in the table 4.13

TABLE 4.13: ANTIBACTERIAL ACTIVITIES OF LOCATION 4 HONEY SAMPLE (H₄)

S N	TYPE OF BACTERIA	SPECIES	ZONE OF INHIBITION IN MM
1	Gram negative	<i>Escherichia coli</i>	--
2		<i>Salmonella typhi</i>	16
3		<i>Pseudomonas fluorescens</i>	13
4	Gram positive	<i>Staphylococcus aureus</i>	15
5		<i>Bacillus subtilis</i>	12
6		<i>Bacillus cereus</i>	12

DISCUSSION

The honey sample H₄ showed its highest activity against the bacterial species *S. typhi* with the zone of inhibition 16 mm. Followed by *S. aures* (15 mm), *Ps. fluorescence* (13 mm), *B. subtilis* (12 mm), and *B. cerus* (12 mm).

The zones of inhibition were at their maximum value for the bacterial species *S. typhi* in three honey samples viz. H₂, H₃, and H₄ while it is on the second position for sample H₁. Thus it can be postulated that the *Melghat* honeys show their highest activity against *S. typhi*. On the contrarily there were no evidences obtained to show the activities of the *Melghat* honey samples against the species *E. coli*.

4.3.5 ANTIBACTERIAL ACTIVITIES OF ALL HONEY SAMPLES AGAINST GRAM NEGATIVE AND POSITIVE HONEY BACTERIA

All the honey samples showed their activities against almost all the bacterial species taken for the experiments. Surprisingly it is found that no honey sample showed its activity against the Gram negative bacterial species *Escherichia coli*. The

comparative tables 4.14 and 4.15 are showing the activities of all honey samples against Gram negative and Gram positive bacteria respectively. Figure 4.1 to 4.6 showing the photographs of the zones of inhibition against the said bacteria.

TABLE 4.14: ANTIBACTERIAL ACTIVITIES OF ALL HONEY SAMPLES AGAINST GRAM-NEGATIVE BACTERIA

S N	HONEY SAMPLES	ZONE OF INHIBITION		
		GRAM-NEGATIVE BACTERIAL SPECIES		
		<i>Escherichia coli</i>	<i>Salmonella typhi</i>	<i>Pseudomonas fluorescence</i>
1	Sample 1 (H ₁)	--	14 mm	12 mm
2	Sample 2 (H ₂)	--	16 mm	12 mm
3	Sample 3 (H ₃)	--	17 mm	14 mm
4	Sample 4 (H ₄)	--	16 mm	13 mm

DISCUSSION

Among the Gram-negative species three out of the four honey samples i.e. sample H₁, H₂, and H₃ have shown their maximum potential against the species *B. cereus*. While for the remaining honey sample i.e. sample four H₄, it is on the second position. Thus the *Melghat* honey samples have shown their highest potential against *B. cereus* among the Gram –ve bacterial species selected for the examination.

Thus the *Melghat* honey samples showed their prospective against five bacterial strains out of the six species that are selected for the experimental work. The zones of inhibition were having significant diameter might make these honey a spectacular natural antibiotic with no side effects. It was revealed that the natural and unheated honeys have comparably excellent potency against pathogenic bacteria (Mandal and Mandal, 2011).

Tambekar and Rathod (2007) had studied the antibacterial potential of the *Melghat* and other branded honeys against the human pathogens *S. aureus*, *S. typhi*, *S. epidermidis*, *E. aeruginosus*, *P. vulgaris*, *E. coli*, *Ps. aeruginosa*, and *K. pneumoniae*. Though the samples did not show their activities against *E. coli*, it was reported that the all *Melghat* honey were found more effective against all the pathogens than the branded honeys. The *Melghat* honeys being wild are most natural and might be useful for the therapeutic applications.

GRAPH 4.12: ZONES OF INHIBITION OF HONEY SAMPLES AGAINST GRAM-NEGATIVE BACTERIA

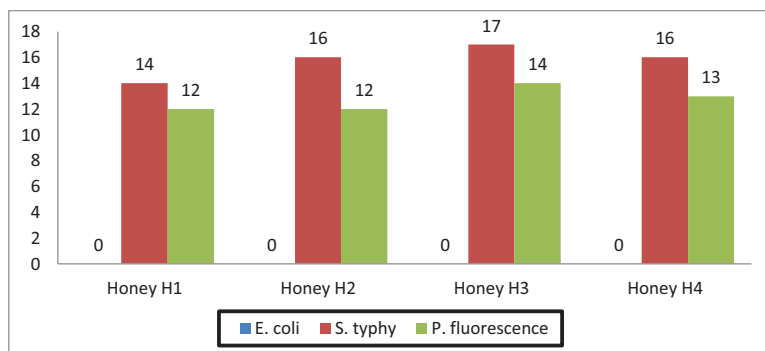


TABLE 4.15: ANTIBACTERIAL ACTIVITIES OF ALL HONEY SAMPLES AGAINST GRAM-POSITIVE BACTERIA

S N	HONEY SAMPLES	ZONE OF INHIBITION		
		GRAM-POSITIVE BACTERIAL SPECIES		
		<i>Staphylococcus aureus</i>	<i>Bacillus subtilis</i>	<i>Bacillus cereus</i>
1	Sample 1 (H ₁)	11 mm	13 mm	16 mm
2	Sample 2 (H ₂)	14 mm	12 mm	15 mm
3	Sample 3 (H ₃)	12 mm	12 mm	14 mm
4	Sample 4 (H ₄)	15 mm	12 mm	12 mm

GRAPH 4.13: ZONES OF INHIBITION OF HONEY SAMPLES AGAINST GRAM-POSITIVE BACTERIA

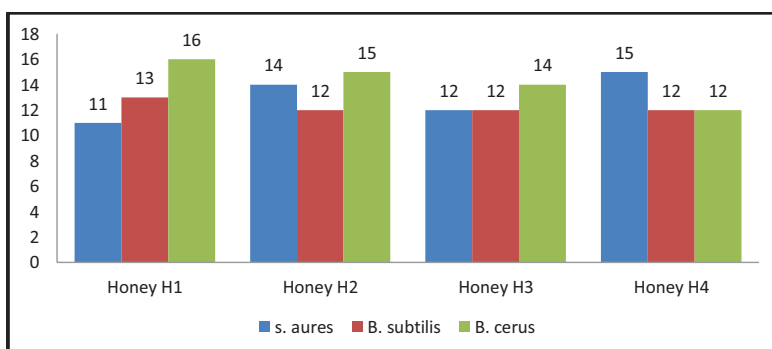


FIGURE 4.1 ZONES OF INHIBITION OF ALL THE HONEY SAMPLES AGAINST BACTERIAL SPECIES *Escherichia coli*

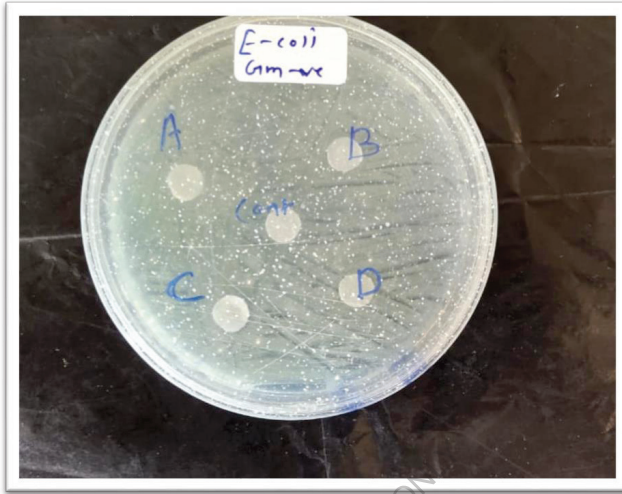


FIGURE 4.2 ZONES OF INHIBITION OF ALL THE HONEY SAMPLES AGAINST BACTERIAL SPECIES *Salmonella typhi*

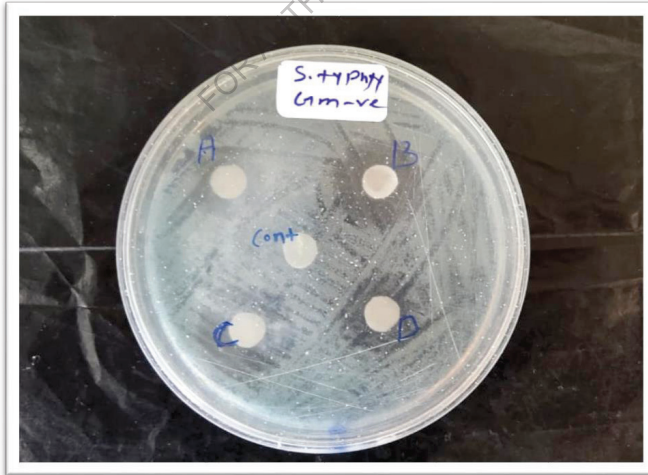


FIGURE 4.3 ZONES OF INHIBITION OF ALL THE HONEY SAMPLES AGAINST BACTERIAL SPECIES *Pseudomonas fluorescens*

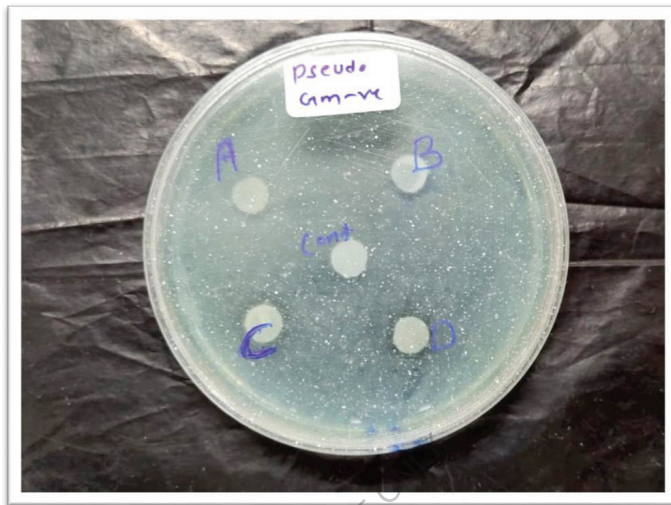


FIGURE 4.4 ZONES OF INHIBITION OF ALL THE HONEY SAMPLES AGAINST BACTERIAL SPECIES *Staphylococcus aureus*



FIGURE 4.5 ZONES OF INHIBITION OF ALL THE HONEY SAMPLES AGAINST BACTERIAL SPECIES *Bacillus subtilis*

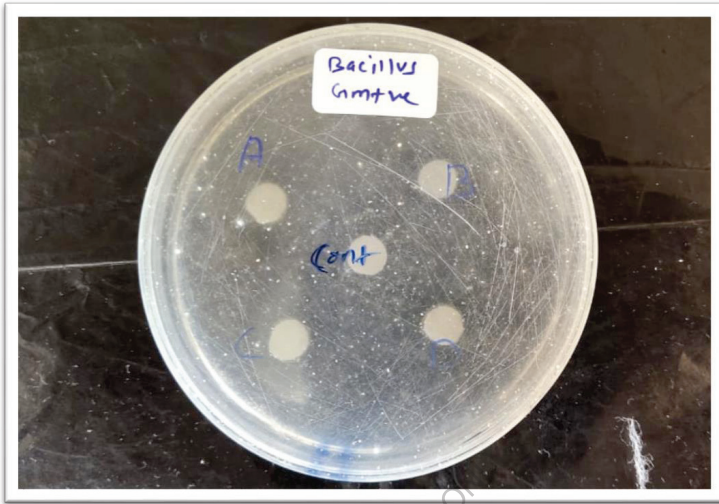
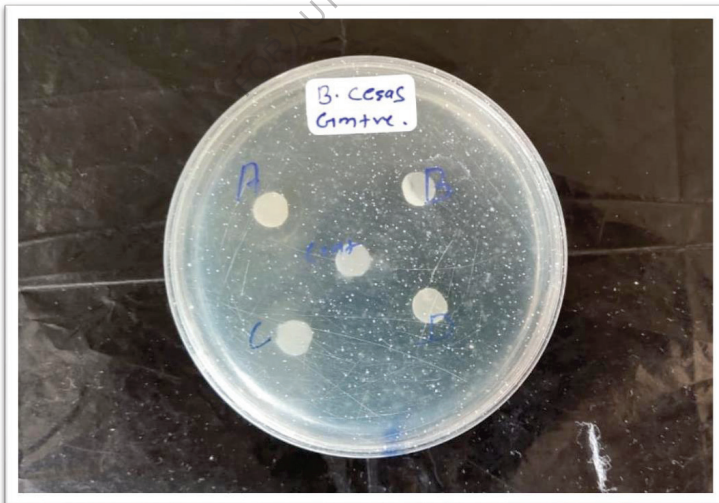


FIGURE 4.6 ZONES OF INHIBITION OF ALL THE HONEY SAMPLES AGAINST BACTERIAL SPECIES *Bacillus cereus*



Kalidasan et al. (2017) evaluated the antibacterial potential of three varieties of honeys viz. Kombu honey, Malan honey, and commercial honey, against some bacterial species such as *S. aureus*, *A. baumani*, *P. aeruginosa*, *S. flexneri*, *P. mirabilis*, *E. coli*, *K. pneumonia*, *S. typhi*, and *B. cereus*. The zones of inhibition observed for the species were, for *S. aureus* 34, 26, and 22 mm, for *E. coli* 28, 19, and 17 mm, for *B. cereus* 32, 23, and 21mm, and for *S. typhi* 24, 21, and 19 mm.

In another study the honey samples under examination had shown their potential against *E. coli* (12-24 mm), *S. typhi* (0-20 mm), *S. aureus* (20-21 mm), and *Ps. Fluorescence* (15-16 mm) (Mandal & Mandal, 2011).

With the exception of *E. coli* the data obtained in the studies done by Mohapatra et al. (2011) and Chauhan et al. (2010) were found analogous with the current work. Mohapatra et al. (2011), who studied the antibacterial activities of raw and processed honeys, got the zones of inhibition against the bacterial species *E. coli* (16.14-28.49 mm), *S. typhi* (31.85-37.94 mm), *Ps. Fluorescence* (13.09-35.95 mm), *S. aureus* (8.58-11.54 mm), *B. subtilis* (7.25-11.19 mm), and *B. cereus* (6.94-23.7 mm). Chauhan et al. (2010) got the data against *E. coli* (14.0-29.4 mm), *S. typhi* (29.47-38.12), *Ps. aeruginosa* (13.09-35.95 mm), *S. aureus* (8.9-10.0 mm), *B. subtilis* (7.25-11.19 mm), and *B. cereus* (6.94-12.83 mm).

4.3.6 MECHANISM OF ANTIMICROBIAL ACTION OF HONEY AND PROPERTIES RESPONSIBLE

The application of honey as an antimicrobial agent in the ancient treatment theories for the infections found dates back to prehistoric periods. The broad continuum of microbial species is restrained by honey. The differences in the activity of honey against the various bacteria may be in the consequences of the effects of its heaps of physical and chemical properties.

The mechanism of the antibacterial potential of honey was not understood clearly but there were many factors that can be attributed for its splendid performance against the range of microorganisms. The physical over and above chemical factors are reported to be important for these properties of honey.

High osmotic pressure exerted due to the high sugar content of honey disables the bacterial cells to grow. The water is squeezed out from their cell that brings the bacterial cells towards death. Due to the high amount of sugar, the viscosity of honey elevated causing the formation of a layer that may protect the infected area from the

septic bacteria. The high acidity (low pH) of honey is also responsible for its inhibitory effect against bacteria (Harun et al., 2017).

Formation of hydrogen peroxide due to the effect of glucose oxidase, an enzyme, is one of the most prominent parameters reported by most of the researchers behind the antibacterial property of honey. It is the byproduct of the synthesis of gluconic acid from glucose that acts as a destroying agent. The accumulation of H_2O_2 is depended on the age of honey, the effect of heating, and the floral origin.

It is said that another reason for the antibacterial properties of honey is due to the presence of 'inhibine', which may be sensitive to the heat and light. It is the reason why heated honey is not accepted in European countries (White & Doner, 1980). Abeshu and Gelata (2016) agreed on the same facts and added that the hydrogen peroxide in honey gets activated on dilution with body fluids and acts as an antibacterial agent.

In addition, phenolic compounds, carbohydrates, the produces of Maillard reactions, some proteins, compounds like peptides methylglyoxal, etc. are also responsible for the antibacterial potential of honey. Zainol et al. (2013) also revealed that besides hydrogen peroxide various non-peroxide components mentioned above, as well as methyl syringate and some unidentified compounds, showed the antibacterial activities.

Saranraj and Sivasakthi (2018) have supported the theory of defensins and the role of peptides in the antimicrobial mechanism. He elaborated that the peptides disrupt the membrane of microorganisms and carry out the depolarization of the inner membrane that leads to the reduction of cytoplasmic ATP. This hurdles the respiration of the bacterial cell causing its death. Yet another theory said that the redox potential of vitamin C in honey plays a key role in its antibacterial activity (Tambekar & Rathod, 2007).

Almost all the civilizations, traditions, and generations of ancient as well as modern era accepted the use of honey as a food and medicine due to its numerous beneficial properties including antimicrobial potency. Honey not only shows its inhibitory effect against bacteria but also against fungus, viruses, and others. Many researchers supported this fact and revealed the various possible mechanisms of the action of honey against microbes (Israili, 2014; De-melo et al., 2017; Szweda, 2017).

4.4 PHYTOCHEMICALS DETECTION

The phytochemicals analysis is said to be a very important aspect of the examination of the medicinal and therapeutic values of any natural material that essentially originated from the plants. Phytochemicals are the bioactive compounds that are commonly known as the secondary metabolites and formed during various metabolic actions of plants that are essential for their growth.

There is a very huge group of substances included in the category of phytochemicals, for instance, polysaccharides, gums, tannins, saponins, flavonoids, tannins, and phenolic compounds, terpenoids and triterpenoids, glycosides, and alkaloids, etc.

The drugs and medicine originated from the parts of plants are found to have a rich profile of phytochemicals. The side effects of the synthetic antibiotics and the danger of increasing consequences of the development of resistance in the pathogenic microorganisms for the synthetic antibiotic insisted the researchers for the use of natural substances having the antimicrobial potential.

These compounds possess a broad spectrum of biological activities such as antimicrobial potential, antioxidant activities, involved in the modulation concerning with the detoxification of enzymes and boosting the immune system; take an active part in the reduction of platelet aggregation as well as modification of hormone system. Their anticancer activities are also remarkable (Ping et al., 2019; Ezeonu & Ejikeme, 2016)

PHYTOCHEMICAL SCREENING TESTS (QUALITATIVE ANALYSIS)

Here in this study, the honey samples under examination were subjected to the screening of phytochemicals qualitatively. Standard methods given in the various research articles and published in the reputed journals were used for the qualitative analysis of phytochemicals such as Glycosides, Alkaloids, Saponins, Tannins, and phenolic compounds, Steroids, Tri-terpenoids, Proteins, carbohydrates, and Flavonoids.

PHYTOCHEMICAL SCREENING OF HONEY SAMPLES

The phytochemical screening of honey samples from all the four locations was done by using the standard screening tests. The data are tabulated in the tables 4.16, 4.17, 4.18, and 4.19.

DISCUSSION

The tests for tri-terpenoids found negative for all the honey samples while only one test out of the eight tests carried out for the detection of alkaloids found positive. Thus it was revealed from the data that tri-terpenoids and alkaloids are not present in the *Melghat* honey samples.

The tests for all other secondary metabolites were found positive as an indication of the presence of glycosides, saponins, steroids, tannins and phenols, carbohydrates, proteins, and flavonoids in the *Melghat* honey samples. There are five results that were positive for tannins and phenolic compounds out of the eight tests carried out thus there is the presence of tannins and phenolic compounds but might not be found in a significant amount.

There is a need for a detailed study of the *Melghat* honey samples for the phytochemical profile. The properties of the phytochemicals present in the *Melghat* honey make it an excellent natural forest produce that might be useful in the treatment of many clinical diseases and disorders.

TABLE 4.16: PHYTOCHEMICAL SCREENING OF HONEY SAMPLE H₁

S N	PHYTOCHEMICAL	TEST PERFORMED	RESULT
1	Glycosides	Keller-Kiliani test	Positive
2		Salkowski's test	Positive
3	Alkaloids	Wagner's Test	Negative
4		Dragendroff's Test	Negative
5	Saponins	Foam Test	Positive
6	Tannins and Phenolic compounds	Lead acetate test	Positive
7		Ferric chloride test	Negative
8	Steroids	Ring test	Positive
9	Tri-terpenoids	Methanol test	Negative
10	Proteins	Ninhydrin test	Positive
11	Flavonoids	Shinoda test	Positive
12	Carbohydrates	Fehling's test	Positive
13		Benedict's test	Positive

TABLE 4.17: PHYTOCHEMICAL SCREENING OF HONEY SAMPLE H₂

S N	PHYTOCHEMICAL	TEST PERFORMED	RESULT
1	Glycosides	Keller-Kiliani test	Positive
2		Salkowski's test	Positive
3	Alkaloids	Wagner's Test	Negative
4		Dragendroff's Test	Negative
5	Saponins	Foam Test	Positive
6	Tannins and Phenolic compounds	Lead acetate test	Positive
7		Ferric chloride test	Positive
8	Steroids	Ring test	Positive
9	Tri-terpenoids	Methanol test	Negative
10	Proteins	Ninhydrin test	Positive
11	Flavonoids	Shinoda test	Positive
12	Carbohydrates	Fehling's test	Positive
13		Benedict's test	Positive

TABLE 4.18: PHYTOCHEMICAL SCREENING OF HONEY SAMPLE H₃

S N	PHYTOCHEMICAL	TEST PERFORMED	RESULT
1	Glycosides	Keller-Kiliani test	Positive
2		Salkowski's test	Positive
3	Alkaloids	Wagner's Test	Negative
4		Dragendroff's Test	Positive
5	Saponins	Foam Test	Positive
6	Tannins and Phenolic compounds	Lead acetate test	Positive
7		Ferric chloride test	Negative
8	Steroids	Ring test	Positive
9	Tri-terpenoids	Methanol test	Negative
10	Proteins	Ninhydrin test	Positive
11	Flavonoids	Shinoda test	Positive
12	Carbohydrates	Fehling's test	Positive
13		Benedict's test	Positive

Flavonoids observed to be present in these honeys have a tremendous clinical significance. These secondary metabolites of plants reported having antioxidant potential, the capacity of scavenging the free radicals, usefulness in the prevention of coronary heart disorders, anticancer, antiviral, and anti-inflammatory potential. They are reported as the essential components in the pharmaceuticals, nutraceuticals, cosmetic and medical applications.

Phenols and tannins are exhibits to active in the uptake of nutrients, enzyme activation, and synthesis of proteins while working as an inhibitor of tumor genesis and pro-carcinogens.

These are also found useful in the prevention of the diseases caused due to free radicals. Tannins work fabulously against diarrhea, stomach tumors over and above as an inhibitor of breast and pancreatic cancer. They are also possessing anti-inflammatory, antiseptic, and antioxidantal properties.

Saponins are synthesized for the defense system in plants. They are useful in wound healing, as anti-hepatotonic, and anti-inflammatory agents. They have a cytotoxic effect against many cancer lines (Ping et al., 2019).

TABLE 4.19: PHYTOCHEMICAL SCREENING OF HONEY SAMPLE H₄

S N	PHYTOCHEMICAL	TEST PERFORMED	RESULT
1	Glycosides	Keller-Kiliani test	Positive
2		Salkowski's test	Positive
3	Alkaloids	Wagner's Test	Negative
4		Dragendroff's Test	Negative
5	Saponins	Foam Test	Positive
6	Tannins and Phenolic compounds	Lead acetate test	Negative
7		Ferric chloride test	Positive
8	Steroids	Ring test	Positive
9	Tri-terpenoids	Methanol test	Negative
10	Proteins	Ninhydrin test	Positive
11	Flavonoids	Shinoda test	Positive
12	Carbohydrates	Fehling's test	Positive
13		Benedict's test	Positive

Shapla et al. (2018) reported that some alkaloids may possess toxic properties. Due to this nature of alkaloids, alkaloids containing honey may not be useful as medicines (Amabye, 2017). But it was said that a low amount of alkaloids did not show the harmful effects (Rahman et al., 2013). Ping et al. (2019), revealed that alkaloids have protective properties that are useful in the inhibition of proliferation as well as it has an antimetastatic effect for the cancers.

Alkaloids, flavonoids, and glycosides have such properties that are beneficial for the good health of the heart favored by stimulating its activities. Alkaloids are effective in cold and cough as well as malaria. Flavonoids are useful in the healing of skin diseases, wounds, and skin ulcers as they reduce the wound acidity and show anti-inflammatory effects (Nwankwo et al., 2014).

TABLE 4.20 PHYTOCHEMICAL SCREENING TEST RESULTS AS PER THE PHYTOCHEMICAL COMPOUNDS

Honey Sample	Test Performed					
	Glycosides		Alkaloids		Saponins	Steroids
	Keller-Kiliani Test	Salkowski's Test	Wagner's Test	Dragendorff's Test	Foam Test	Ring Test
H ₁	+ ve	+ ve	-ve	-ve	+ ve	+ ve
H ₂	+ ve	+ ve	-ve	-ve	+ ve	+ ve
H ₃	+ ve	+ ve	-ve	+ ve	+ ve	+ ve
H ₄	+ ve	+ ve	-ve	-ve	+ ve	+ ve

Honey Sample	Test Performed						
	Tannins And Phenols		Carbohydrates		Tri-terpenoids	Proteins	Flavonoids
	Lead Acetate Test	FeCl ₂ Test	Fehling's Test	Benedict's Test	Methanol Test	Ninhydrin Test	Shinoda Test
H ₁	+ ve	-ve	+ ve	+ ve	-ve	+ ve	+ ve
H ₂	+ve	+ ve	+ ve	+ ve	-ve	+ ve	+ ve
H ₃	+ ve	-ve	+ ve	+ ve	-ve	+ ve	+ ve
H ₄	-ve	+ ve	+ ve	+ ve	-ve	+ ve	+ ve

Many researchers have reported the presence of various phytochemicals in the honey samples investigated. Most of them detected the phenolic compounds and flavonoids. There was no data found regarding the investigation of the *Melghat* honey samples for the phytochemicals. The results are varied significantly. There are differences found in the phytochemical profile of honey samples from different origins. But it is cleared from all the reports that the honeys are rich in phytochemicals, some may be lacking some particular secondary metabolites.

The phytochemicals in honey are mainly responsible for its restorative properties against plenty of pathogens that are the cause of its traditional use in the remedies of many ailments. The differences in the use of honey in their wound healing, anti-allergic, antioxidant, anti-inflammatory, and in the various therapeutic applications are due to the variations in the climatic conditions of the geographical area as well as the locations and other properties (Asokan & Jayanthi, 2017; Koula, 2014; Mohamed et al., 2016; Yelin & Kuntadi, 2019; Josha et al., 2019).

4.5 ANALYSIS OF KUTKI (LITTLE MILLET)

Besides honey, *kutki* or little millet is another prime material selected for study in the current research. There are efforts done for creating the nutritionally rich, economically bearable as well as novel products from the locally available raw materials. It was the basic aim of the current study of developing the products with the use of locally available produce only. *Kutki* is one of the major crops cultivated in the region of *Melghat*. *Panicum sumatrense* is the botanical name of little millet.

There are many research articles available on the subject of the analysis of popular cereals and some millets, but very few studies are available regarding the research on the properties of little millets more ever none of them was on the little millet grown in *Melghat*. The physicochemical analysis of *kutki* was completed by using the methods prescribed in the published articles or in the publications by the standard agencies working in this field.

The data obtained were tabulated in the given table. The values were compared with the values published by Rao et al. (2017), in the book published by the Director, IIMR (Indian Institute of Millets Research) of ICAR (Indian Council of Agriculture Research) and other published articles.

4.5.1 PHYSICAL AND FUNCTIONAL PARAMETERS OF KUTKI

Regardless of its nutritional supremacy, very less work was done on the properties of millets and the literary documentation is more scrappy and poorer than other popular cereals like wheat, rice, etc. Its consumption as a portion of food is restricted to tribal populations which is the traditional consumers. The scenario might be due to the non-availability of the products that are ready to eat and friendly to consumers.

The commercial and large scale production of the millet consequently needs a thorough study of its physical as well as functional properties. The knowledge of these properties helps in designing useful equipments and the machinery that may be used for the purpose of cleaning, storing, handling, and processing while preparing the popular products. For the preparation of various processed products on large scale, *kutki* might be a popular food ingredient that is perfectly suitable in making infant foods, snacks, flakes, instant mixes, etc. (Rao et al., 2018, Rao et al., 2016).

Some physical and functional properties such as dry grain weight of 1000 grains and its volume, bulk density of dry grains, weight and volume of 1000 soaked grains, bulk density of soaked grains, hydration capacity and index, swelling capacity and index, moisture, and ash content of the locally grown *kutki* from the *Melghat* region are detected. The results that obtained are presented in table 4.21

DISCUSSION

Kutki is a kind of millet that having very small grains resembling mustard seeds in size. The weight of 1000 grains of *kutki* was measured as 3.91 grams and the volume observed was 4.12 ml. The bulk density of dry grains of little millet was obtained 0.95 g/ml. The grain dimensions affect strongly the 1000 grain weight.

The 1000 grain weight is a very important characteristic of cereals and millets as its knowledge helps in designing and performing the plenty of unit operations such as cleaning, grading and especially during the execution of threshing operations where the particular sizes of screens are essential used for the separation of the grains from other unwanted materials (Reddy et al., 2019).

In a similar way, the dimensions of soaked grains were measured. The grains were soaked for 24 hours. The weight of 1000 soaked grains observed was 4.5 grams while its volume was 4.76 ml. There was a similar increase found in the weight and volume of grains after soaking which resulted in the similarity of the bulk density of

dry and soaked grains. The bulk density of soaked grains was calculated as 0.94 g/ml similar to the dry grain density which is 0.95 g/ml in this case.

TABLE 4.21: PHYSICAL AND FUNCTIONAL PROPERTIES OF KUTKI

S N	CHARACTERISTICS	VALUES OBTAINED
1	Dry Grain Weight in gram (1000 grains)	3.91
2	Dry Grain Volume in ml (1000 grains)	4.12
3	Bulk Density of dry grains (gram/ml)	0.95
4	Weight of 1000 grains in gram (Soaked)	4.5
5	Volume of 1000 grains in ml (Soaked)	4.76
6	Bulk Density of Soaked grains (gram/ml)	0.94
7	Hydration Capacity (gram)	0.59
8	Hydration Index	15.09
9	Swelling Capacity (ml/100g)	0.64
10	Swelling Index	15.53
11	Moisture (mass %)	11.25
12	Total Ash (mass %)	1.06

The hydration capacity and hydration index were calculated for the *kutki* grains. The hydration capacity was obtained to have value 0.59 and the hydration index was 15.09 percent. As well as swelling capacity and swelling index were also calculated and got the values 0.64 ml and 15.53 percent respectively for the *kutki* grains under examination.

The knowledge about these water-related functional properties could be useful in the contribution of the quality of the value-added products, both in the preservation and processing.

It is well known that addition of water i.e. hydration or wetting of the grains is one of the most important steps involved in the manufacturing of the cereals and millets based popular value-added and extruded products such as noodles, pasta, bakery items, ready to eat materials, etc. During the interaction of water and the cereals and millets, there is a formation of bonding between the particles of water and solid materials that is responsible for the formation of dough or other mixes.

It can be said that little millet might be appropriate for the large scale use in the manufacturing of certain processed products like baby foods, breakfast cereals, and other snacks, etc. The moisture was found at the level of 11.25 % in the *kutki* from the *Melghat* and the ash content was observed to be 1.06 %. The values of moisture and ash are well in accordance with the values estimated by Reddy et al. (2019).

4.5.2 NUTRITIONAL AND CHEMICAL COMPOSITION OF *KUTKI*

Millets are found high in the nutrients content. Due to their splendid nutritional profile, they are also known as nutri-cereals. Some of the nutritional and chemical compositional parameters of the little millet from the *Melghat* were evaluated by following the standard procedures. In these parameters total carbohydrates and energy, dietary fibers, total fat content as well as mono-saturated, saturated, and polyunsaturated fats, amount of protein, minerals like sodium, calcium, and iron were included. The values obtained were inserted in table 4.22

TABLE 4.22: NUTRITIONAL AND CHEMICAL COMPOSITION OF *KUTKI*

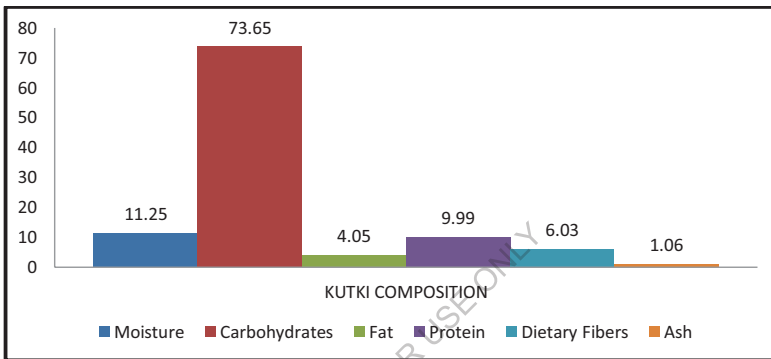
S N	PARAMETERS	VALUES OBTAINED
1	Total Carbohydrates (mass %)	73.65
2	Total Fat (mass %)	4.05
3	Total Proteins (mass %)	9.99
4	Energy (Kcal/ 100g)	371.01
5	Dietary Fibers (mass %)	6.03
6	Monounsaturated Fats (mass %)	0.79
7	Saturated Fats (mass %)	0.63
8	Poly unsaturated Fats (mass %)	2.59
9	Ash content (mass %)	1.06
10	Sodium (mg/100g)	12.45
11	Calcium (mg/100g)	4.18
12	Iron (mg/100g)	5.23

DISCUSSION

There were 73.65 % total carbohydrates found in the *kutki* sample. Total carbohydrates are the material that is remained after deducting the amount of

moisture, protein, fat, and ash. The carbohydrates present in the little millet are mostly in the form of starch followed by dietary fibers as well as other mono and disaccharides in minute amount. The energy value of *kutki* was found to be 371.01 Kcal/100g. Since the amount of carbohydrates, proteins, and fats is at a significant level in the *kutki*, it is an excellent source of food energy and proved to be one of the cheapest sources of energy.

GRAPH 4.14: COMPOSITION OF KUTKI



According to the report by WHO nutritionally little millet is more advantageous than rice as it has a low glycemic index than rice. The complex carbohydrates containing in the little millet release glucose during the digestion at a quite slower rate that is found to be beneficial for the diabetic patients since the level of satiety of millet is better than other cereals. The high content of fibers in the millet also gives additional support in preventing diabetes by lowering the rate of digestion. Thus the consumption of little millet is beneficial over rice (Padulosi et al., 2015; Bhat et al., 2018).

The dietary fiber content of the *kutki* was found to be 6.03 %, which is at a good level compared to other cereals and millets.

The moisture content of the *kutki* sample was 11.25 %. The amount of total fat was 4.05% in the *kutki* sample.

The amount of content of saturated fats was observed as 0.63%, that of monounsaturated fat was 0.79%, and polyunsaturated fats were observed to have at a level of 2.59%. The polyunsaturated fats that are good for health care in the highest amount and the less beneficial saturated fats are observed at a very low level. The

excellently beneficial fat profile of little millet make them preventive agents against various fat-related clinical disorders such as hyperlipidemia, obesity, cardiovascular diseases, etc. (Jaybhave et al., 2014; Kamatar et al., 2013)

Total amount of 9.99% of proteins was observed to be found in the *kutki* under examination. It can be said that a significantly good amount of protein was found in the *Melghat kutki* compared to other cereals and millets. The total ash content of *kutki* was 1.06%, shows a significant amount of minerals. The minerals that are detected were found in the *Melghat kutki* as sodium- 12.45 mg/100g, calcium- 4.18 mg/100g, and iron- 5.23 mg/100g.

The values obtained are in accordance with the data given by Kajuna (2001) for FAO of UN; Shivkumar et al. (2006); and Rao et al. (2018). It can be postulated from the observation that the *kutki* from the *Melghat* is of excellent quality.

There is a need for the implementation of modern methods of cultivation and cropping in order to enhance the yield and overall quality of the *kutki* in this region. The crop might not only be proved as a remedy for the problem of malnutrition due to its splendid nutritional quality but also could be helpful in the conservation of environment as it is an agent that withdraws environmental carbon hence helpful to deduct the burden of GHG (Green House Gases) (NAAS, 2013).

The little millet might be helpful in the prevention of a number of clinical disorders such as diabetes, high blood pressure, cardiac-related problems, and many more. It is a gluten-free crop that is proved to be a gift for the celiac patients. The anti acidic nature of millets might help in the detoxification of the body.

Consumption of millets might reduce the gastrointestinal tract related diseases like colon cancer or gastric ulcer. The problems of gasses, constipation, etc can be solved by using millets regularly in food. It is also beneficial in the treatment of respiratory disorders such as asthma and in the optimization of the capacity of the liver, kidney, and overall immune system. The phytochemicals, nutraceuticals, and antioxidants present in the millets are capable of maintaining good health. It serves as a probiotic (IIMR; Himanshu et al., 2018).

4.6 SENSORY EVALUATION

Keeping in mind the nutritional and medicinal importance of honey and *kutki* from the *Melghat*, the products were such developed that could be manufactured from

these above two materials and other mostly the *Melghat* oriented materials. *Ladoo* and *kheer* are such products that were selected for the current study.

Sensory evaluation is one of the tools that is used to evaluate the quality of food. The response of the customers towards any eatable products is strongly dependent on its quality. Here in the current study, the value-added products were subjected to the sensory evaluation for the determination of their quality. Sensory evaluation is the tool that may be useful for the prediction of the acceptability of the food product.

Here in the current study, a nine-point hedonic test was applied for the determination of the quality of the value-added products prepared. One to four samples were served to the panel of judges at once for the assessment. The evaluation was done by the panel of five semi-trained judges on the basis of their pleasurable and un-pleasurable experiences. The nine-point hedonic scale from extremely like to extremely dislike was formulated.

4.6.1 SENSORY EVALUATION OF *LADOO*

Ladoo is an Indian traditional sweet dish which has religious, cultural, and ancient importance and that is prepared in almost all type of ceremonial celebrations. There are plenty of ingredients from which *ladoo* are prepared in almost all the parts of Indian cultures. Among which wheat flour, gram flour (*besan*), *bundi* (prepared from the gram flour), *sattu*, etc are most popular. In the current study, the *ladoo* using the flour of *kutki* were tried to prepare with the standard recipe.

Generally, sugar is the only sweetener used in the preparation of *ladoo*, but here different samples of honey were used at varying amounts as the additional sweeteners with a constant amount of sugar for the value addition of the products. Different combinations of the honey and *kutki* flour were incorporated for the standardization of the novel recipe. The combinations of *kutki* flour and honey used are as per the given table 4.23

4.6.1.1 DATA OF SENSORY EVALUATION OF *LADOO* WITH INDIVIDUAL HONEY SAMPLES

The quality of *ladoo* was tasted by using the technique of sensory evaluation. The panel of trained judges was employed for this evaluation and the results were given in the tables 4.24 (i) to 4.24 (iv)

TABLE 4.23: FORMULATION OF *LADOO* WITH VARIED AMOUNT OF HONEY AND THE CODE NAMES

Amount of honey	Code Names				
	Honey Samples Added				
	Sample 1	Sample 2	Sample 3	Sample 4	Without Honey
2 %	LH _{1a}	LH _{2a}	LH _{3a}	LH _{4a}	L _{blank}
4 %	LH _{1b}	LH _{2b}	LH _{3b}	LH _{4b}	
6%	LH _{1c}	LH _{2c}	LH _{3c}	LH _{4c}	
8%	LH _{1d}	LH _{2d}	LH _{3d}	LH _{4d}	
10 %	LH _{1e}	LH _{2e}	LH _{3e}	LH _{4e}	
Total <i>Ladoo</i> Samples Prepared= 21					

TABLE 4.24 (i): SENSORY EVALUATION OF *LADOO* WITH SAMPLE H₁

SENSORY ATTRIBUTES	<i>LADOO</i> SAMPLES							
	LH _{1a}	LH _{1b}	LH _{1c}	LH _{1d}	LH _{1e}	T	M	L _{blank}
Color	7	7	8	6	6	34	6.80	7
Texture	7	8	6	5	7	33	6.60	8
Taste	7	9	8	6	6	36	7.20	7
Appearance	9	8	7	8	6	38	7.60	9
Overall Acceptability	8	8	7	7	7	37	7.40	8
Total Score	38	40	36	32	32	178	35.6	39

DISCUSSION

For the *ladoo* samples prepared by using honey as an additional sweetener, the results of the sensory evaluation were tabulated as above. The *ladoo* samples prepared by adding honey sample H₁ at varied amount i.e. at the rate of 2%, 4%, 6%, 8%, and 10% were mentioned in table 4.24 (i). In a similar way the results of sensory evaluation of the *ladoo* samples prepared by adding honey sample from location two i.e. H₂ were mentioned in table 4.24 (ii), and so on.

It was found that the *ladoo* prepared from honey sample 1 with the amount of 4% (LH_{1b}) got the highest position with a total score of 40. The blank sample (L_{blank})

i.e. the *ladoo* prepared without honey were at the second position (score 39) and the *ladoo* with honey 2% (LH_{1a}) were third (score 38) in the table.

Overall total score in this category was 178. The scores for these three *ladoo* samples were very close to each other. But it was decreasing significantly as the amount of honey was increasing i.e. 36 for 6% (LH_{1c}), and 32 for each 8% (LH_{1d}) and 10% (LH_{1e}) honey. The *ladoo* samples with the amount of honey above 4% were not liked by the judges in each category.

TABLE 4.24 (ii): SENSORY EVALUATION OF LADOO WITH SAMPLE H₂

SENSORY ATTRIBUTES	LADOO SAMPLES							
	LH _{2a}	LH _{2b}	LH _{2c}	LH _{2d}	LH _{2e}	T	M	L _{blank}
Color	8	8	7	6	6	35	7.00	7
Texture	9	9	7	7	6	38	7.60	8
Taste	7	8	7	6	7	35	7.00	7
Appearance	8	8	9	7	7	39	7.80	9
Overall Acceptability	6	8	8	7	8	37	7.40	8
Total Score	38	41	38	33	34	184	36.8	39

TABLE 4.24 (iii): SENSORY EVALUATION OF LADOO WITH SAMPLE H₃

SENSORY ATTRIBUTES	LADOO SAMPLES							
	LH _{3a}	LH _{3b}	LH _{3c}	LH _{3d}	LH _{3e}	T	M	L _{blank}
Color	7	7	7	6	7	34	6.80	7
Texture	8	8	7	7	6	36	7.20	8
Taste	8	7	7	7	6	35	7.00	7
Appearance	9	8	8	6	5	36	7.20	9
Overall Acceptability	7	7	7	7	7	35	7.00	8
Total Score	39	37	36	33	31	176	35.2	39

As all the honey samples were somewhat darker in color, the color of *ladoo* was not accepted by the judges up to that extent as well as the texture was slightly tended towards unlike side may be due to the stickiness of *ladoo*. The texture was at the higher side as the overall score towards the parameter 'appearance' for all the

ladoo samples was highest i.e. 38. The overall acceptability was significantly good as the differences in the scores were not in the considerable amounts.

TABLE 4.24 (iv): SENSORY EVALUATION OF *LADOO* WITH SAMPLE H₄

SENSORY ATTRIBUTES	LADOO SAMPLES							
	LH _{4a}	LH _{4b}	LH _{4c}	LH _{4d}	LH _{4e}	T	M	L _{blank}
Color	7	7	7	6	6	33	6.60	7
Texture	7	8	8	7	7	37	7.40	8
Taste	8	8	7	7	6	36	7.20	7
Appearance	7	8	7	5	5	32	6.40	9
Overall Acceptability	7	7	8	6	6	34	6.80	8
Total Score	36	38	37	31	30	172	34.4	39

Similar kinds of scores were obtained for the *ladoo* samples prepared by using the honey sample 2 i.e. H₂. The scores showed that the acceptability of these *ladoo* samples was on a little bit higher side than the *ladoo* samples prepared from honey 1. The highest total score was 41 again for the *ladoo* with honey added at the amount of 4% (sample LH_{2b}) followed by *ladoo* with honey 2% (sample LH_{2a}) and 6% (sample LH_{2c}) with total score 38 and then the *ladoo* with honey 10% (sample LH_{2e}) (score 34) and lastly with 8% honey (sample LH_{2d}) (score 33). The color of the honey sample two (H₂) was a little lighter than that of sample one (H₁) this might be one of the reasons for more acceptability of *ladoo* with honey sample two.

The score for the texture of these *ladoo* samples was considerably higher than the previous one. On the other hand, the overall score of taste was found inferior. The amount of fructose might also affect the taste of honey added *ladoo* as fructose is a very sweet sugar among all the sugars present in honey. But not any considerable trend found in the amount of fructose and the sensory acceptability of the *ladoo*. The overall total score for all categories was 184 with mean 36.8, which was the highest among all the *ladoo* samples. The total overall mean score was found less than that of the blank.

The *ladoo* with sample three were less acceptable than *ladoo* with honey samples one and two. The highest score 39 was found for the *ladoo* sample with

honey 2% (LH_{3a}). The *ladoo* with honey at the level of 4% (LH_{3b}) were at the second position with the total score 37 followed by *ladoo* with honey 6% (sample LH_{3c}) (score 36), 8% (sample LH_{3d}) (score 33), and 10% (sample LH_{3e}) (score 31). Here the gradual decrease in the total scores was observed with the increase in the amount of honey.

Texture and appearance were the top scoring parameters in this category, while color was the comparatively less scoring parameter. The overall score for all categories was 176 with mean 35.2. Thus these *ladoo* samples were at the third place after *ladoo* with honey samples two and one.

The *ladoo* prepared by using the honey sample from location four (H₄) were the least acceptable products. The color of these honey samples was darkest among all the honey samples. The highest score was obtained for the *ladoo* prepared by using 4% of honey (sample LH_{4b}) i.e. 38 while *ladoo* prepared with 10% honey (LH_{4e}) were at the bottom of the table. *Ladoo* with 6% honey (LH_{4c}) were at second position with score 37, followed by samples prepared with 2% (LH_{4a}) (score 36), and 8% (LH_{4d}) (score 31) honey.

The textures of these *ladoo* samples were the top scoring parameter with a total score of 37 (average 7.4). The judges gave a bigger score for the texture of these *ladoo* than the *ladoo* samples with honey one and three. The appearance and color were the least scoring parameters. This might happened due to the darkest color of these honey samples. The overall score for these *ladoo* was 172 (mean value 34.4).

4.6.1.2 DATA OF SENSORY EVALUATION OF LADOO WITH EQUAL AMOUNT OF HONEY

In the following tables 4.25 (i), (ii), (iii), (iv), and (v) the comparison of data of sensory evaluation for *ladoo* prepared from all the four types of honey samples taken in the same amount was done. The data was compared with the blank samples.

DISCUSSION

When 2% of each honey sample was added for the preparation of *ladoo*, the *ladoo* with the honey sample no three (LH_{3a}) were got the maximum total score i.e. 39, followed by *ladoo* with honey one (LH_{1a}) and two (LH_{2a}) with score 38 each and then with honey four (LH_{4a}).

TABLE 4.25 (i): LADOO WITH DIFFERENT HONEY SAMPLES (2% HONEY)

SENSORY ATTRIBUTES	LADOO SAMPLES						
	LH _{1a}	LH _{2a}	LH _{3a}	LH _{4a}	TOTAL	MEAN	L _{blank}
Color	7	8	7	7	29	7.25	7
Texture	7	9	8	7	31	7.75	8
Taste	7	7	8	8	30	7.5	7
Appearance	9	8	9	7	33	8.25	9
Overall Acceptability	8	6	7	7	28	7.00	8
Total Score	38	38	39	36	151	37.75	39

TABLE 4.25 (ii): LADOO WITH DIFFERENT HONEY SAMPLES (4% HONEY)

SENSORY ATTRIBUTES	LADOO SAMPLES						
	LH _{1b}	LH _{2b}	LH _{3b}	LH _{4b}	TOTAL	MEAN	L _{blank}
Color	7	8	7	7	29	7.25	7
Texture	8	9	8	8	33	8.25	8
Taste	9	8	7	8	32	8.00	7
Appearance	8	8	8	8	32	8.00	9
Overall Acceptability	8	8	7	7	30	7.50	8
Total Score	40	41	37	38	156	39	39

The average score for all the samples was less than that of blank for each of the parameters except for the color and taste which was slightly higher than the score for the blank. The overall acceptability of the *ladoo* with the honey sample at the rate of 2% was significantly good perhaps it is less than that of blank with a little amount.

The data obtained for the *ladoo* prepared from all the honey samples by adding it at an amount of 4%, represented the fact that the overall total score was highest than all the other *ladoo* samples with honey amount more or less than that of 4%. The *ladoo* with 4% honey were also having the top score within the category of *ladoo* with individual honey sample (LH_{1b}, LH_{2b}, and LH_{4b}) except for the *ladoo* with

honey sample three (LH_{3b}) that showed its highest score for *ladoo* with 2% honey (LH_{3a}).

TABLE 4.25 (iii): LADOO WITH DIFFERENT HONEY SAMPLES (6% HONEY)

SENSORY ATTRIBUTES	LADOO SAMPLES						
	LH _{1c}	LH _{2c}	LH _{3c}	LH _{4c}	TOTAL	MEAN	L _{blank}
Color	8	7	7	7	29	7.25	7
Texture	6	7	7	8	28	7.00	8
Taste	8	7	7	7	29	7.25	7
Appearance	7	9	8	7	31	7.75	9
Overall Acceptability	7	8	7	8	30	7.50	8
Total Score	36	38	36	37	147	36.75	39

TABLE 4.25 (iv): LADOO WITH DIFFERENT HONEY SAMPLES (8% HONEY)

SENSORY ATTRIBUTES	LADOO SAMPLES						
	LH _{1d}	LH _{2d}	LH _{3d}	LH _{4d}	TOTAL	MEAN	L _{blank}
Color	6	6	6	6	24	6.00	7
Texture	5	7	7	7	26	6.50	8
Taste	6	6	7	7	26	6.50	7
Appearance	8	7	6	5	26	6.50	9
Overall Acceptability	7	7	7	6	27	6.75	8
Total Score	32	33	33	31	129	32.25	39

The mean score in this category was observed to have similarity with the blank sample i.e. 39. Here in the category of *ladoo* with 4% honey, the *ladoo* with honey from location two (LH_{2b}) got the top recognition from the panel of judges with a total score of 41. *Ladoo* with honey sample one (LH_{1b}) were at the second position (score 40) followed by sample four (LH_{4b}) (score 38), and three (LH_{3b}) (score 37). The scores for each of the parameters were higher than that of blank except for the

parameter 'overall acceptability'. The mean overall acceptability for the *ladoo* with 4% honey was slightly lower (7.5) than the value for the blank (8).

TABLE 4.25 (v): LADOO WITH DIFFERENT HONEY SAMPLES (10% HONEY)

SENSORY ATTRIBUTES	LADOO SAMPLES						
	LH _{1e}	LH _{2e}	LH _{3e}	LH _{4e}	TOTAL	MEAN	L _{blank}
Color	6	6	7	6	25	6.25	7
Texture	7	6	6	7	26	6.50	8
Taste	6	7	6	6	25	6.25	7
Appearance	6	7	5	5	23	5.75	9
Overall Acceptability	7	8	7	6	28	7.00	8
Total Score	32	34	31	30	127	31.75	39

For the *ladoo* prepared by adding 6% of honey samples were having the overall score lower than that of the blank. In this category, the *ladoo* samples with honey four (LH_{4e}) were at the top with a total score of 37 followed by the *ladoo* with honey sample one (LH_{1e}) and three (LH_{3e}) with the score 36 for each and lastly with honey two (LH_{2e}) with score 35.

The mean scores for each parameter were lower than the score for the blank for the same parameter. The overall mean score for the *ladoo* with honey at the rate of 6% was 36.75 and it was lower than the blank and the *ladoo* samples with honey at the rate of 2% and 4%.

In the category of *ladoo* with 8% honey, the overall mean score was again decreased. It was 32.25, which was much lower than the total score obtained for the blank *ladoo* samples as well as the overall mean scores obtained for the *ladoo* with 2%, 4%, and 6% added honey.

Ladoo with honey samples two (LH_{2d}) and three (LH_{3d}) were at the top position in this category with the score of 33 for each, while the *ladoo* with honey sample one (LH_{1d}) were on the second position with the score of 32 followed by the *ladoo* samples with honey number four (LH_{4d}) (score 31). The mean scores in each category of sensory parameters were much lower than the respective scores obtained for the blank *ladoo* samples. The highest amount of honey was added in the last

category of *ladoo* samples i.e. with honey at the rate of 10%. It was observed that it was the least liked category because judges had given very low scores for the samples in each of the category of the sensory parameters than that of the blank *ladoo* samples and all the other *ladoo* samples prepared by taking 2%, 4%, 6%, and 8% honey.

The overall mean score obtained for the samples in this category was 31.75 which was much lower than the total score for blank which was 39. *Ladoo* with honey sample two (LH_{2e}) scored highest total i.e. 34 in this category while *ladoo* with honey sample one (LH_{1e}) were on the second position with total score 32 followed by sample three (LH_{3e}) (score 31), and sample four (LH_{4e}) (score 30).

4.6.1.3 ONE-WAY ANOVA FOR COMPARISON OF MEAN VALUES OF SENSORY ATTRIBUTES (*LADOO*)

The one-factor method is used for the analysis of the data of the mean values obtained in the sensory evaluation of one of the products i.e. *ladoo*. The data is given in table no. 4.26 (i) and 4.26 (ii). The mean values of the sensory attributes are compared honey sample-wise and amount-wisely.

TABLE 4.26 (i): ONE-WAY ANOVA HONEY-WISE

SENSORY ATTRIBUTES	MEAN VALUES FOR <i>LADOO</i> SAMPLE WITH HONEY					
	H ₁	H ₂	H ₃	H ₄		
Color	6.80	7.00	6.80	6.60		
Texture	6.60	7.60	7.20	7.40		
Taste	7.20	7.00	7.00	7.20		
Appearance	7.60	7.80	7.20	6.40		
Overall Acceptability	7.40	7.40	7.00	6.80		
SUMMARY						
Groups	Count	Sum	Average	Variance		
Color	4	27.2	6.8	0.027		
Texture	4	28.8	7.2	0.19		
Taste	4	28.4	7.1	0.013		
Appearance	4	29	7.25	0.38		
Overall Acceptability	4	28.6	7.15	0.09		
ANOVA (ONE-FACTOR)						
Source of Variation	SS	df	MS	F	P-value	F _{crit}
Between Groups	0.5	4	0.125	0.89	0.49	3.056
Within Groups	2.1	15	0.14			
Total	2.6	19				

TABLE 4.26 (ii): ONE-WAY ANOVA AMOUNT-WISE

SENSORY ATTRIBUTES	MEAN VALUES FOR <i>LADOO</i> SAMPLE WITH HONEY					
	2%	4%	6%	8%	10%	
Color	7.25	7.25	7.25	6	6.25	
Texture	7.75	8.25	7	6.5	6.5	
Taste	7.5	8	7.25	6.5	6.25	
Appearance	8.25	8	7.75	6.5	5.75	
Overall Acceptability	7	7.5	7.5	6.75	7	
SUMMARY						
Groups	Count	Sum	Average	Variance		
Color	5	34	6.8	0.39		
Texture	5	36	7.2	0.61		
Taste	5	35.5	7.1	0.52		
Appearance	5	36.25	7.25	1.16		
Overall Acceptability	5	35.75	7.15	0.11		
ANOVA (ONE-FACTOR)						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.625	4	0.156	0.281	0.887	2.866
Within Groups	11.125	20	0.556			
Total	11.75	24				

Thus in both cases, the null hypothesis is accepted. Therefore it can be concluded that as there is no significant difference between the rows the mean values of sensory parameters do not show significant change though the type or amount of honey is changed. It may be remembered that this is only for the mean values of the parameters.

RESULTS AND DISCUSSION (ANOVA TEST)

- a. **For table 4.26 (i)**
 $F(\text{cal}) < F(\text{crit})$ i.e. $0.89 < 3.056$ {Ho (null hypothesis) is **accepted**}.
- b. **For table 4.26 (ii)**
 $F(\text{cal}) < F(\text{crit})$ i.e. $0.281 < 2.866$ {Ho (null hypothesis) is **accepted**}.

4.6.1.4 COMPARISON OF THE TOTAL SCORES (*LADOO*)

In the table number 4.27 the data of the comparison of the total scores obtained by the *ladoo* samples according to the honey sample and its amount are mentioned.

It was observed from the data that the *ladoo* with honey sample two (LH₂) were mostly liked by the judges. The total score for the *ladoo* with honey sample two was 184 that was the highest score secured by any other honey sample. The *ladoo* with honey sample two were on the top position in four categories i.e. *ladoo* with 4% honey, 6% honey, 8% honey, and 10% honey (LH_{2b}, LH_{2c}, LH_{2d}, and LH_{2e}), while it was on the second position in rest of the category i.e. *ladoo* with 2% honey (LH_{2a}).

Thus it was observed that the honey sample from location two was mostly liked by the judges for the addition in the *ladoo* prepared from the *kutki* flour. The honey sample one was on the second position in its suitability for the addition in the *kutki* flour *ladoo* with an overall score of 178. Though these samples were not top in any category but consistently in the better position made it the second acceptable product. *Ladoo* with honey sample three were at the third position with score 176 followed by the *ladoo* with honey sample four with score 172. There were no significant differences found in these scores.

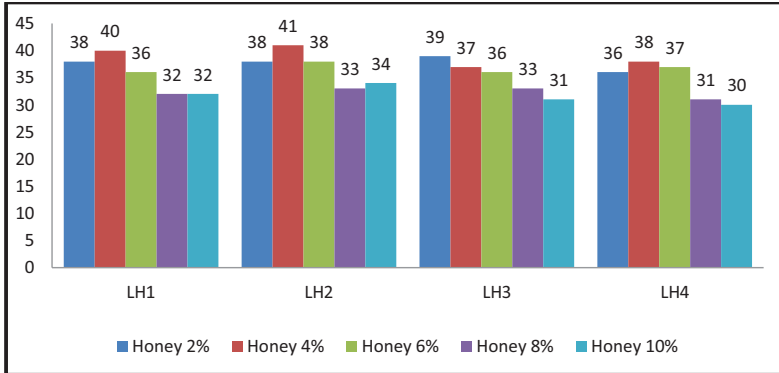
TABLE 4.27: HONEY SAMPLE VIZ TOTAL SCORE OF SENSORY EVALUATION (LADOO)

LADOO SAMPLE	TOTAL SCORES WITH VARYING AMOUNT OF HONEY						
	2%	4%	6%	8%	10%	TOTAL	MEAN
LH ₁	38	40	36	32	32	178	35.6
LH ₂	38	41	38	33	34	184	36.8
LH ₃	39	37	36	33	31	176	35.2
LH ₄	36	38	37	31	30	172	34.4
Total	151	156	147	129	127	710	142.0
Mean	37.75	39.00	36.75	32.25	31.75	177.5	35.5

On the other hand, it was found that the *ladoo* prepared by adding 4% honey were having the highest mean score i.e. 39, and hence mostly accepted by the panel of judges. The score 39 is exactly identical with the score of the blank *ladoo* sample. While the *ladoo* samples made with the addition of honey at the rate of 2% were second highest in terms of acceptability. It got the total mean score 37.75 and it is little below the total score by the blank. The addition of honey at the rate of 6% was accepted by the panel of judges at the third position with a total mean score of 36,

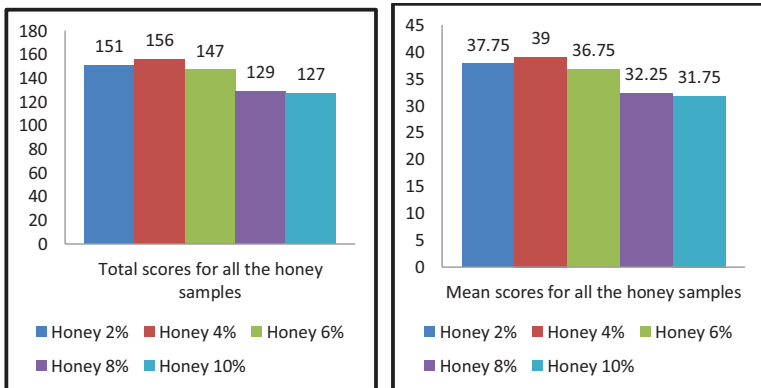
followed by honey with amount 8% with the score 32.25 and lastly with honey 10% with score 31.75.

GRAPH 4.15: SCORES OF SENSORY EVALUATION OF *LADOO* WITH

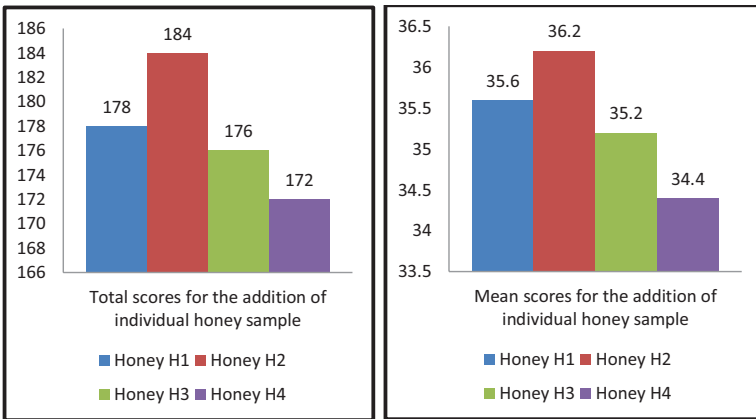


It can be concluded that the *ladoo* with honey sample two were mostly accepted by the judges and the addition of honey at the rate of 4% is most suitable as it got the highest score. As the amount of honey increased the acceptability of the products went on decreasing. The typical taste of honey and its stickiness might be some of the reasons behind this. But overall it could be said that the *ladoo* prepared from the *kutki* flour with the addition of honey were accepted by the panel of judges.

GRAPH 4.16: TOTAL AND MEAN SCORES OF SENSORY EVALUATION OF *LADOO* ACCORDING TO THE AMOUNT OF HONEY



GRAPH 4.17: TOTAL AND MEAN SCORES OF SENSORY EVALUATION OF LADOO ACCORDING TO THE TYPE OF HONEY



The main ingredients used i.e. *kutki* or little millet as well as honey, were the highly nutritious and healthy food stuffs as discussed earlier. Moreover, both the ingredients owing to their composition have an excellent potential to work as a medicine as they have shown their performances against various clinical disorders. Both the ingredients are the excellent sources of antioxidants, phytochemicals, vitamins, and minerals, so the *ladoo* prepared from these ingredients must have the potential to fight against malnutrition if used through proper channels.

4.6.1.5 TWO-WAY ANOVA FOR COMPARISON OF TOTAL SCORES OF SENSORY EVALUATION (LADOO)

The total scores of the sensory evaluation are compared by two-way ANOVA method both honey type-wise and amount-wise. The data is given in table 4.28.

RESULTS AND DISCUSSION (TWO-WAY ANOVA TEST)

a. For rows

$F(\text{cal}) > F(\text{crit})$ i.e. $4.286 > 3.49$ { H_0 (null hypothesis) is **rejected**}.

b. For columns

$F(\text{cal}) > F(\text{crit})$ i.e. $37.285 > 3.26$ { H_0 (null hypothesis) is **rejected**}.

Thus in both cases (for rows and columns), the null hypothesis is rejected. Therefore it can be concluded that the total score of sensory evaluation of the *ladoo* prepared with different kinds of honey at different amounts show the variation in their

sensory properties. It is also reflected in the previous discussion that according to the amount of honey added and the type of honey the scores of sensory evaluation show differences.

TABLE 4.28: TWO-WAY ANOVA FOR TOTAL SCORES

LADOO SAMPLE	TOTAL SCORES OF SENSORY EVALUATION					
	2%	4%	6%	8%	10%	
LH ₁	38	40	36	32	32	
LH ₁	38	41	38	33	34	
LH ₁	39	37	36	33	31	
LH ₁	36	38	37	31	30	
SUMMARY						
Summary	Count	Sum	Average	Variance		
LH ₁ (Row 1)	5	178	35.6	12.8		
LH ₂ (Row 2)	5	184	36.8	10.7		
LH ₃ (Row 3)	5	176	35.2	10.2		
LH ₄ (Row 4)	5	172	34.4	13.3		
2% (Column 1)	4	151	37.75	1.583333		
4% (Column 2)	4	156	39	3.333333		
6% (Column 3)	4	147	36.75	0.916667		
8% (Column 4)	4	129	32.25	0.916667		
10% (Column 5)	4	127	31.75	2.916667		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Rows	15	3	5	4.286	0.028	3.49
Columns	174	4	43.5	37.285	1.12E-06	3.26
Error	14	12	1.167			
Total	203	19				

4.6.2 SENSORY EVALUATION OF *KHEER*

Kheer is also an Indian traditional sweet dessert with delicious taste and high nutritional value. It has cultural and religious importance from ancient times in all the Indian states and cultures. There are numerous types of *kheer* prepared with the different types of raw materials throughout India with various dissimilar names.

Mostly milk is used as the prime ingredient in almost all types of *kheer*. With milk, sugar and various forms of cereals are the other main ingredients.

TABLE 4.29: FORMULATION OF *KHEER* WITH VARIED AMOUNT OF HONEY AND CODE NAMES

Amount of honey	Code Names				
	Honey Samples Added				
	Sample 1	Sample 2	Sample 3	Sample 4	Without Honey
2 %	KH _{1a}	KH _{2a}	KH _{3a}	KH _{4a}	K _{blank}
4 %	KH _{1b}	KH _{2b}	KH _{3b}	KH _{4b}	
6%	KH _{1c}	KH _{2c}	KH _{3c}	KH _{4c}	
8%	KH _{1d}	KH _{2d}	KH _{3d}	KH _{4d}	
10 %	KH _{1e}	KH _{2e}	KH _{3e}	KH _{4e}	
Total <i>Kheer</i> Samples Prepared= 21					

During the current study, the *kheer* was made by using milk and soaked grains of *kutki*. Honey was added at varied amount with sugar as an additional ingredient for value addition. The amount of honey added at the different amounts for the standardization of the recipe. The combinations used are as per the table 4.29

4.6.2.1 DATA OF SENSORY EVALUATION OF *KHEER* WITH INDIVIDUAL HONEY SAMPLES

The quality of the *kheer* was tasted by using the technique of sensory evaluation. The panel of semi-trained judges was employed for this evaluation and the results were given in the tables 4.30 (i) to 4.30 (iv)

DISCUSSION

For the *kheer* samples prepared by using the varied amount of honey as an additional sweetener, the results of the sensory evaluation were as given. The *kheer* samples prepared by adding honey sample H₁ at different amount (KH₁) i.e. at the rate of 2%, 4%, 6%, 8%, and 10% were mentioned in table number 4.30 (i). In a similar manner, the results of the sensory evaluation of *kheer* with honey H₂, H₃, and H₄ were mentioned in the tables 4.30 (ii), 4.30 (iii), and 4.30 (iv) respectively.

In the *kheer* samples prepared by adding the honey one (KH₁), it was found that for the *kheer* prepared by adding 4% honey (KH_{1b}) was on the top position with

score 37. *Kheer* with honey 6% (KH_{1c}) was second (score 36) followed by the *kheer* with honey 2% (KH_{1a}) (score 33), *kheer* with 8% honey (KH_{1d}) (score 30), and at last the *kheer* with 10% honey (KH_{1e}) (score 27).

TABLE 4.30 (i): SEONSOY EVALUATION OF *KHEER* WITH SAMPLE H₁

SENSORY ATTRIBUTES	KHEER SAMPLES							
	KH _{1a}	KH _{1b}	KH _{1c}	KH _{1d}	KH _{1e}	T	M	K _{blank}
Color	7	7	7	6	6	33	6.60	7
Texture	6	7	7	6	5	31	6.20	7
Taste	7	8	8	7	6	36	7.20	8
Appearance	7	7	7	5	5	31	6.20	8
Overall Acceptability	6	8	7	6	5	32	6.40	8
Total Score	33	37	36	30	27	163	32.6	38

TABLE 4.30 (ii): SEONSOY EVALUATION OF *KHEER* WITH SAMPLE H₂

SENSORY ATTRIBUTES	KHEER SAMPLES							
	KH _{2a}	KH _{2b}	KH _{2c}	KH _{2d}	KH _{2e}	T	M	K _{blank}
Color	7	7	7	6	6	33	6.60	7
Texture	7	7	7	7	6	34	6.80	7
Taste	7	8	9	8	7	39	7.80	8
Appearance	8	7	8	6	6	35	7.00	8
Overall Acceptability	7	8	8	6	6	35	7.00	8
Total Score	36	38	39	33	31	176	35.2	38

The control or blank *kheer* i.e. the *kheer* without honey scored the points 38. Thus it might say that the *kheer* with a 4% sample was very close to the blank sample.

The scores were increased first as the amount of honey increased, for example from 2% to 4%, but after further addition of honey, the scores were continuously tended to decrease. Thus the *kutki kheer* products prepared with the addition of honey one were liked by the judges but not to that extent. The overall total and average score

for the *kheer* samples with honey one was 163 and 32.6 respectively not much below the blank.

TABLE 4.30 (iii): SEONSOY EVALUATION OF *KHEER* WITH SAMPLE H₃

SENSORY ATTRIBUTES	KHEER SAMPLES							
	KH _{3a}	KH _{3b}	KH _{3c}	KH _{3d}	KH _{3e}	T	M	K _{blank}
Color	7	8	7	6	6	34	6.80	7
Texture	6	8	6	6	5	31	6.20	7
Taste	7	8	8	7	6	36	7.20	8
Appearance	7	7	7	6	6	33	6.60	8
Overall Acceptability	6	8	7	6	5	32	6.40	8
Total Score	33	39	35	31	34	166	33.2	38

The score obtained for the *kheer* samples prepared from the honey two (KH₂) were at some higher level than that of *kheer* samples with honey one (KH₁). The highest score obtained in this category was 39 for the *kheer* prepared with 6% of honey (KH_{2c}). The score was higher than that of the blank. The scores were decreased for the values on the both sides of the 6% honey. The *kheer* with the honey sample at an amount of 4% (KH_{2b}) got the score 38 and with 2% honey (KH_{2a}) 36, while the *kheer* with 8% honey (KH_{2d}) got to score 33 followed by *kheer* with 10% honey (KH_{2e}) i.e. with score 31 which is the least score.

TABLE 4.30 (iv): SEONSOY EVALUATION OF *KHEER* WITH SAMPLE H₄

SENSORY ATTRIBUTES	KHEER SAMPLE CODE							
	KH _{4a}	KH _{4b}	KH _{4c}	KH _{4d}	KH _{4e}	T	M	K _{blank}
Color	6	7	7	6	6	32	6.40	7
Texture	7	7	7	7	6	34	6.80	7
Taste	7	8	8	7	7	37	7.40	8
Appearance	8	7	8	6	5	34	6.80	8
Overall Acceptability	7	7	8	6	5	33	6.60	8
Total Score	35	36	38	32	29	170	34.0	38

A higher amount of honey in *kheer* was not much accepted by the judges. The *kheer* prepared with the honey sample two (KH₂) were liked more than that of the *kheer* prepared by adding the honey one (KH₁). The mean score was 35.2 which was the lower than that of the blank. The total and mean scores obtained by the *kheer* samples prepared from honey two were having the highest scores (score 176) among all the other honey *kheer* samples.

In the *kheer* samples prepared with the honey three (KH₃), the *kheer* with honey at an amount of 4% (KH_{3b}) was at the top, followed by the *kheer* with honey 6% (KH_{3c}) (score 35), 2% (KH_{3a}) (score 33), 8% (KH_{3d}) (score 31), and 10% (KH_{3e}) (score 28).

The highest value for the *kheer* samples in this category was 39 i.e. for the *kheer* with 4% honey, which was more than the blank and equal to the highest score got by the *kheer* with 6% honey in type-two sample (KH_{2c}). The overall total score was 166 which is less than the *kheer* samples with honey sample two (KH₂) and more than that of the *kheer* with honey sample one (KH₁). The average score was 33.2 much less than that of the blank.

The scores for the *kheer* samples from honey four (KH₄) were somewhat higher than that of the *kheer* samples with honey one (KH₁) and three (KH₃). The highest score (score 38) in this category was for the *kheer* with honey at an amount of 6% (KH_{4c}). The *kheer* with honey 4% (KH_{4b}) was at second position with the score 36 followed by the *kheer* with honey 2% (KH_{4a}) (score 35), 8% (KH_{4d}) (score 32), and 10% (KH_{4e}) (score 29). The average score in this category was 34 which was also less than the blank but on the second position after the *kheer* samples prepared with honey two.

4.6.2.2 DATA OF SENSORY EVALUATION OF *KHEER* WITH EQUAL AMOUNT OF HONEY

In the following tables 4.29 (i), (ii), (iii), (iv), and (v) the comparison of data of sensory evaluation for *kheer* prepared from all the four types of honey samples taken in the same amount was done. The data was compared with the blank samples.

DISCUSSION

When the data of sensory evaluation for the *kheer* samples prepared by adding all the honey samples at the rate of 2% was considered then it was observed that the *kheer* with honey sample two (KH_{2a}) scored at top with highest points i.e. 36. This

means that when 2% of honey was added the *kheer* with honey sample two was the mostly liked item by the panel of judges. The *Kheer* with honey sample four (KH_{4a}) was on the second position with a total score of 35, followed by the *kheer* with honey one (KH_{1a}) and three (KH_{3a}) both with the total score of 33. The scores were less than the scores obtained by the blank *kheer* sample (K_{blank}).

TABLE 4.31 (i): KHEER WITH DIFFERENT HONEY SAMPLES (2% HONEY)

SENSORY ATTRIBUTES	KHEER SAMPLES						
	KH _{1a}	KH _{2a}	KH _{3a}	KH _{4a}	TOTAL	MEAN	K _{blank}
Color	7	7	7	6	27	6.75	7
Texture	6	7	6	7	26	6.50	7
Taste	7	7	7	7	28	7.00	8
Appearance	7	8	7	8	30	7.50	8
Overall Acceptability	6	7	6	7	26	6.50	8
Total Score	33	36	33	35	137	34.25	38

TABLE 4.31 (ii): KHEER WITH DIFFERENT HONEY SAMPLES (4% HONEY)

SENSORY ATTRIBUTES	KHEER SAMPLES						
	KH _{1b}	KH _{2b}	KH _{3b}	KH _{4b}	TOTAL	MEAN	K _{blank}
Color	7	7	8	7	29	7.25	7
Texture	7	7	8	7	29	7.25	7
Taste	8	8	8	8	32	8.00	8
Appearance	7	7	7	7	28	7.00	8
Overall Acceptability	8	8	8	7	31	7.75	8
Total Score	37	37	39	36	149	37.25	38

The appearance of the samples was the most liked parameter with a total score of 30 (mean 7.5), while texture and overall acceptability were at the bottom.

TABLE 4.31 (iii): KHEER WITH DIFFERENT HONEY SAMPLES (6% HONEY)

SENSORY ATTRIBUTES	KHEER SAMPLES						
	KH _{1c}	KH _{2c}	KH _{3c}	KH _{4c}	TOTAL	MEAN	K _{blank}
Color	7	7	7	7	28	7.00	7
Texture	7	7	6	7	27	6.75	7
Taste	8	9	8	8	33	8.25	8
Appearance	7	8	7	8	30	7.50	8
Overall Acceptability	7	8	7	8	30	7.50	8
Total Score	36	39	35	38	148	37.00	38

From the data obtained for the addition of honey samples at the rate of 4%, it was cleared that the *kheer* with honey sample three (KH_{3b}) was mostly accepted by the judges. It should be noted that the total score i.e. 39 was higher than the score for the blank. The *kheer* samples with other kinds of honey also score well in this category. *Kheer* with honey sample two (KH_{2b}) and *kheer* with honey one (KH_{1b}) was on the second position with the total score of 37, followed by *kheer* with honey four (KH_{4b}) (score 36). The scores were found to be very close in this category.

TABLE 4.31 (iv): KHEER WITH DIFFERENT HONEY SAMPLES (8% HONEY)

SENSORY ATTRIBUTES	KHEER SAMPLES						
	KH _{1d}	KH _{2d}	KH _{3d}	KH _{4d}	TOTAL	MEAN	K _{blank}
Color	6	6	6	6	24	6.00	7
Texture	6	7	6	7	26	6.50	7
Taste	7	8	7	7	29	7.25	8
Appearance	5	6	6	6	23	5.75	8
Overall Acceptability	6	6	6	6	24	6.00	8
Total Score	30	33	31	32	126	31.50	38

TABLE 4.31 (v): *KHEER* WITH DIFFERENT HONEY SAMPLES (10% HONEY)

SENSORY ATTRIBUTES	<i>KHEER</i> SAMPLES						
	KH _{1e}	KH _{2e}	KH _{3e}	KH _{4e}	TOTAL	MEAN	K _{blank}
Color	6	6	6	6	24	6.00	7
Texture	5	6	5	6	22	5.50	7
Taste	6	7	6	7	26	6.50	8
Appearance	5	6	6	5	22	5.50	8
Overall Acceptability	5	6	5	5	21	5.25	8
Total Score	27	31	28	29	115	28.75	38

The average scores in each sensory parameter for all kinds of honey were less than that of blank except the average score for the parameter color and texture. The average scores for the parameter color and texture were 7.25 which are slightly higher than that of blank which was at 7. The overall total average score for the *kheer* samples with honey at the rate of 4% was 37.25, which is the highest average score for all categories. Thus it could be concluded that the *kheer* samples were liked at the greatest level by the panel of judges when the honey was added at the rate of 4%.

The points got by the *kheer* samples with honey at the rate of 6% were also at a considerable range. The highest total score was secured by the *kheer* with honey two (KH_{2c}) in this category with a score of 39. In accordance with the *kheer* samples with honey at the rate of 2%, here also the *kheer* with honey four (KH_{4c}) was on the second position with score 38 which was slightly less than the sample KH_{2c}. The overall average score secured by the *kheer* samples in this category was the second-highest i.e. 37 that is slightly higher than the *kheer* samples with honey 2% and less than the blank samples.

In the category of *kheer* with 8% honey, it was observed that the *kheer* was liked at a lesser extent by the panel of judges. In this category again the *kheer* sample KH_{2d} got the highest position with the score 33. The *kheer* with honey four (KH_{4d}) was on the second position with score 32 followed by sample KH_{3d} (score 31) and KH_{1d} (score 30). It was found that these *kheer* samples were also liked by the judges

and were in the fourth position. The scores of all the sensory parameters were less than the blank in this category.

In the case of the *kheer* samples prepared by using the honey at the rate of 10%, it was observed that these samples were less liked by the judges. The overall average score was 28.75 in this category. *Kheer* with honey two (KH_{2e}) was at the top with score 31 followed by the sample KH_{4e} (score 29), sample KH_{3e} (score 28), and at the bottom sample KH_{1e} with score 27. It can be postulated that as the amount of honey increased the overall score decreased above 6% honey.

4.6.2.3 ONE-WAY ANOVA FOR COMPARISON OF MEAN VALUES OF SENSORY ATTRIBUTES (*KHEER*)

The one-factor method is used for the analysis of the data of the mean values obtained in the sensory evaluation of one of the products i.e. laddoo. The data is tabulated in table no. 4.32 (i) and 4.32 (ii). The mean values of the sensory attributes are compared honey sample-wise and amount-wisely.

TABLE 4.32 (i): ONE-WAY ANOVA HONEY WISE

SENSORY ATTRIBUTES	MEAN VALUES FOR <i>KHEER</i> SAMPLE WITH HONEY					
	LH ₁	LH ₂	LH ₃	LH ₄		
Color	6.6	6.6	6.8	6.4		
Texture	6.2	6.8	6.2	6.8		
Taste	7.2	7.8	7.2	7.4		
Appearance	6.2	7	6.6	6.8		
Overall Acceptability	6.4	7	6.4	6.6		
SUMMARY						
Groups	Count	Sum	Average	Variance		
Color	4	26.4	6.6	0.027		
Texture	4	26	6.5	0.12		
Taste	4	29.6	7.4	0.08		
Appearance	4	26.6	6.65	0.117		
Overall Acceptability	4	26.4	6.6	0.08		
ANOVA (ONE-FACTOR)						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	2.16	4	0.54	6.38	0.0033	3.06
Within Groups	1.27	15	0.085			
Total	3.43	19				

TABLE 4.32 (ii): ONE-WAY ANOVA AMOUNT WISELY

SENSORY ATTRIBUTES	MEAN VALUES FOR LADOO SAMPLE WITH HONEY					
	2%	4%	6%	8%	10%	
Color	6.75	7.25	7.00	6.00	6.00	
Texture	6.50	7.25	6.75	6.50	5.50	
Taste	7.00	8.00	8.25	7.25	6.50	
Appearance	7.50	7.00	7.50	5.75	5.50	
Overall Acceptability	6.50	7.75	7.50	6.00	5.25	
SUMMARY						
Groups	Count	Sum	Average	Variance		
Color	5	33	6.6	0.33		
Texture	5	32.5	6.5	0.41		
Taste	5	37	7.4	0.52		
Appearance	5	33.25	6.65	0.925		
Overall Acceptability	5	33	6.6	1.081		
ANOVA (ONE-FACTOR)						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	2.7	4	0.675	1.034	0.414	2.866
Within Groups	13.05	20	0.652			
Total	15.75	24				

RESULTS AND DISCUSSION (ANOVA TEST)

a. For table 4.32 (i)
 $F(\text{cal}) > F(\text{crit})$ i.e. $6.38 > 3.06$ {Ho (null hypothesis) is **rejected**}.

b. For table 4.32 (ii)
 $F(\text{cal}) < F(\text{crit})$ i.e. $1.034 < 2.866$ {Ho (null hypothesis) is **accepted**}.

Thus in the table of means of parameters of honey-wise kheer evaluation the hypothesis is rejected. Thus the mean values of parameters showed considerable difference in their values as the honey sample changed. On the other hand, the null hypothesis is accepted in the case of the mean values (amount wise) of sensory evaluation of kheer. Thus it can be said that the mean values showed no considerable difference in their values as the amount of honey used for the preparation is changed. It should be noted that these observations are only for the mean values of the parameters.

4.6.2.4 COMPARISON OF TOTAL SCORES (*KHEER*)

In the table 4.33 the combined data that showing the comparison of the total scores obtained by the *kheer* samples as per the different honey samples as well as their amounts are mentioned.

DISCUSSION

It was observed from the data that the *kheer* samples prepared by using the honey sample from location two (KH₂) were at the top according to the choice of the panel of judges in the sensory evaluation. It got the total overall score 176 with an average of 35.2 in all the categories of varying amounts of honey. The *kheer* samples prepared with honey H₂, were at the top of the list in four categories i.e. in *kheer* with 2% honey, 6% honey, 8% honey, and 10% honey (KH_{2a}, KH_{2c}, KH_{2d}, and KH_{2e}), while it was on the second position in the remaining category i.e. *kheer* with 4% honey (KH_{2b}).

TABLE 4.33: HONEY SAMPLE VIZ TOTAL SCORE OF SENSORY EVALUATION (*KHEER*)

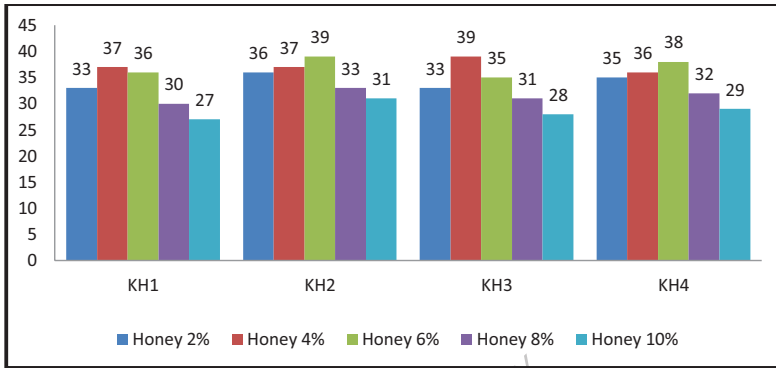
<i>KHEER</i> SAMPLE	TOTAL SCORES WITH VARYING AMOUNT OF HONEY						
	2%	4%	6%	8%	10%	TOTAL	MEAN
KH ₁	33	37	36	30	27	163	32.6
KH ₂	36	37	39	33	31	176	35.2
KH ₃	33	39	35	31	28	166	33.2
KH ₄	35	36	38	32	29	170	34.00
Total	137	149	148	126	115	675	135.0
Mean	34.25	37.25	37.00	31.50	28.75	168.75	33.75

Thus it was concluded that the honey samples with location two were found most suitable according to the sensory evaluation test for the addition in the *kheer*. One more thing that observed was the honey sample from location two (H₂) was liked most by the judges for the preparation of *ladoo* also.

Again it was observed that the *kheer* samples with honey from location four (KH₄) were in the second position with the overall score of 170. Though it was not on the top of any individual category list, but consistently it was on the second position

in all the four categories, i.e. *kheer* with honey at the rate of 2%, 6%, 8%, and 10%. The average mean score by the *kheer* with honey sample four was calculated as 34.

GRAPH 4.18: SCORES OF SENSORY EVALUATION OF *KHEER* WITH HONEY



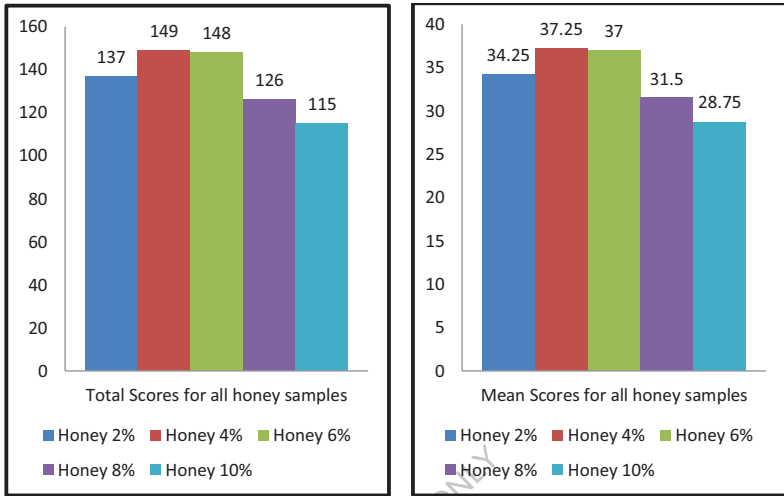
The *kheer* samples with honey three (KH₃) were on the third position and with the honey one (KH₁) were at the bottom of the table. The overall mean scores for all the *kheer* samples with honey from various locations were ranging between 32.6 and 35.2. It was a very narrow range so it could be said that all the honey samples were accepted by the judges for the use in *kheer* as the total score for blank was slightly higher than this range.

As per as the amount of honey that is suitable for adding in the *kheer* concerned it was clear from the data that the samples with the honey at the rate of 4% were on the top (with total overall score 149 and mean 37.25) and with honey at the rate of 6% were just closed (total overall score 148 and mean 37).

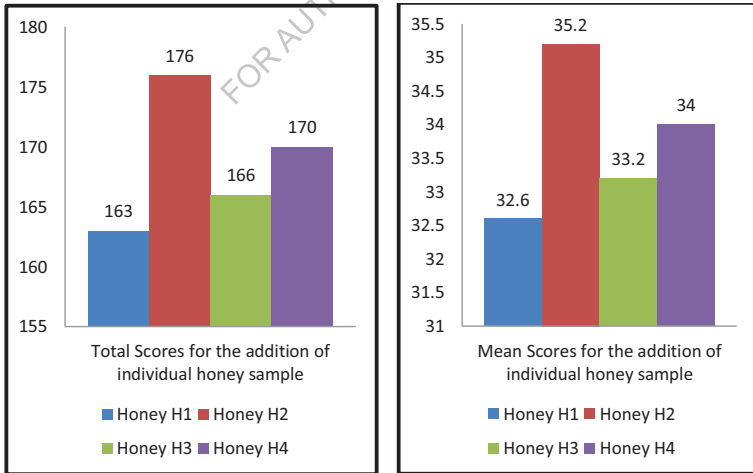
Thus it could be said that the *kheer* samples with honey at the rate of 4% and 6% were highly accepted by the judges. The scores were very close to the score for blank (38). Comparably it was found that the *kheer* samples with honey at the rate of 2%, 8%, and 10% were not liked by the judges up to that extent as the differences were significantly high than the top scores.

The overall scores for the *kheer* samples with 2% honey, 8% honey, and 10% honey were 137 (mean 34.25), 126 (mean 31.5), and 115 (mean 28.75) respectively.

GRAPH 4.19: TOTAL AND MEAN SCORES OF SENSORY EVALUATION OF *KHEER* ACCORDING TO THE AMOUNT



GRAPH 4.20: TOTAL AND MEAN SCORES OF SENSORY EVALUATION OF *KHEER* ACCORDING TO THE TYPE OF HONEY



Thus it can be concluded that the honey sample H₂ was found most suitable for the use in *kheer* as a sweetener which was also on the top in case of *ladoo*. As well as the amount of honey that should use in the *kheer* was selected by judges as 4% and

6% (with a slightly low score). For *ladoo*, it was 4%. The amount of honey at a higher amount was not accepted by the judges to a considerable extent for both *kheer* and *ladoo*.

4.6.2.5 TWO-WAY ANOVA FOR COMPARISON OF TOTAL SCORES OF SENSORY EVALUATION (KHEER)

The total scores of the sensory evaluation are compared by two-way ANOVA method both honey type-wise and amount-wise (table number 4.34).

TABLE 4.34: TWO-WAY ANOVA FOR TOTAL SCORES

KHEER SAMPLE	TOTAL SCORES OF SENSORY EVALUATION					
	2%	4%	6%	8%	10%	
KH ₁	33	37	36	30	27	
KH ₂	36	37	39	33	31	
KH ₃	33	39	35	31	28	
KH ₄	35	36	38	32	29	
SUMMARY						
Summary	Count	Sum	Average	Variance		
KH₁ (Row 1)	5	163	32.6	17.3		
KH₂ (Row 2)	5	176	35.2	10.2		
KH₃ (Row 3)	5	166	33.2	17.2		
KH₄ (Row 4)	5	170	34	12.5		
2% (Column 1)	4	137	34.25	2.25		
4% (Column 2)	4	149	37.25	1.58		
6% (Column 3)	4	148	37	3.33		
8% (Column 4)	4	126	31.5	1.667		
10% (Column 5)	4	115	28.75	2.92		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Rows	18.95	3	6.317	4.65	0.022	3.49
Columns	212.5	4	53.13	39.11	8.59E-07	3.26
Error	16.3	12	1.358			
Total	247.75	19				

RESULTS AND DISCUSSION (TWO-WAY ANOVA TEST)

a. For rows

$F(\text{cal}) > F(\text{crit})$ i.e. $4.65 > 3.49$ { H_0 (null hypothesis) is **rejected**}.

b. For columns

$F(\text{cal}) > F(\text{crit})$ i.e. $39.11 > 3.26$ { H_0 (null hypothesis) is **rejected**}.

Thus in both the cases, (for rows and columns), the null hypothesis is rejected. Therefore it can be concluded that the total score of sensory evaluation for the kheer prepared with different types of honey samples at different amounts show the variation in their scores for sensory properties. It is also stated in the previous previously that the data of sensory evaluation is changed as the type and amount of honey changed.

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CHAPTER 5

SUMMARY AND CONCLUSION

5.1 INTRODUCTION

In the current study, honey and *Kutki*, the products that are grown and used in the region *Melghat* were selected for the analysis and value-addition. The thorough analysis of both the materials was done as per the requirement. The most popular Indian sweet dishes were prepared from these ingredients with the incorporation of milk also. It is the locally produced product, used for the purpose of value addition. Sensory evaluation was done for the detection of the quality of the products. All the data obtained were compared with the literature values and after discussion, the conclusions are made.

5.1.1 HISTORY AND BACKGROUND

The *Melghat* is a province of Maharashtra occupied with the dense forest and tribal population that comes under the district Amravati. It is situated in the ranges of the hills of the Satpuda and located in the central region of India. The huge forest area of the *Melghat* is full of the special ecological unit comprising of the prosperous and varied flora and fauna. Hundreds of naturally grown species of herbs, trees, bushes, sedges, grasses, and climbers are reported to have in the forest.

One more specialty of the region is that it is the area of Gugamal National Park in addition to the *Melghat and the Wan* sanctuary. The whole area mostly comes under to tehsils i. e. *Dharni and Chikhaldara*. Gaolan, Gaoli, Gond, Nihal, Korku, and Balai are most of the tribes residing predominantly in the region *Melghat* since years.

The region is suffering from the severe problem of malnutrition among the kids that is the cause of the casualty of many children of the region. The money problem as a result of unemployment as well as wrong practices of taking an improper diet with low nutritional status maybe some of the reasons for the issue.

Some common problems that found in the *Melghat* region are

- Unemployment
- Economically weak population
- Low literacy rate
- Consequences of Malnutrition among the children

Common occupations of the *Melghat* people

- Collection of the jungle products such as honey, medicinal plants, lac, tendu-patta, bamboo, etc and selling in the nearby market
- Agriculture
- Keeping the animals for mostly milk and milk products
- Going on daily wages through the government and private development works

5.1.2 MELGHAT HONEY

Honey is one of the major forest merchandises of the *Melghat*. According to the National Honey Mission publications, most of the honey of the *Melghat* forest is produced by the rock bees *Apis dorsata* and wild nests of *Apis cerana*. The *Melghat* forest region takes pride in its dense forest and rich biodiversity of medicinal plants. Due to its splendid bio-diversity, it is a source of high quality nectar and constructs a wonderful natural environment for the honey bees throughout the year. The '*Melghat* Honey' is the honey produced by the honey bees by collecting the nectar from the botanical sources of these region which have been supposed to absorb the medicinal properties.

A quick look at the *Melghat* honey

- It is mainly collected by tribal people for centuries and It may help in tackling the problem of malnutrition faced
- It has a distinct taste
- It might have antibacterial and wound healing properties
- It may provide the source of money for the local tribal population

The honey collection and trading might be good employment for the tribal to upgrade their economic status as a remedy to overcome the problem of malnutrition. If the value-added products developed from it that might bring the attention of consumers towards the *Melghat* region.

5.1.3 KUTKI (Little Millet)

We are still suffering from the problem of malnutrition in some regions of India. Many researchers suggested that the change in the eating pattern is one of the most important reasons for the problem of malnutrition. Millets are found to be prosperous in nutraceuticals and many of the micronutrients, but they are not

consumed by most of the population nowadays. Owing to the nutritional properties of millet it may have useful in maintaining health without any side effects.

Kutki, also known as little millet, is one of the main crops that grow in the *Melghat*. Its botanical name is '*Panicum Sumatrense*'. It can withstand drought and waterlogging and can cultivate in the hilly area. In the current study, the physicochemical analysis of *Kutki* (little millet) that grows in the *Melghat* region is done and it is further incorporated in the products such as *Ladoo* and *Kheer* for the standardization of the recipes.

5.1.4 MILK

The *Gaoli* community has been involved in the business of selling milk and milk products from the generations. The animals are fed with the food from the *Melghat*, thus it might be having tremendous quality with medicinal potential. In addition, milk is readily available in this area.

5.1.5 LADOO

Ladoo is one of the most popular Indian sweet dishes that are prepared during celebrations of various types of traditional or religious programs. The *ladoo* are made in India using the varied number of raw materials such as wheat flour, *besan* (horse gram flour), etc. with sugar and ghee. The product *ladoo* is chosen because it is delicious, popular, as well as nutritious. In addition, it can be made by using local ingredients. In the current study, the *Kutki* flour was used as an innovation instead of wheat flour/*besan* for *ladoo* making and honey is added as an additional sweetener with sugar for value addition.

5.1.6 KHEER

Kheer is a traditional Indian sweet dish prepared by cooking milk, sugar, and some cereals together with the addition of condiments over and above dry fruits. The cereals that are used may be in whole grains, cracked grain or coarsely ground, and flour form. *Kheer* has a great cultural, social, religious, economic, and medicinal importance associated with celebration and festivities. The nutritional value of *kheer* is varied according to its ingredients. In the current study, a novel recipe of *kheer* by using the little millet and the *Melghat* honey was standardized and the product was subjected for the sensory evaluation to check its acceptance.

5.2 WORK PLAN AND PROGRESSION OF WORK

The work in the study was planned and progressed as follows

5.2.1 REVIEW OF LITERATURE

The available literature was collected and sorted according to its type and relevance. Total numbers of 175 articles were reviewed. These articles include the research papers published in the journals (with *ISSN*), books (with *ISBN*), various reports and publications by the government and other reputed and authorized agencies, and the articles available on the internet or the blogs, etc. Proper references were also mentioned.

While writing the reviews the articles were divided according to the category of its relevance. A total of 117 articles among the total that reviewed were related to the analysis or study of the physical, chemical, nutritional, medicinal, antioxidant, antibacterial, and other properties of honey. While the articles related to the use of honey in value-added products i.e. products development with honey, were 19 in numbers. The articles containing the study of the properties and products of *kutki* were 10 in numbers. It has shown that very little research work was done regarding the study of *kutki* or little millet. There were 12 articles each containing the study of the properties of *ladoo* and *kheer* reviewed. The novel recipes and the influence on their qualities were included in these articles. Other articles with the subjects not related to the above-mentioned items were five in numbers. Thus total of 175 articles were reviewed.

5.2.2 MATERIALS AND METHODS

This chapter gives the details regarding the experimental work done and the procedures followed as well as the methods used during the study for achieving the target.

5.2.2.1 RESEARCH METHODOLOGY, APPROACH, AND DESIGN

The present study was gone through the structural type of research. The data was generated quantitatively through the experimental works and by making the necessary comparisons. The approach that was taken up for the current work maybe fallen into the category of the evaluative type of approach. The blueprint of the study was shaped up through the process of collection of published data, generation of

experimental values, and then comparing both the values with proper discussion to draw the conclusions and findings.

5.2.2.2 PROCESS OF IMPLEMENTATION:

Various steps were involved in the way while reaching the target. The steps involved were discussed in detail during the chapter number 3.

PART I: RAW MATERIALS AND THEIR PROCUREMENT

The raw materials such as honey, *kutki*, and milk were procured from the local area. A total of sixteen honey samples from four different locations of the *Melghat* were collected. From each location, four different honey samples were chosen for the study. The honey samples were designated location wise as H₁, H₂, H₃, and H₄. *Kutki* was purchased from the local market. Fresh milk was purchased from the nearby village at the time of development of the product *kheer*.

PART II: ANALYSIS OF HONEY AND KUTKI

Various properties of the raw materials used in the current study (i.e. honey and *kutki*) were determined by using the standard procedures. Honey was analyzed for the determination of its

- Physical parameters (color, moisture, pH, optical activity, and specific gravity)
- Chemical and nutritional content (carbohydrates, sugars, energy, protein, HMF, acidity, and minerals)
- Antibacterial activity (against *Escherichia coli*, *Staphylococcus aureus*, *Bacillus subtilis*, *Bacillus cereus*, *Salmonella typhi*, and *Pseudomonas fluorescens*)
- Phytochemical Screening

Kutki was subjected to the experimental examination of

- Functional and physical parameters (dry grain weight and volume, soaked grain weight and volume, hydration index and capacity, bulk density, swelling index and capacity, ash, and moisture)
- Chemical and nutritional content (carbohydrates, energy, protein, fats, fibers, and minerals)

PART III: PRODUCT DEVELOPMENT

After the analysis of honey and *kutki*, two Indian sweet and popular products i. e. *kheer* and *ladoo* were made by using novel recipes by taking honey and *kutki* as

primary ingredients. Locally available milk was also used in the preparation of *kheer*. The traditional recipes with some modifications were employed for this purpose. Honey was used with sugar for the sweetening purpose as well as for value addition.

PART IV: SENSORY EVALUATION OF THE PRODUCTS

The value-added products that were developed by using the locally available raw materials were subjected to the quality check by using the method of sensory evaluation. The nine-point hedonic scale method was used for the organoleptic evaluation of the products.

5.2.3 RESULTS AND DISCUSSION

The observations that observed during the experimental works were noted down and the results were drawn after proper discussions

5.2.3.1 HONEY ANALYSIS

Four honey samples per location in this way total sixteen *Melghat* honey samples were collected from four different locations. Some important physical parameters that are recommended by the BIS (Bureau of Indian Standards) such as color, pH, relative density (specific gravity), moisture content, ash content, and optical density at 660 nm wavelength were detected. The Fiehe's test was carried out for the detection of any consequences of adulteration in each honey sample.

Analysis of carbohydrates and sugars was done for these honey samples from all the locations to determine the important parameters determining the quality of honey such as total carbohydrates, energy value, total sugar, total non-reducing sugar, and reducing sugar, glucose, and fructose. Fructose to glucose and glucose to water ratios were calculated for the detection of freshness, adulteration, and granulation tendency of honey. The honey samples were subjected to the determination of their potential against some bacterial species. Gram-negative bacteria such as *Escherichia coli*, *Salmonella typhi*, and *Pseudomonas fluorescens* and Gram-positive bacteria such as *Staphylococcus aureus*, *Bacillus subtilis*, and *Bacillus cereus* were selected for this analysis.

The honey samples from all the four locations were subjected for the qualitative evaluation of the presence of some important phytochemicals such as glycosides, alkaloids, saponins, tannins, and phenolic compounds, steroids, triterpenoids, proteins, flavonoids, and carbohydrates.

COLOR

The color of liquid honey was found at a variety of ranges. It was come to know from the data that the honey samples examined in the current study were ranging from light to dark amber in color. Extremely light color samples were totally absent in the present set. The honey samples from the same locations were having a similarity in color pattern. The average of specific gravity values for each honey sample in this study was found in relation with its color i.e. the values were slightly lower in the lighter samples than the darker once. Other properties of the honey samples did not show any significant relationship with its color.

pH

The basic or acidic characteristic of any honey sample can be revealed from its pH value. All the previously published literature says that the nature of honey is always acidic. The pH of the different honey samples under this study was measured using the digital pH meter and recorded. The pH values were ranging from 3.39 to 5.07 and all the honey samples were found acidic. There were significant similarities found in the pH of honeys belonging to the same locations. The low pH values of the *Melghat* honey samples show that these honeys might have the potential to fight strongly against microorganisms as well as with high stability and shelf life. The *Melghat* honey might have tremendous medicinal and therapeutic potential.

SPECIFIC GRAVITY (RELATIVE DENSITY)

The relative density of honey reflects the amount of sugar and moisture present in it. There is a strong relationship found in the moisture content and specific gravity. Here in this study, the values of specific gravity were lying between 1.37 and 1.45. The values of location one honey samples were towards the higher side while location four honey samples were at the bottom of the table. There was a significant relation found between pH and specific gravity, while the latter was in the inverse relationship with the water content. The variation in the values of the specific gravities of different honey samples might be due to the difference in their composition especially the content of moisture and sugar.

MOISTURE

The water in the honey is one of the most crucial parameters to determine the quality of honey. In its composition, it is the second most bulk-forming agent both by

weight and volume. Water also acts as a solvent in which all other constituents of honey were dissolved or remained as the suspended particles. The water in honey may vary tremendously depending upon the numerous factors. It was revealed from the data that the entire samples have found the moisture content below 20%. It is clear that all the samples were of special grade as specified by the BIS and the EU. The water contents were ranging between 18.24% and 19.89%. More ever, the specific gravity and moisture were found to have an inverse relationship with few exceptions. It can be said that the *Melghat* honeys would have a high shelf life and excellent quality and tremendous potential to fight against microorganisms.

ASH CONTENT

In the current study, the honey samples under examination were subjected to the estimation of ash as it was observed that the ash content of any food item is its important characteristic in the determination of its quality especially true in the case of honey. Many factors such as the floral origin of honey, types of pollen, etc, affect the ash content of honey.

It was cleared that the values of ash content obtained for the *Melghat* honey samples were within the limit specified by the BIS. The ash content of the samples was laid below 0.39%. The ash content of some honey samples was too low to determine and it found no relevance with the other factors. The low ash content of the *Melghat* honey samples might be an indication of fresh honey without adulteration.

OPTICAL DENSITY

The optical activity of a substance is determined by using a spectrophotometer. It is measured in terms of absorbance of light and it is a logarithm of the ratio of the falling light intensity to the intensity of trasmitted light. The turbidity due to any objectionable matter, the freshness of the honey, and its color can be detected by using this tool.

It was revealed from the results that the optical densities were ranging between 0.12 and 0.32 and within the limit of BIS (max 0.3). Significant similarities were observed for the values of optical densities for the honey samples collected from identical locations with very infinitesimal variations. The optical densities were appeared to be in accordance with its color and moisture content.

FIEHE'S TEST

Fiehe's test was employed for all the *Melghat* honey samples under study. It is used as an indication of adulteration. Since almost all samples with some exceptions showed a negative result of Fiehe's test, the samples were found to exhibit no adulteration as per the guidelines given by BIS (IS 4941, 2002) for the grading of honey samples in standard, A, or special grade. Although the positive result of Fiehe's test did not always confirm the consequences of adulteration in honey, it might be due to aging, or due to the presence of impurities that appeared during handling, extraction, processing, and storage of honey.

CARBOHYDRATES AND SUGARS

The largest part of the honey is comprised of carbohydrates especially sugars since the largest part of carbohydrates of the honey is comprised of the various sugars. In the current study, the values of total carbohydrates were laying between very narrow brackets i.e. 78.12 to 80.50%.

The energy values of the honey samples were ranging between 314.72 and 325.24 Kcal for 100 grams of the sample.

Besides this, the amount of total sugar was ranging between 74.67 and 79.54%. It was concluded from the values that there is no significant difference found in the total sugars of the *Melghat* honey samples from different locations. Here total sugars were referring to both non-reducing and reducing sugars.

Sucrose, the non-reducing sugar was found in a considerable amount ranging between 2.62-4.24%. All the values were within the range specified by the BIS (max 5%) for special grade honey.

Fructose and glucose are the chief reducing sugars found in honey. The honey samples examined in the current study were significantly good in the amount of total reducing sugars and the values were stuck in the range from 71.71 to 76.18%. The fructose content was in the range of 34.84- 39.12% as well as glucose was found to have in the range of 35.12- 36.92%. As per the values obtained for the content of sugars concerns, the *Melghat* honey must be fallen in the category of the special grade that is specified by the BIS.

The fructose to glucose ration was found to exhibit greater than one in all kinds of honey except for sample from location four (H₄), which is slightly lower. As per the BIS standards, it should be above one. If the amount of fructose is greater than

that of glucose then the value of fructose to glucose obviously comes greater than one and it shows that there is less tendency of granulation in these types of honeys. The honeys with higher fructose are also sweeter comparatively.

The granulation tendency or the granulation index may not be detected to that extent with the help of only fructose to glucose ratio. For forecasting, the crystallization and granulation tendency of honey glucose to water ratio found most appropriate than fructose to glucose ratio. The glucose and its solubility play an important role in deciding the granulation tendency of honey. In the current study, the value was found maximum 2, meaning the *Melghat* honey samples were less susceptible to granulation.

Owing to the above-shown sugar profile of the *Melghat* honey, it may be said that these honeys will be found useful not only as food and food ingredient but also as a functional food.

TOTAL PROTEIN

A considerable amount of protein was found to have in the *Melghat* honey samples under examination. The values were fallen in the range starting from 0.56 % to 1.07%. There may be plenty of factors due to which the honey samples from various locations differ in their protein content. These affecting factors may be the type of nectar as well as species of plant, quality, and quantity of the pollens as well as the species of the honey bee. From the data obtained about the protein content of the *Melghat* honey samples, it can be stated that these honeys are of good quality and more ever fresh.

ACIDITY

All kinds of honey are always acidic irrespective of its floral source or the geographical difference. The honey samples from the *Melghat* showed free acidity that was ranging from 20.03 meq/kg to 32.17 meq/kg of honey. The values of free acidity of honeys were matching with their pH. The free acidity of all the *Melghat* honey samples are lying well below the maximum standard values prescribed by the authorizing agencies such as EU standards (< 50 meq/kg) or Agmark, 2008 (< 40 meq/kg). The differences in the acidity might be due to lots of reasons.

HYDROXYMETHYLFURFURAL (HMF)

HMF is a cyclic aldehyde compound that is produced due to the degradation of sugars through the non-enzymatic browning reaction. The honey samples were having a significant amount of HMF in them. The HMF content is ranging between 8.1 and 37.86 mg/kg of honey. The HMF content was comfortably within the range specified by the standard agencies such as BIS or Agmark. The result of Fiehe's test was found significantly following the values of HMF contents. Many parameters such as temperature, the content of glucose and fructose, pH, acidity, water activity, age, etc. influence HMF.

MINERALS

In the current study, iron, calcium, and sodium content of the *Melghat* honey were determined.

There was comparatively very low iron that was found in the honey samples from the *Melghat* province. It was found between 0.68 to 1.84 mg/kg of honey. Other minerals that were detected are calcium and sodium. The amount of calcium was between 1.38 and 11.7 mg/kg and that of sodium was between 5.29 to 33.82 mg/kg of honey.

ANTIBACTERIAL ACTIVITIES

Honey has got the recognition as a natural antimicrobial over and above antioxidant substance. The use of honey in the treatment of various diseases was practiced from years only due to these properties. In the present study, the *Melghat* honey samples were examined for their potential against some selected Gram-positive and Gram-negative bacterial species. Gram-negative bacterial species that were selected were *Salmonella typhi*, *Pseudomonas fluorescens*, and *Escherichia coli* while *Bacillus cereus*, *Staphylococcus aureus*, and *Bacillus subtilis* were the Gram-positive bacterial species used for the purpose of experimentation.

It was observed that among the *Melghat* honey samples all the samples showed antibacterial properties against five out of six bacterial species. Surprisingly it was *E. coli* against whom no honey sample showed its potential. There were no zones of inhibition found for the bacteria *E. coli*. The *Melghat* honeys showed their potential against five bacterial strains out of the six selected species.

Melghat honey samples have shown their highest potential against *B. cereus* among the Gram –ve bacterial species selected for the examination. The diameter of the zone of inhibition in each case was of significant size, thus it may be concluded that these honey samples are extravagant natural antibiotics especially without any side effects.

PHYTOCHEMICAL SCREENING TESTS

Detection of the phytochemicals was done qualitatively in the current study by keeping in mind the importance of phytochemicals in the detection of the therapeutic as well as medicinal properties of any natural food material.

The secondary metabolites produced during the plant's metabolism and that are essential for their growth are known as phytochemicals. Phytochemicals are the member of a large group of such compounds such as gums, Saponins, polysaccharides, terpenoids and triterpenoids, flavonoids, phenolic compounds and tannins, glycosides, and alkaloids, etc.

During the current work, the *Melghat* honey samples were examined qualitatively for the screening of phytochemicals. Some of the important phytochemicals such as tannins and phenolic compounds, alkaloids, Glycosides, Saponins, Steroids, carbohydrates, proteins, Tri-terpenoids, and Flavonoids were detected qualitatively by applying the standard screening test methods that are published earlier.

It was observed from the results that tri-terpenoids did not present in any of the honey samples since all the honey samples gave a negative response for its screening tests. The same conclusion could be drawn for alkaloids also as only one screening test was found positive for alkaloids while total of eight tests were done. Thus alkaloids were also absent in the *Melghat* honey samples under examination.

Other than the above-discussed phytochemicals i.e. alkaloids and tri-terpenoids, other remaining compounds were found to be present in the honey samples. Flavonoids, glycosides, steroids, saponins, tannins and phenols, proteins, carbohydrates, and proteins got positive inference by all the honey hence said to be present in the *Melghat* honey samples. For phenolic compounds and tannins, five tests out of eight were positive thus the amount of these phytochemicals might be very less in the samples.

Most of the honeys showed good results towards the screening tests of the remaining compounds. It can be concluded from the results that the *Melghat* honey samples are having a good profile of phytochemicals which make them natural curative agents against plenty of diseases.

5.2.3.2 KUTKI (*PANICUM SUMATRENSE*) ANALYSIS

Kutki or little millet is the second prime material selected in the current research. There was an effort of creating the nutritionally rich, economically bearable as well as novel products. It was the basic aim of the current study of developing such products with the use of locally available products only. *Kutki* is one of the major crops cultivated in the region *Melghat*. *Panicum sumatrense* is its botanical name.

TABLE 5.1: PHYSICAL AND FUNCTIONAL CHARACTERISTICS (*KUTKI*)

S N	CHARACTERISTICS	VALUES OBTAINED
1	Dry Grain Weight in gram (1000 grains)	3.91
2	Dry Grain Volume in ml (1000 grains)	4.12
3	Bulk Density of dry grains (gram/ml)	0.95
4	Weight of 1000 grains in gram (Soaked)	4.5
5	Volume of 1000 grains in ml (Soaked)	4.76
6	Bulk Density of Soaked grains (gram/ml)	0.94
7	Hydration Capacity (gram)	0.59
8	Hydration Index	15.09
9	Swelling Capacity (ml/100g)	0.64
10	Swelling Index	15.53
11	Moisture (mass %)	11.25
12	Total Ash (mass %)	1.06

There are few studies done on *Kutki* from the *Melghat*. In the current study, the functional and physical properties of little millet were determined. In addition to that nutritional parameters were also detected. All the values are following the literature values.

The values are found in the range given in the previous research. The mineral content of *Kutki* is found significantly in a higher amount. The *Kutki* of the *Melghat* found to be low in the amount of calcium comparatively.

TABLE 5.2: CHEMICAL AND NUTRITIONAL PARAMETERS OF KUTKI

S N	CHARACTERISTIC	VALUES OBTAINED
1	Total Carbohydrates (mass %)	73.65
2	Total Fat (mass %)	4.05
3	Total Proteins (mass %)	9.99
4	Energy (Kcal/ 100g)	371.01
5	Dietary Fibers (mass %)	6.03
6	Monosaturated Fats (mass %)	0.79
7	Saturated Fats (mass %)	0.63
8	Poly unsaturated Fats (mass %)	2.59
9	Sodium (mg/100g)	12.45
10	Calcium (mg/100g)	4.18
11	Iron (mg/100g)	5.23

5.2.3.3 PRODUCT DEVELOPMENT AND SENSORY EVALUATION

Following products were developed by using honey and *Kutki* as ingredients by taking at different combinations.

A. LADOO: *Ladoo* is an Indian traditional sweet dish that is having nutritional, festive, and traditional importance in Indian culture. In the current study, *ladoo* were prepared by using *kutki* flour with other ingredients. The *Melghat* honey was added in the varied amount and the product thus developed by evaluated organoleptically. The various *ladoo* samples that were prepared are as per table 5.3

B. SENSORY EVALUATION OF LADOO: The *ladoo* were subjected to sensory evaluation by using the nine-point hedonic scale. This was done with the help of a panel of trained judges.

The data of sensory evaluation of the *ladoo* indicate that the *ladoo* prepared by adding location two honey i.e. LH₂ were liked by the judges at the top position. *Ladoo* prepared by adding this honey at various amounts got the highest total score i.e. 184. The *ladoo* with honey sample two got the highest scores in three categories i.e. *ladoo* with 4% honey (LH_{2b}), 8% honey (LH_{2d}), and 10% honey (LH_{2e}), and, while it was on the second position in rest of the categories i.e. *ladoo* with 2% and 6% honey (LH_{2a}

and LH_{2c}). Thus it was revealed from the data that the honey sample (H₂) was found most suitable for the addition in *ladoo*.

TABLE 5.3: FORMULATION OF LADOO WITH DIFFERENT COMBINATIONS OF HONEY

Amount of honey	Code Names				
	Honey Samples Added				
	Sample 1	Sample 2	Sample 3	Sample 4	Without Honey
2 %	LH _{1a}	LH _{2a}	LH _{3a}	LH _{4a}	L _{blank}
4 %	LH _{1b}	LH _{2b}	LH _{3b}	LH _{4b}	
6%	LH _{1c}	LH _{2c}	LH _{3c}	LH _{4c}	
8%	LH _{1d}	LH _{2d}	LH _{3d}	LH _{4d}	
10 %	LH _{1e}	LH _{2e}	LH _{3e}	LH _{4e}	
Total Ladoo Samples Prepared= 21					

The *ladoo* prepared by adding the honey sample H₁ was on the second position with an overall total score of 178. *Ladoo* with sample H₃ were at the third position (score 176) followed by the last entry i.e. the *ladoo* prepared by adding the honey sample four (H₄) with a score 172.

Alternatively, it was observed that 4% of honey was found most suitable for the preparation of *ladoo* by the panel of judges as these samples were having the highest mean score i.e. 39. On the other hand, the *ladoo* samples with honey at the rate of 2% were in the second position in terms of scores of judges (score 37.75). 6% of the honey in *ladoo* were given a score 36.75 i.e. these *ladoo* samples were liked by the judges at the third position, followed by the *ladoo* with honey at the rate of 8% (score 32.25) and *ladoo* with honey 10% at last position with the score of 31.75.

Thus finally the conclusion may be drawn that the honey sample (H₂) was accepted mostly by the judges for making the *ladoo*, while the most suitable amount is at the rate of 4%.

C. SENSORY EVALUATION OF KHEER: *Kheer* is another most popular Indian traditional sweet item with excellent nutritional value and amazing taste. In the current study, the *kheer* was made by using soaked grains of *kutki* that are cooked in milk. For value addition and for the sweetening purpose, honey samples were added

at a different rate as done in *ladoo* in addition to sugar. The combinations used are as per the table 5.4

The *kheer* samples were tested for its quality by using sensory evaluation techniques. Results showed that here also the location two honey sample (H₂) was liked most by the judges for the addition in *kheer*, as these samples were at the top in the score tally. The total overall score 176 was obtained to the *kheer* samples with honey two with an average score of 35.2.

TABLE 5.4: FORMULATION OF *KHEER* WITH VARIED AMOUNT OF HONEY AND CODE NAMES

Amount of honey	Code Names				
	Honey Samples Added				
	Sample 1	Sample 2	Sample 3	Sample 4	Without Honey
2 %	KH _{1a}	KH _{2a}	KH _{3a}	KH _{4a}	K _{blank}
4 %	KH _{1b}	KH _{2b}	KH _{3b}	KH _{4b}	
6%	KH _{1c}	KH _{2c}	KH _{3c}	KH _{4c}	
8%	KH _{1d}	KH _{2d}	KH _{3d}	KH _{4d}	
10 %	KH _{1e}	KH _{2e}	KH _{3e}	KH _{4e}	
Total <i>Kheer</i> Samples Prepared= 21					

These *kheer* samples were got the top score in four categories i.e. in the *kheer* with 2% honey (KH_{2a}), 6% honey (KH_{2c}), 8% honey (KH_{2d}), and 10% honey (KH_{2e}), while in the category of *kheer* with 4% honey it was on the second position (KH_{2b}).

Thus in the end the conclusion could be drawn from the sensory evaluation scores that for the preparation of *kheer*, location two honey samples were best. The same result was obtained for *ladoo* also. Honey sample H₂ was found most suitable for *ladoo* also.

If we go amount viz, again the honey at the rate of 4% was accepted mostly by the judges for addition in *kheer*. It is similar as in the case of *ladoo*. The *kheer* samples with 4% honey got an overall score of 149 with a mean 37.25. There was a very minute difference found in the overall score of *kheer* samples with honey at the rate of 4% and 6% (total overall score 148 and mean 37). Thus the panel of judges liked the *kheer* with honey at the rate of 4% and 6% almost equally.

The scores got by the *kheer* samples with the honey at the rate of 2% (total overall score 137 and mean 34.25), 8% (total overall score 126 and mean 31.50), and 10% (total overall score 115 and mean 28.75) were comparatively low. Thus the *kheer* samples were not that much liked by the judges.

Thus, in conclusion, it could be postulated that the honey sample H₂ was liked by the judges at best for the use in the *kheer* as well as *ladoo* as an additional sweetener. On the other hand for *ladoo* preparation 4% honey was found most suitable and for *kheer*, honey at the rate of 4% and 6% got almost identical scores thus found most suitable.

5.3 FINDINGS AND CONCLUSIONS

- The honey samples of the *Melghat* are highly nutritious, fresh, and without the consequences of adulteration.
- All the physico-chemical parameters that are recommended by BIS are within the specified limits. Thus all the honey samples that were examined fall under the category of special grade.
- All the samples have shown their activity against five species of bacteria out of the six species taken for study. Thus the honeys have excellent potential against bacteria.
- Most of the honey samples have shown positive results in the phytochemical screening tests, thus having a good phytochemical profile.
- *Kutki* (little millet) from the *Melghat* found nutritionally excellent as well as having significant functional properties.
- *Kutki* flour was found suitable for the preparation of nutritional *ladoo*. Honey could be used as an additional sweetener for the value addition as it was accepted by the judges in the sensory evaluation.
- *Kutki* and honey were having excellent potential to be used as the ingredient in the making of *kheer*.
- Both the products were accepted by the judges in the sensory evaluation and can be used for giving as supplementary food to overcome the problem of malnutrition.
- The products with location two honey sample at the rate of 4% was liked at the most by the judges.

5.4 LIMITATIONS

- The research is restricted to the products honey and *kutki* of only the *Melghat* region
- The phytochemical analysis is done only qualitatively, so it only gives the indication of the presence of the phytochemicals
- Products were checked only for its sensory properties

5.5 RECOMMENDATIONS

- There is a need for more detail study of the *Melghat* honey
- There is a further need for proper branding of the *Melghat* honey and *kutki*
- Efforts must be done in order to explore the beneficial properties of honey and *kutki* from the *Melghat* and making of a variety of value-added products for their commercialization.
- The medicinal properties and the content of phytochemicals should be done extensively for creating the brand *Melghat*.
- The need for study of the other valuable produce from the *Melghat* for its overall socio-economic growth.

5.6 POSSIBLE UTILITIES AND SCOPE

- It explored new dimensions towards the research regarding the properties and uses of honey
- The value-added products developed from these materials might be of low cost and would be a good source of nutrition.
- It might be helpful for giving the identity to the local produce.
- These value-added products may promote food diversity and may also be helpful in preserving the genetic resources of plants.
- The research may be helpful in the commercialization of these products to establish a *Melghat* brand.
- Product development and commercialization may be useful in the socio-economic development of this tribal and rural population.
- It may be the solution of the problem of malnutrition.

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ABBREVIATIONS

SN	ABBREVIATION USED	FULL FORM
1	AISC	Apiary Industry Sectional Committee
2	BIS	Bureau of Indian Standards
3	Da	Dalton (Unit of atomic weight measurement)
4	DF	Dietary Fibers
5	Df	Degree of freedom
6	EU	European Union
7	FSSAI	Food Safety and Standards Authority of India
8	HMF	Hydroxymethylfurfural
9	IHC	International Honey Commission
10	ISI	Indian Standards Institution
11	M _{eq}	Milliequivalent
12	MS	Mean of squares
13	PFA	Prevention of Food Adulteration
14	SD	Standard Deviation
15	SS	Sum of Squares

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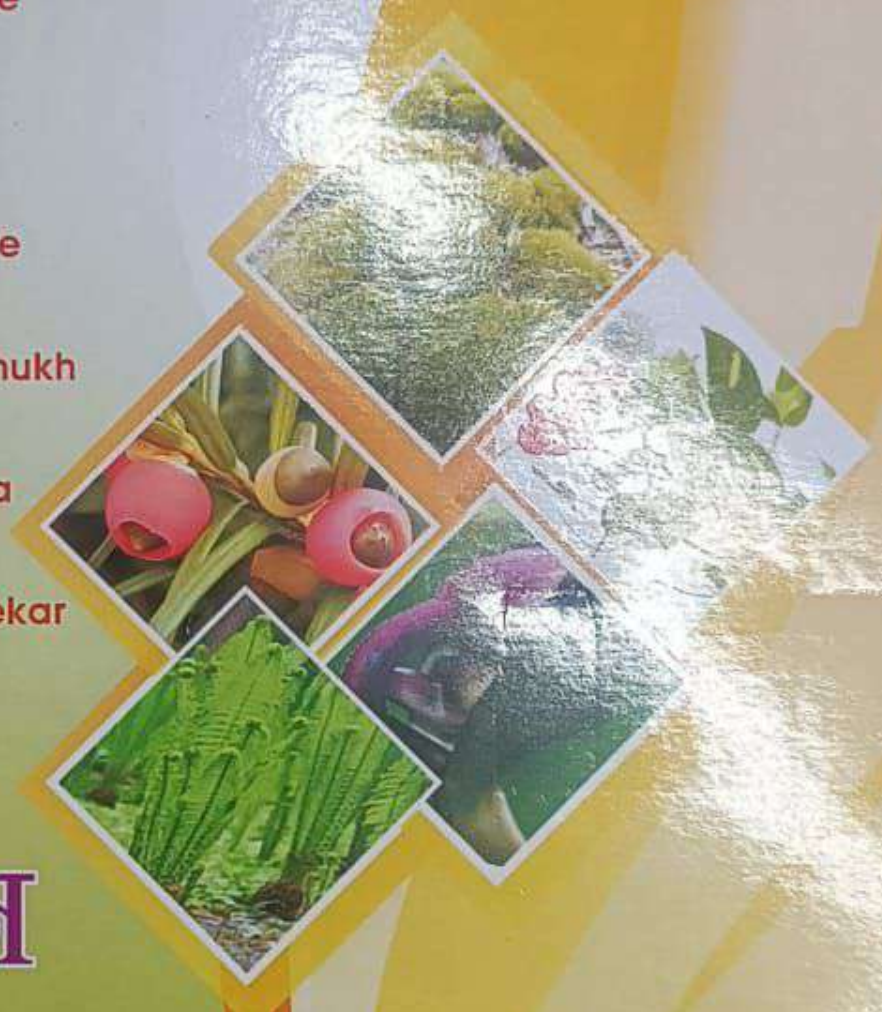
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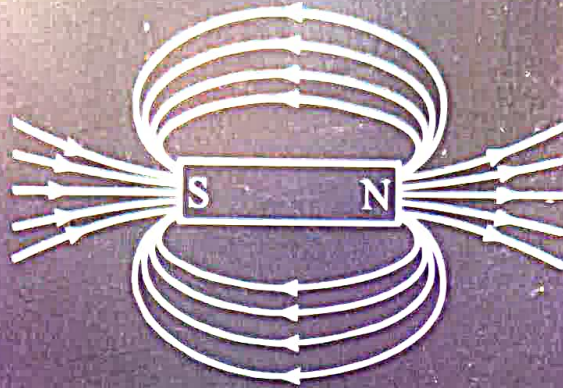

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A Text Book of Algebra and Trigonometry

B.Sc. Part - I, Semester - I
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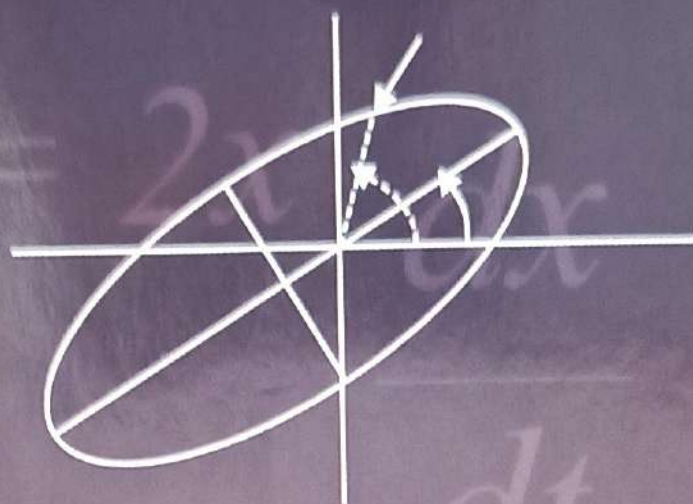
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A Textbook of
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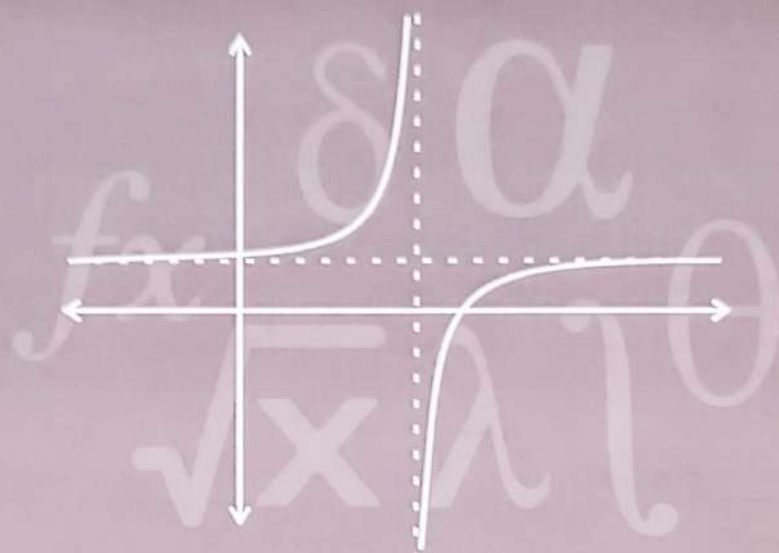
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Mathematical Analysis

B.Sc. Part III, Semester V
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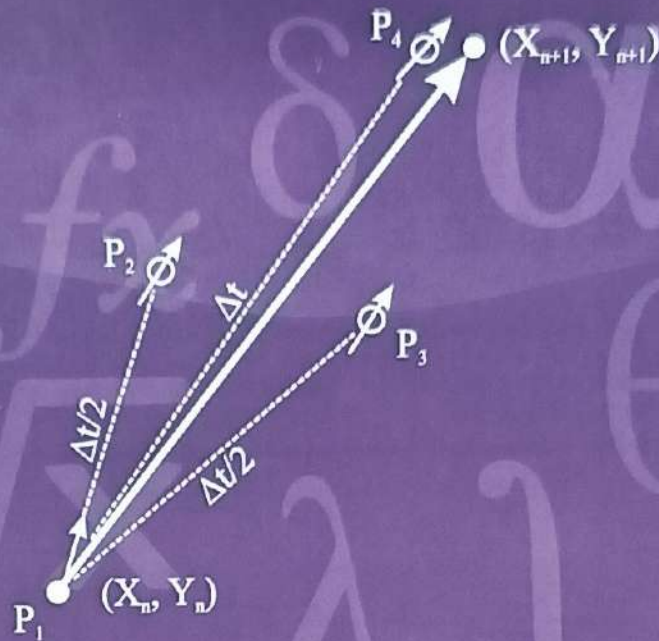
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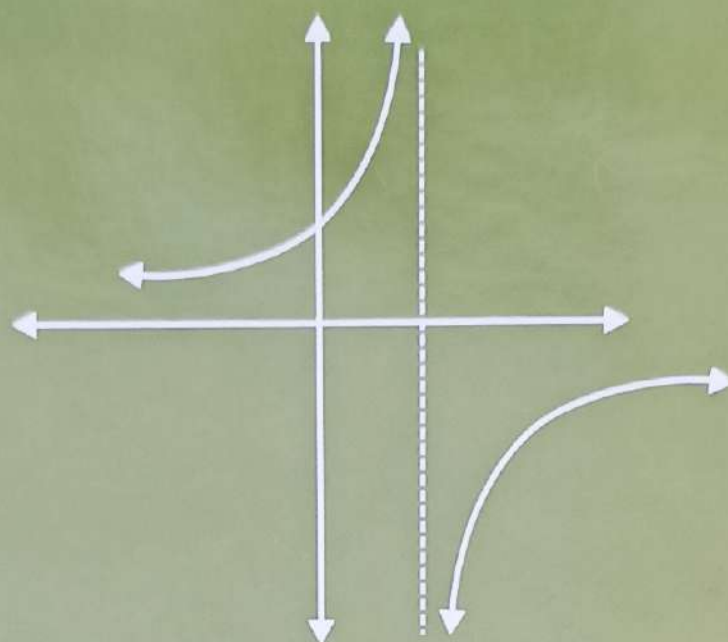
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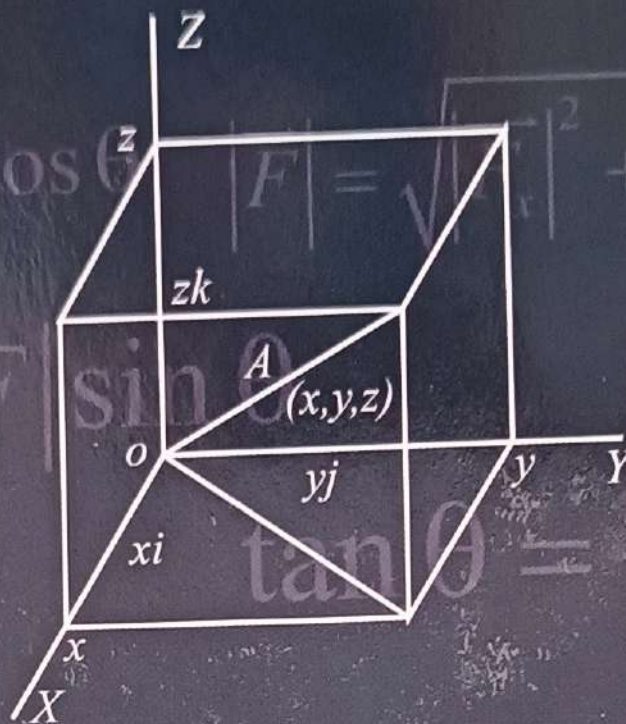
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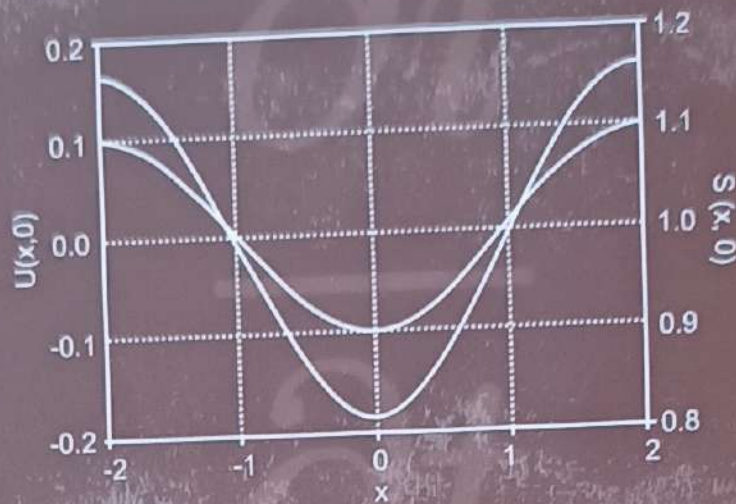
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As Per Sant Gadge Baba Amravati University Syllabus



A Textbook of Partial Differential Equations

B.Sc. Part II, Semester III
Paper VI (DSC-VI)

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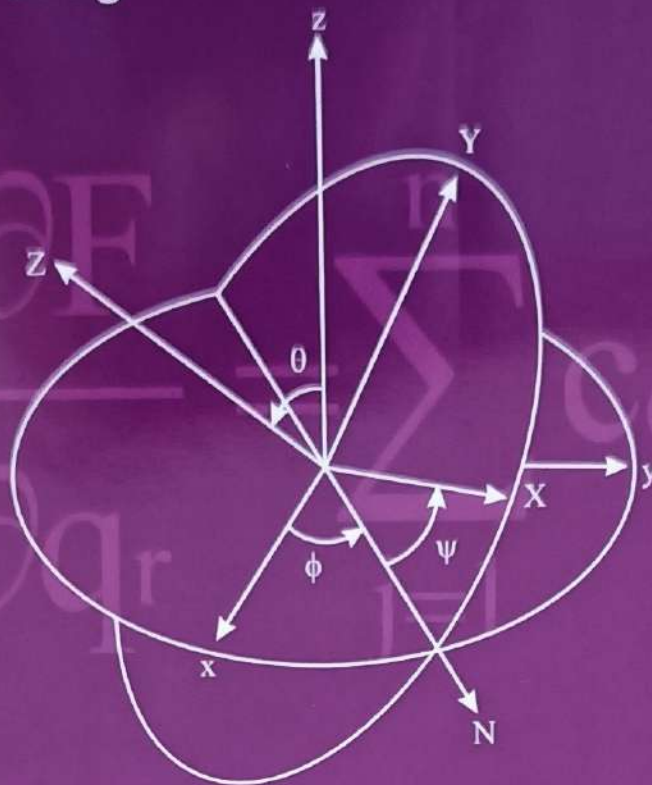
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