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National Conference on

Multidisciplinary Research and Innovations

NCMRI-2024

Friday, 27th September 2024

Organized By

The Berar General Education Society's

Shri R . L . T. College of Science, Akola

Civil Lines, Akola, Maharashtra - 444 001

Accredited by NAAC with 'A' Grade, CGPA-3.18 (4th Cycle)

In association with

Microbiologist's Society, India

Special Issue (No.138)

Chemical Sciences, Material Science & Mathematics

Chief Editor

Dr. Pramod P. Tandale

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"Multidisciplinary Research and Innovation (NCMRI-2024)"

Chemical Science

(Special Issue No.138)

Chief Editor

Dr. Pramod P. Tandale

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Shri R.L.T. College of Science Akola

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Dr. Milind A. Barhate
Vice-Chancellor

Sant Gadge Baba Amravati University,
Amravati - 444 602, Maharashtra (India)

No. SGBAU/P-100/ /202

Date : 12/09/2024



MESSAGE

I am happy to know that Shri R.L.T. College of Science, Akola in association with Microbiologist Society, India is organising the National Conference on Multidisciplinary Research and Innovation (NCMRI -2024) on Friday, 27th September 2024 and publishing a Souvenir on this occasion. The main aim of this conference is to present upto date researches and the results in the field of Life Sciences and Environmental Science, Chemical Sciences, Material Sciences and Mathematics, Humanities, Languages and other Disciplines too. This conference will definitely provide an ideal platform and opportunity to share research ideas with the eminent scientists, academicians, industrialists and policy makers working in various fields of Science, Technology and Humanities. It will also provide an opportunity for delegates from all over the country to share their findings and exchange cutting edge ideas and applications to establish relationship with each other.

I am, therefore, sure that this conference will be meaningful, relevant, purposive, interactive and credible worth remembrance and will be the best platform for dealing with all issues related to the field.

I congratulate the organising committee members of NCMRI -2024 and extend my best wishes for successful organisation of the National Conference.

(Dr. Milind A. Barhate)

Dr. V.D.Nanoty,
Principal,
Shri R.L.T. College of Science,
Akola.

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PROF. MAHENDRA P. DHORE
M.Sc. M.Phil. Ph.D. (Computer Science)
Pro-Vice Chancellor

SANT GADGE BABA
AMRAVATI UNIVERSITY
AMRAVATI - 444 602
MAHARASHTRA (INDIA)

No. : SGBAU/PVC/28 /2024
Date : 6/9/2024



Message

I am delighted to know that Shri R.L.T. College of Science, Akola is organizing National Conference on "Multidisciplinary Research and Innovations" NCMRI – 2024 on Friday, 27th September, 2024 in collaboration with Microbiologist's Society, India.

This multidisciplinary National Conference will be useful for young researchers, academicians, students and industrialists to exchange and share views on their research work carried out in the areas of Science, Technology, Humanities as well as other disciplines. I am sure that, this conference will provide a common platform towards understanding the need of the society.

I welcome the initiative of Shri R.L.T. College to organize National Conference considering broad areas of multidisciplinary research approach. I do hope that participants will find the deliberations rewarding. I extend my heartiest greetings to the organizers and delegates. I wish the conference a grand success.

Dhore

(Prof. Mahendra Dhore)
Pro-Vice Chancellor
S.G.B.Amravati University.

To,
Dr. Vijay D. Nanoty,
Principal,
Shri R.L.T. College of Science,
Akola.

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REGISTRAR

SANT GADGE BABA
AMRAVATI UNIVERSITY
AMRAVATI - 444 602
MAHARASHTRA (INDIA)

31 AUG 2024



MESSAGE

It gives me joy and pride to know that Shri Radhakisan Laxminarayan Toshniwal College of Science, Akola is organising **National Conference on "Multidisciplinary Research and Innovations" NCMRI-2024** on 27th September, 2024, and bringing out Souvenir on this occasion.

Such conference will provide a common platform for the experts from various Institutes, Research Organizations and participant researchers from various parts of the country to discuss the technological developments in the field of multidisciplinary research and innovations. I am sure that the discussions and deliberations would be fruitful and abstracts of the research papers presented by the delegates shall be beneficial for the students pursuing higher education in the 21st century.

I congratulate the Principal and Organising Committee for having chosen such a significant & relevant topic for this national conference. I wish the Conference a grand success.

(Dr.Avinash Asanare)
Registrar

To,
The Principal,
Shri R.L.T.College of Science,
Akola.

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Adv. Motisingh G. Mohta
President
The Berar General Education Society,
Akola

Date : 27th September 2024



Message

I am extremely delighted to know that our The Berar General Education Society's Shri R.L.T. College of Science, Akola is organizing 'National Conference on Multidisciplinary Research and Innovations' (NCMRI-2024) in association with Microbiologist's Society India on Friday, September 27, 2024.

Development of any nation depends on sharing innovations, discussing new ideas, propagating knowledge and also on taking new initiatives for the benefit of the society. This initiative to organize Multidisciplinary Conference brings scientists, academicians and research scholars from different disciplines under one roof for sharing their innovations from their area of research.

I strongly believe that, deliberations in this conference will strengthen the knowledge and enhance the quality of research, which paved the way to make our nation self-sufficient and Viksit Bharat.

I compliment the organizers for publishing souvenir of the NCMRI-2024 for making this event more memorable.

I extend my greetings to the Principal and faculties of Shri R.L.T. College of Science, Akola for their commendable efforts and my best wishes for the success of the conference.

M.G. Mohta

(Adv. Motisinghji G. Mohta)

Dr. Pavan N. Maheshwari
Hon. Secretary
The Berar General Education Society,
Akola

Date : 27th September 2024



Message

It gives me an immense pleasure to note that The Berar General Education Society's Shri R.L.T. College of Science, Akola is organizing National Conference on "Multidisciplinary Research and Innovation" NCMRI-2024 in collaboration with Microbiologist's Society, India on Friday, 27th September, 2024 and publishing souvenir on this occasion.

Recently, Government of Maharashtra has implemented new education policy NEP-2020 which is based on Multidisciplinary approach in higher education. Shri R.L.T. College of Science, Akola has taken good step to organize National Conference on "Multidisciplinary Research and Innovation" for researchers working in areas of Science, Technology, Humanities and other disciplines. The sub-themes of conference are selected which really suits the demand of time.

This conference will definitely establish a unique and effective platform for scientists, technologists, researchers, academicians and students to come together, share innovative ideas and present their research work. Such interaction is essential for motivation and overall development of our young scientists to scale new heights of innovation and excellence. I am sure that this conference will be fruitful and give positive contribution to the research in field of Science, Technology, Humanities and all other disciplines.

I congratulate the principal, members of organizing committee and teaching and non-teaching staff of the college for taking efforts for successful organization of this National Conference.

I extend my best wishes for grand success of the event.

Dr. Pavan N. Maheshwari

MICROBIOLOGISTS SOCIETY, INDIA

(Reg. No. MAH/4814/SAT)

President,
Dr. A. M. Deshmukh
Website www.microbiosociety.org

Office,
C-2/12, Parijatak Apartment,
Naikwadi Nagar
Osmanabad 413 501, (M.S.), IND



Message

It is indeed a pleasure to know that the Shri. R. L. T. College of Science, Akola in association with the Microbiologist's Society, India organizing the National Conference on **"Multidisciplinary Research and Innovations" (NCMRI-2024)** on Friday, 27th September 2024.

Microbiologist's Society, India has been instrumental in holding and sponsoring or supporting conferences, seminars, symposia, exhibitions and meetings and in arranging lectures and demonstrations on any aspects of Microbiology. It is catalytic to encourage and support research in Microbiology in Universities, Colleges, Industry and society. We have been coordinating scientific events in India and abroad spreading across 140 countries all over the globe with the hard work of professors, scientists, industrialists, administrators, and students to spread the knowledge of Science which is so multidisciplinary and vast under the umbrella of Microbiologist's Society, India.

I am very proud to announce this National Conference to be organized at Shri. R. L. T. College of Science, Akola, Maharashtra. I thank all the patrons, conveners, and organizing committee of this National Conference – NCMRI-2024 and wish a grand success of this event on all forefronts. I congratulate all the delegates for their active participation in this event and wish them good luck for their future.

Dr. Arvind M. Deshmukh

President, Microbiologist's Society, India

From the Desk of Principal and Convener



It is a matter of great privilege and pride for Shri R.L.T. College of Science, Akola to host National Conference on "Multidisciplinary Research and Innovation" NCMRI-2024 in association with Microbiologist's Society, India on Friday, 27th September 2024. I am pleased to welcome all the eminent speakers, academicians, researchers and students participants for the National Conference.

The Berar General Education Society's Shri R.L.T. College of Science, Akola was established on 1st April, 1970. The college dedicates itself for science education and propagation of scientific temper among the students with social commitment. A journey of 54 years is a long period and it is a momentous occasion for us. The college earned reputation and recognition as one of the leading educational institutions for academic excellence due to the dedication, devotion, discipline and cooperative supports of all past and present stakeholders of this college. The college is re-accredited by NAAC with 'A' grade with CGPA-3.18 (4th Cycle).

The aim of organizing this National Conference is to share and enhance the knowledge of researcher in the field of Science, Technology, Humanities and all other disciplines for the benefit of society. This conference provides an opportunity to the participants to listen to the eminent speakers and personalities from different fields and to interact with them on a common platform for exchanging information through the scientific presentations and discussion. The technical program of the conference will consist of a keynote address, invited talks and oral and poster presentations.

I sincerely thanks to Adv. Motisingh Mohta, Hon'ble President, Dr. Pavan Maheshwari, Hon'ble Secretary and all Executive members of The Berar General Education Society, Akola for allowing and motivating us to organize this National Conference. I would like to thanks Microbiologist's Society, India for their support in organizing this conference.

I extend my hearty welcome to all the delegates, academicians, researchers, students and experts participating in this National Conference. This conference will definitely provide them good platform to share their views on the latest development in the field of their research. I whole heartedly appreciate and thanks to the eminent speakers, delegates, research scholars, teaching and non-teaching staff and students of college who contributed significantly in making this conference a grand success and memorable. I must mention that the organising committee has been hard working for the success and fruitful outcome of the conference.

I hope that this conference will be a milestone in the field of Science, Technology, Humanities and all other disciplines and will be of immense use to researchers. I wish all the success to the National Conference and the Souvenir to be published on this occasion.

Dr. Vijay D. Nanoty
Principal / Convener

MESSAGE FROM ORGANIZING SECRETARIES



Prof. Dr. Archana S. Sawarkar



Mr. Prashant P. Gedam



Dr. Pravin R. Kawle



Mr. Mangesh R. Ubale

It is our privilege and pleasure to welcome you all for National Conference on "Multidisciplinary Research and Innovation" NCMRI-2024 organized by Shri R.L.T. College of Science, Akola on Friday, 27th September 2024.

This National Conference on "Multidisciplinary Research and Innovation" is aimed at providing high level academics and research oriented education about the different areas of research. The basic aim in selecting such a broad theme for the conference was to provide a platform for the interaction amongst the scientists, teachers, researchers and students to share their ideas, thoughts and scientific findings with the current significant trends in Science, Technology and Humanities and other Disciplines.

We received the kind consent of Dr. Milind Barhate, Hon'ble Vice Chancellor, Sant Gadge Baba Amravati University, Amravati to inaugurate the National Conference and Dr. Subodh Bhandarkar, Hon'ble Joint director of higher Education, Amravati Region, Amravati as a Chief guest for valedictory function. We also received consent of Adv. Motisingh Mohta, Hon'ble President, The B.G.E. Society as the Chairman for inaugural function and Dr. Pavan Maheshwari, Hon'ble Secretary, The B.G.E. Society as the Chairman for valedictory function.

Kind acceptance of our invitation received from eminent scientists of the stature of Prof. Dr. P. B. Vidyasagar, Former Vice Chancellor, Swami Ramanand Teerth Marathwada University, Nanded, Dr. N. N. Karde, Professor, Department of Chemistry, Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur, Dr. B. T. Prabhakar, Associate Professor, Department of Biotechnology, Sahyadri Science College, Kuvempu University, Shivamogga (Karnataka), Dr. Arvind Sarode, Professor, School of Physical Sciences, Swami Ramanand Teerth Marathwada University, Nanded andProf.Dr. Vaishali P. Gudadhe (Choukhande), Dean, Interdisciplinary Studies, S.G.B. Amravati University, Amravati to be our key note and invited speakers greatly boosted our moral.

We whole heartedly appreciate and acknowledge the overwhelming response to our call of research papers given by dedicated researchers who have sent their abstracts and full length papers at a very short notice. We are very happy to say that, we have successfully brought out the souvenir covering keynote address, invited talks and abstracts of contributed papers in time. More than 500 registrations have been done till date. There are about 200 contributory full length research papers covering various aspects of Science, Technology and Humanities with good contribution from colleges, universities and research institutions. After review, selected full length research papers will be published in peer reviewed 'Ayushi International Interdisciplinary Research Journal (AIIRJ)' having good impact factor. We sincerely hope and assure the readers that this souvenir as well as special issue of journal will prove to be a valuable research document and will be immensely useful to both upcoming researchers and established scientists.

We are grateful to Adv. Motisingh Mohta, Hon'ble President, Dr. Pavan Maheshwari, Hon'ble Secretary and all Executive members of The B. G. E. Society, Akola for allowing and motivating us to organize this National Conference. We are thankful to Hon,ble Principal Dr. V. D. Nanoty for inspiration, guidance and constant support in organization of this conference. We are also thankful to all delegates, members of advisory committee, organising committee, our colleagues from teaching and non-teaching staff of the college and students for their wholehearted support.

We want to put on record our special thanks to M/s Prakash Printers for printing souvenir. Last but not least, we gracefully accept responsibility for any error of commission or omission during preparation of souvenir.

Prof. Dr. Archana S. Sawarkar
Mr. Prashant P. Gedam
Dr. Pravin R. Kawle
Mr. Mangesh R. Ubale

Organizing Secretaries, NCMRI-2024

DEDICATION



To the Man who strongly Believed in,
"Not me But You"

This souvenir is dedicated to the person who has inspired and motivated many generations in the field of education and learning, a remarkable leader and a keen learner **Dr. Vijay Digambar Nanoty.** His passion for imparting knowledge paved his way towards the noble profession of teaching. Starting from a very young age, he has unceasingly worked towards teaching and learning around 40 years. With advances in education, he has constantly shown enthusiasm in upgrading his expertise. He has not only imparted the knowledge of Microbiology but also influenced student's confidence, motivation and love for learning. His determination and empathy towards community development was put to use in NSS. Through various NSS activities, he has fostered a sense of responsibility among students, encouraging them to become active citizens who contribute to the betterment of society. Accepting any responsibility requires courage, and he has exhibited immense courage as he chaired as the Principal of Shri R.L.T. College of Science, Akola in 2008. Even with this demanding responsibility, he managed to inspire students to become academically competent and responsible citizens. In this role, he has gone beyond administrative duties to enrich the ethos of the institution. He has been a source of inspiration for students and staff alike. His open-door policy made it easy for anyone to approach him with ideas and concerns.

We want to express deepest gratitude for his visionary leadership. His indelible mark on this institution and his legacy will continue to inspire us for years to come.

- All the stake holders of Shri R.L.T. College of Science, Akola

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Skin Graft is Transplantation of Human Skin Layer For Repigmentation of Vitiligo Patches

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Abstract

Biotechnology means any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use as per UN Convention on Biological Diversity, Art. 2. The human skin and diseases related to human skin are many. The vitiligo is a commonly found skin disorder in which the skin color is lost and white macules are visible. It is due to lack of melanin formation activity. The melanin decide color of the skin there are many treatment methods for vitiligo. The purpose is to regain original skin color at the sites which are white. The transplantation of skin layer from the unaffected pigmented skin to the affected white skin area. It cannot stop the progression of the disease, but definitely it helps to treat many delicate areas like eyelids, lips which does not show adequate response to medical therapy.

Keywords: *vitiligo, melanin, repigmentation, skin graft*

Introduction

Vitiligo is a skin disorder in which depigmented macules (white patches) start appearing and progressing. It has high psychosocial impact, particularly in darker skins. With vitiligo, the body's own immune system starts attacking those cells, which is why it's considered an autoimmune disease. Surgical methods become important in cases where medical therapy fails to cause repigmentation or in cases of

segmental vitiligo where the response to surgery is excellent.

The vitiligo is treated by various methods like phototherapy, herbal medicine therapy, allopathic medicines and homeopathic treatment is also one of the options for patient. The idea of skin graft comes under surgical treatment. In this technique natural skin colour is obtained by transplanting the skin from unaffected body part to the affected area of skin which has lost colour. The transplanted skin patch helps to achieve the repigmentation.

Skin grafting was first described in India in ancient Sanskrit texts around 2500 - 3000 BC as a technique for nasal reconstruction for mutilated noses. Thin split thickness skin grafts were first introduced in 1872 by Ollier in France, and later by Thiersch in Germany in 1874. Brown in England developed the electric dermatome in 1944, to harvest thin homogenous grafts. In 1947, Haxthausen transplanted thin split thickness skin grafts from normal to vitiliginous skin in three cases, to study the pathogenesis of the disease.[3,4] In 1964, Behl from India was the first to describe the surgical treatment of vitiligo in a large series of 107 patients with thin Thiersch grafts.[5] Falabella described the suction blister technique for repigmentation of vitiligo in 1971[6] and later the miniature punch grafting technique in 1978.[7] Falabella *et al*.,[8] in 1989, also described the use of *in vitro* cultures of melanocyte-bearing epidermis for the treatment of vitiligo. The use of epidermal suspensions obtained by trypsinization was first reported in 1992 by Gauthier and Surleve-Bazeille[8] and further improved by Olsson and Juhlin,[9] by adding a melanocyte culture medium, for additional growth. Kahn and Cohen [10] utilized the motorized dermatome, to obtain ultrathin grafts for vitiligo, and later in 1996 Kahn*et al*.,[11] reported the use of a short-pulse carbon dioxide laser, to denude the recipient area. Subsequently, the excimer laser and targeted phototherapy have been developed to treat vitiligo. Thus, surgical treatment of vitiligo has evolved over the centuries, even though the etiology and pathogenesis of vitiligo remain elusive.

Method

Raising of blisters Blisters may be raised using syringes or suction pump and suction cups or a negative pressure cutaneous suction chamber system. Using syringes to raise blisters is the most commonly employed

method. The bases of syringes of sizes 10 ml and 20 ml are coated with vaseline and are applied on the donor site. Approximately 20ml to 30ml of air is aspirated using a 50ml syringe and a three-way-cannula. Larger syringes (>20ml) take a longer time to generate a blister, and smaller syringes (<10ml) provide blisters that are difficult to handle. It usually takes 1.5 to 2.5 hours for the development of blisters. A single unilocular non-hemorrhagic blister is the best result. In case of smaller blisters, one can either increase the negative pressure in the syringe by another 5ml or intradermally inject saline into the blister to expand it.

Dr. Pandya, the only full-time pigmentary disorders specialist in Texas, has spent more than a decade treating vitiligo patients in the Pigmentation Disorders Clinic at UT Southwestern. Vitiligo affects about 2 million people in the United States. Traditional treatments include phototherapy, requiring different types of machines to shine ultraviolet light on the whole body, localized areas, or the hands and feet. UT Southwestern also uses an excimer laser to treat smaller lesions.

For the transplant procedure, a syringe and a heat lamp to create a small blister graft on the thigh. Thousands of cells are removed from the blister roof and those cells are then applied to the affected area. Suction blister grafting (SBG) is a technique where the pigmented epidermis is harvested from the donor site by using suction to raise a blister which is then transferred to the vitiliginous area.





Figure 1: Raising suction blisters by the syringe method

Figure 2: Blisters formed after 2 hours of suction

Conclusions

The differentiation and development of the epidermal cells is regulated by the dermis. In surgical techniques like split skin thickness grafting and punch grafting, where both the epidermis and dermis are grafted, the graft retains some of the characteristics of the donor site, hence, the cosmetic outcome may not be an exact match. However, in suction blister grafting, cleavage occurs between the basal cells and the basal lamina of the basement membrane zone and only the epidermal portion of the donor area is grafted. Hence, the graft generally acquires the characteristics of the recipient site, thus leading to a better color match and cosmetic outcome.

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Artificial Intelligence [AI] and its Future Impact

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Abstract:

In recent years Artificial Intelligence [AI] has grabbed the highest attention from the community working in information systems [IS] and this constantly growing development and use of AI has raised lot many issues as to its impact on the society. This paper is an attempt to study the future of AI and effects of it on society in connection with the social, ethical and biological health issues. Here the comprehensive literature review about the current status of existing AI technology, its applications in varied fields in addition to the future scope with the unavoidable drawbacks and its ultimate impact on society is studied. The paper concludes with the recommendations for policymakers and future research directions.

Keywords: *Artificial Intelligence [AI], Information Systems [IS], future of AI, social, ethical, biological health issues, unavoidable drawbacks*

Introduction:

Artificial intelligence (AI) deals with the development of intelligent machines, especially intelligent computer programs which are capable of performing different tasks that require human intelligence such as decision making, visual perception, speech recognition, language translation and so on maximizing the chances of success and is one of the reason as why AI has been a topic of interest and research for several decades. AI is broadly characterized as the study of computations which allows perception, reason and action. AI has tremendous potential to revolutionize society, but there are lot many issues about its impact on society which prominently includes; economy, healthcare, education, and employment. The purpose of this research paper is to explore the future of AI and its potential implications for society. To be more specific, the research aims to search the potential benefits and drawbacks of AI, its impact on different sectors of society, such as the economy, healthcare, education, and employment, and the challenges and risks associated with its use. The paper will also provide recommendations and future research directions to ensure that the development and use of AI are transparent, accountable, and unbiased, and address the ethical concerns associated with its use in society.

Future with AI: AI existing right now is also termed as Weak AI, as it is with limitations. Basically it is evolving out of the rule-based systems to machine learning which actually allows the machines to learn and improve from the previous experience and is one of the reasons that AI is increasingly adoptable with growing capabilities. In the coming years AI is going to transform varied industrial sectors as Healthcare, Education Finance and many more. [1]

AI and Ethics: AI is greatly influencing the ethical concern in society as its use is been increasing constantly. Actually AI raises several queries related to privacy, responsibility and transparency and hence integrating the ethical consideration while designing and development of AI systems is a must. [2]

AI in Healthcare: AI is making great transformation in healthcare, from diagnosis and treatment to drug discovery and personalized medicine. AI has tremendous potential to improve upon healthcare outcomes that to with reducing costs. However, the care must be taken that AI is used ethically and responsibly. [3]

Finance and AI: Finance is also having an impact of AI. AI is proving its importance in finance through fraud detection to risk assessment and investment management. Efficiency and accuracy in finance has improved like anything through AI while the transparency and accountability is greatly needed while using of AI in finance. [4]

AI in transportation: Transportation has been improved a lot, from self-driving cars to traffic management and logistics.AI has improved upon the safety. It has reduced congestion and increase efficiency in transportation. Despite this the need for ethical and responsible use of AI in transportation is required. [5]

AI in education: AI is not restricted to personalized learning but also has spread to an assessment and grading. AI can improve the educational outcomes and at the same time reduces costs. Learning through AI needs to be an ethical and not just learning through machine. [6]

Outcome and Analysis: Upon the analysis one can infer that though the AI has tremendous potential for the transformation by improving efficiency, accuracy, and productivity in various fields like healthcare, finance, transportation, and entertainment. Still there are several potential drawbacks associated with it like job displacement, exacerbating income inequality, and ethical concerns, such as bias, privacy, and security. AI can improve diagnosis and treatment, but there are concerns about the privacy and security of patient data. The analysis recommends public education and awareness about AI and its potential benefits and risks.

Conclusion: Increasing development and use of AI have raised several questions about its impact on society, including economic, social, ethical, and legal issues. Potential for AI to be used for malicious purposes, such as cyber-attacks and surveillance is a major concern. In short, AI is developed and used in a responsible and equitable manner. One has to focus on creating policies and programs to support workers who are at risk of job displacement due to AI. Accountability and Transparency is badly needed in a system built using AI. Policymakers, researchers, and stake holders need to work together to ensure that AI is developed and used in a way to benefit the society as a whole.

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Generalization of R-Annihilator δ-Lifting Module

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Abstract:

In this Paper, we generalized the notion of R-annihilator -δ-lifting module with some properties. An R-module m is called R-annihilator -δ-lifting module, if for every sub module L of M with $\frac{M}{L}$ *is hollow, there exists a fully invariant direct summand K of M and* $K \leq_{ace} L$ *in M such that* $\frac{L}{K} << \frac{M}{K}$.

Key words: *Annihilator, small submodule, fully invariant, direct Summand, δ-small submodule, δ-lifting.*

Introduction:

Throughout this article all rings are commutative rings with identity, and all modules are unitary left R-module. A proper submodule L of a module M is called small (denoted by L ≪ M), if for every proper submodule K of M, L + K ≠ M. A module M is called hollow if every proper submodule of M is called small, [1]. As a generalization of the concept small submodule, Zhou in [2] introduce the concept δ-small submodule, where a submodule N of an R-module M is called δ-small (denoted by N<<$_{\delta}$M) if whenever N + K = M and M/K is singular module, then K = M. In fact, an R-module M is called singular (non-singular) if Z(M) = {m ∈ M: (m) is an essential ideal of R} = M ((0)), [3], and a submodule N of an R-module M is called essential in M (denoted by Ne≤M) if N ∩ W ≠ (0) for any non-zero W ≤ M, [4].

A nonzero module M is called hollow, if every proper submodule of M is small, [1]. A submodule K of M is called coessential submodule of N in M (denoted by $K \leq_{ce} M$, if $\frac{N}{K} << \frac{M}{K}$. Let R be aring and M anR-module, recall that a submodule N of M is R-annihilator-small in M,(N <<a M), if whenever N+T = M, where T is a submodule of M, implies that $ann_R(T) = 0$ where $ann_R(T) = \{r \in R : r.T = 0\}$. Following Sahira M Yaseen in [5], introduced a module M is called R-annihilator-lifting (R-a-lifting) module if for every submodule N of M there exists submodules L and K of M such that M = L ⊕ K with L ≤ N and $N \bigcap K <<_a K$. [6] Introduced the concept of hollow-lifting module, where a module M is called hollow-lifting module if for every submodule F of M with M/F hollow, then there exists a direct sum and K of M and $K \leq_{ce} F$ in M. R-annihilator-coessential: Let M be anR-module, for K ≤ F, K is said to be R-annihilator-coessential submodule of F in M (briefly R-a-coessential) If $\frac{F}{K} << \frac{M}{K}$ (denoted by $K \leq_{ace} F$ [6, 7].

In this paper we introduce the concept of R-annihilator-δ-lifting module: an R-module M is called R-annihilator-δ-lifting module (briefly R-a-δ-lifting), iff every submodule F of M with M/F is hollow, there exists a fully invariant direct sum and K of M and $K \leq_{ace} F$ in M such that $\frac{F}{K} << \frac{M}{K}$.

δ-small submodule: A submodule N of an R-module M is called δ-small submodule of an R-module, if N+K=M and $\frac{M}{K}$ is singular then K=M . Denoted by $N<<_{\delta}M$.

δ-lifting module: An R-module M is called δ-lifting module, if for every submodule K of M there exists a direct summand N of M with $N \leq K$ and $\frac{K}{N}<<_{\delta}\frac{M}{N}$.

The dual concept is that R-annihilator δ-lifting module. An R-module M is called R-annihilator δ-lifting module, if for every submodule K of M there exists a direct summand N of M with $N \leq K$ and $\frac{K}{N}<<_{a\delta}\frac{M}{N}$ with ann(K)=0 .

R-annihilator lifting module: An R-module M is called R-annihilator lifting module, if for every submodule K of M there exists a submodule L and N of M such that $M=L \oplus N$ with $L \leq N$ and $K \bigcap N<<_{a} N$.

Hollow lifting Module: An R-module M is called hollow-lifting module, if for every submodule K of M with $\frac{M}{K}$ is hollow then there exists a direct summand N of M such that $N \leq_{ce} K$ in M.

Hollow R-annihilator lifting module: An R-module M is called hollow R-annihilator lifting module, if for every submodule K of M with $\frac{M}{K}$ is hollow there exists a fully invariant direct summand N of M such that $N \leq_{ace} K$ in M.

1. R Annihilator small sub module:

A submodule N of an R-module M is called R Annihilator small submodule of an R-module, if $N+K=M$ where K is submodule of M then $ann(K)=0$ where $ann(K)=\{r \in R : rk=0,\ \forall k \in K\}$ Denoted by $N<<_{a}M$.

Uaseen S.M. (2018) introduce the concept of R Annihilator – hollow module, where a non-trivial module M is called R Annihilator – hollow module (R-a-hollow) if every proper submodule of M is R-a-small. {0} is a small in Z_4 as Z-module, but we have $0+Z_4=Z_4$ with $annZ_4=4Z\neq 0$ so {0} is not a-small submodule in Z_4 .

Proposition 1.1 [4] Let A and B be submodule of M such that $A \leq B$, if $A \ll_a B$ then $A <<_a M$.

Proof. Let M = A + X, where $X \leq M$, by modular law, we have $M \bigcap B=(A+X)\bigcap B$ and B=A+(X⋂B). Since $A <<_a B.$, then $ann(X \bigcap B)=0$ but $X \bigcap B \subseteq X \Rightarrow annX \subseteq ann(X \bigcap B)=0 \Rightarrow annX=0$ thus $A <<_a M$.

Proposition 1.2 [9] Let A and B be submodules of M such that $A \leq B$, if $B <<_a M$. then $A <<_a M$.

Proof. Let $M=A+X$, where $X \leq M$. Then $M=B+X$. Since A⊆B, then $A+X \subseteq B+X$ So $M \subseteq B+X$. But $B+X \subseteq M$, thus $M=B+X$. Since $B <<_a M$. Then $annX=0$.

Proposition 1.3 [3] Let M and N be two R-modules and $f : M \to N$ be an epimorphism if $H <<_a N$. then $f^{-1}(H) <<_a M$.

Proof. Let $M=f^{-1}(H)+X$, since f is an epimorphism, $N=H+f(X)$. But $H <<_a N$ therefore $annf(X)=0$. To prove $annX \subseteq annf(X)$. For this let $r \in annX \Rightarrow rx=0\ \forall\ x \in X$, so $f(rx)=f(0)=0$, but $f(rx)=rf(x)$, then $rf(x)=0\ \forall\ x \in X$, then $r \in annf(X) \Rightarrow ann(X)=0$.

Theorem 1.4 [3] Let M be a faithful module if $N << M$, then $N <<_a M$.

Proof. Let $X \leq M$ such that $N + X = M$. Since $N << M$ implies that X=M, hence $annX = annM$.
But M is faithful, $annM = 0$, thus $annX = 0$, therefore $N <<_a M$.

Proposition 1.5 Let M be a module and $A \leq B$ be submodules of M, then $annRB \subseteq annRA$.

Proof. Let $r \in annRB \Rightarrow ra = 0 \ \forall \ r \in R, a \in B.$, but we have $A \leq B$, hence $ra = 0 \ \forall \ a \in A \Rightarrow r \Rightarrow annRA \Rightarrow annRB \subseteq annRA.$

Proposition 1.6 [3] Let M_1, M_2 be modules, if $K_1 <<_a M_1$ and $K_2 <<_a M_2$ then $K_1 \oplus K_2 <<_a M_1 \oplus M_2$.

Proof. Let $p_i : M_1 \oplus M_2 \to M_i$, $i = 1,2$ be the projection maps. Since $K_1 <<_a M_1$ and $K_2 <<_a M_2$ $K_1 \oplus M_2 = P_1 - (K_1) <<_a M_1 \oplus M_2$ and $M_1 \oplus K_2 = P_2 - (K_2) <<_a M_1 \oplus M_2$. $(K_1 \oplus M_2) \bigcap (M_1 \oplus K_2) = K_1 \oplus K_2 <<_a M_1 \oplus M_2.$

Remark:

Let R be an integral domain and let M be a torsion free module then every proper submodule of M is R-a-small in M.

Proposition 1.7 Let N and K be two submodules of a module M then $ann(N + K) = annN \bigcap annK$.

Proof. Since $N \subseteq N + K, K \subseteq N + K \Rightarrow ann(N + K) \subseteq annN$ and $ann(N + K) \subseteq annK$. therefore $ann(N + K) \subseteq annN \bigcap annK$. Let $r \in annN \bigcap annK \Rightarrow r \in annN$ and $r \in annK \Rightarrow ra = 0$ for all $a \in N$ and $rb = 0$ for all $b \in K$. This implies $r(a + b) = 0$ for all $a \in N$ and $b \in K$, then $r \in ann(N + K)$, therefore $annN \bigcap annK \subseteq ann(N + K)$. Hence we get $ann(N + K) \subseteq annN \bigcap annK$.

Proposition 1.8 [1] Let M be a faithful R-module, N be a submodule of M such that $annN \leq_e R$, then $N <<_a M$.

Proof: Let $M = N + K$, then $0 = annM = ann(N + K)$ and $ann(N + K) \subseteq annN \bigcap annK$. Then $0 = annN \bigcap annK$, but $annN \leq_e R$, therefore $annK = 0, thus \ N <<_a M$.

Proposition1.9 [1] Let R be an integral domain, let M be a faithful R-module, then every submodule N of M with $annN \neq 0$ is R-a-small.

Proof. Assume that $M = N + K$, then $0 = annM = ann(N + K)$ and $ann(N + K) \subseteq annN \bigcap annK$. since $annN \neq 0$ and R is an integral domain, then $annN \leq_e R$, Therefore $annK = 0$ .Thus N is R-a-small.

Proposition1.10 Let R be an integral domain and M be a faithful and torsion module, every finitely generated submodule N of M is R-a-small.

Proof. "Let $N = R_{x_1} + R_{x_2} + R_{x_3} + R_{x_4} + ...R_{x_n}$ be a submodule of M and $M = N + K$, Then $0 = annM = ann(N + K)$ and $ann(N + K) \subseteq annN \bigcap annK$. $0 = annM = ann(N + K) = annN \bigcap annK = ann(R_{x_1} + R_{x_2} + R_{x_3} + R_{x_4} + ...R_{x_n}) \bigcap annK$ $= annR_{x_i} \bigcap annK$. Since M is torsion, then $annR_{x_i} \neq 0 \ \forall \ i - 1,2,3....n.$ But R is an integral domain, there for $annR_{x_1}$ is essential in R, for all i, hence $\bigcup_{i=1}^{n} annx_i = R_{x_i} = annK = 0.$

Thus $N <<_a M$.

The singular of an R-module M is the set $Z(M) = \{x \in M : ann(x) \leq_e R\}$ where $ann(x) = \{r \in R : rx = 0\}$ if Z(M)=M then M is called singular module, if Z(M)=0 then M is called non-singular module.

2. Generalization of R-a-δ-small submodules:

Proposition 2.1[10] Let M be a finitely generated module and $K <<_{a\delta} M$ then $K + Rad(M) + Z(M) <<_{a\delta} M$.

Proof. Let $M = R_{m_1} + R_{m_2} + R_{m_3} + ...R_{m_n}, \ \forall \ i = 1,2,3....n$ and $K + Rad(M) + Z(M) + X$. Since M is finitely generated. Then $RadM << M$, and hence $M = K + Z(M) + X$. So $m_i = k_i + z_i + x_i$, $\forall \ x_i \in X, z_i \in Z, k_i \in K, \ i = 1,2,3,...n \ M = K + R_{z_1} + R_{z_2} + ...R_{z_n} + X$, but $K <<_{a\delta} M$, therefore $ann(R_{z_1} + R_{z_2} + R_{z_3} + ...R_{z_n} + X) = 0$. Hence $(\bigcap annR_{z_i}) \bigcap X_{n_i} = 0, annX = 0,$ since $ann(z_i) \leq_e R, \forall \ i - 1,2,3...n$ and hence $\bigcap ann(z_i) \leq_e R = 1$. So $annX = 0$. Thus $K + Rad(M) + Z(M) <<_{a\delta} M$.

Proposition 2.2 [3] Let M be a module and $K <<_{a\delta} M$. If $Rad(M) << M$ and $Z(M)$ is finitely generated, then $K + Rad(M) + Z(M) <<_{a\delta} M$.

3. Annihilator essential submodules:

Definition: [11]Let N be a nonzero submodule of an R- module M. N is said to be annihilator essential submodule of M (shortly ann-essential submodule) denoted by $N \leq_{ae} M$ *if* $N \bigcap K = 0$ then $ann(K) \leq_e R$ for every submodule K of M. That is a non-zero submodule N is annihilator essential if $N \bigcap K \neq 0$ for every submodule L of M such that $ann(K)$ is not essential in R. A non-zero ideal I of a ring R is ann-essential ideal if $I \bigcap E = 0$ then $ann(E) \leq_e R$ for every ideal E of R as an R-module.

Remarks and Examples:

1.Every essential submodule of an R-module M is ann- essential submodule.

Proof: let N be an essential submodule of M such that $N \bigcap K = 0$, Since N is essential then K= 0 and $ann(0) = \{r \in R : r0 = 0\} = R \leq_e R$ Thus, N is ann- essential submodule.

But the converse in general is not true as the following example shows:

Let M = Z_6 as Z- module, Let $N = \{\bar{0}, \bar{2}, \bar{4}\}$ the submodules of Z_6 such that $N \bigcap K = 0$ are $K_1 = \{\bar{0}, \bar{3}\}$ and $K_2 = \{\bar{0}\}$, $N \bigcap K_1 = 0$ and $Ann(K_1) = 2Z \leq_e Z$ then and $N \bigcap K_2 = 0$ and $Ann(K) = Z \leq_e Z$, thus K is ann-essential submodule. But N is not essential submodule Z_6, since $N \bigcap K = 0$ and K $\neq$ 0.

(2). Consider Z_6 as Z_6 – module. Let $N = \{\bar{0}, \bar{2}, \bar{4}\}$ and let $K = \{\bar{0}, \bar{3}\}$. N is not ann-essential submodule since $N \bigcap K = 0$ and $Ann(K) = N$ which is not essential ideal of Z_6.

(3). If M is a singular R- module then every submodule is ann- essential submodule

Proof: Let N ≤ M. we want to prove that N is ann- essential submodule, Let K ≤ M such that $N \bigcap K = 0$, Since M is singular then $Ann(K) \leq_e R$. Hence N is ann- essential submodule of M.

For example. Let M = Z_n as Z - module, Z_n is singular module, every submodule of Z_n is ann- essential submodule.

The converse in general is not true as the following example shows: Let M=Z as Z- module,

Every sub module of M is ann- essential submodule but M is non-singular module.

Proposition 3.1: Let A, B be a submodule of an R- module M such that $A \leq B \leq M$, If $A \leq_{ae} M$ then $B \leq_{ae} M$.

Proof: Let $L \leq M$ such that $B \bigcap L = 0$. Since $A \leq B$ then we have $A \bigcap L = 0$ and since $A \leq_{ae} M$ then we get $annL \leq_e R$,Thus $B \leq_{ae} M$. The converse in general is not true as the following example shows:

Let M = Z_{12} as Z_{12} - module, Let $K = \{\bar{0}, \bar{6}\} \leq \bar{2} \leq_{ae} Z_{12}$, since $\bar{2} \leq_e Z_{12}$. But K is not ann- essential in Z_{12}. Since $K \bigcap \bar{4} = 0$ but $ann\bar{4} = \bar{3}$ which is not essential in Z_{12} .

Corollary: If $N_1 \bigcap N_2 \leq_{ae} M$ then both of N_1 and N_2 are ann-essential submodules of M.

Proof: Since $N_1 \bigcap N_2 \leq N_1 \leq M$ and $N_1 \bigcap N_2 \leq N_1 \leq M$, we get $N_1 \leq_{ae} M$ and $N_2 \leq_{ae} M$. The converse in general is not true for example: Let M= Z_6 as Z- module and let $K = \{\bar{0}, \bar{2}, \bar{4}\} \leq_{ae} M$ and let $L = \{\bar{0}, \bar{3}\} \leq_{ae} M$. But $K \bigcap L = 0 \not\leq_{ae} M$.

Proposition 3.2: Let M and N be an R- modules with $B \leq M$. Let $f : M \to N$ be an isomorphism, if B is ann-essential submodule of M then f(B) is ann- essential submodule of N.

Proof: Let $L \leq N$ such that $f(B) \bigcap L = 0$, since f is monomorphism we have $B \bigcap f^{-1}(L) = 0$, since $B \leq_{ae} M$ then $ann(f^{-1}(L)) \leq_e R$, $ann(f^{-1}(L)) \leq ann(f(f^{-1}(L)) \leq R$, since f is epimorphism then we have $ann(f^{-1}(L)) \leq ann(L) \leq R$, since $ann(f^{-1}(L)) \leq_e R$ then we have $ann(L) \leq_e R$, Therefore f(N) is ann-essential submodule of M.

Proposition 3.3: If $A \leq_e B \leq M$ and $A_1 \leq_{ae} B_1 \leq M$ where M is an R- module then $A \bigcap A_1 \leq_{ae} B \bigcap B_1$ where $A_1 \leq A$ *and* $B_1 \leq B$.

Proof: Let $L \leq (B \bigcap B_1)$ such that $(A \bigcap A_1) \bigcap L = 0$, then $A \bigcap (A_1 \bigcap L) = 0$, since $(A \bigcap L) \leq L \leq B$ *and* $A \leq_e B$. Then $A_1 \bigcap L = 0$. Since $L \leq B_1$ and $A_1 \leq_{ae} B_1$ then we get $ann(L) \leq_e R$.

Proposition 3.4: Let M be a faithful multiplication R- module and let N be a submodule of M such that $N = EM$ for some ideal E of R, then if E is ann- essential ideal of R then N is ann- essential submodule of M.

Proof: Let L be a submodule of M such that $N \bigcap L = 0$, since M is multiplication R- module, there exist an ideal I of R such that $L = IM$, $N \bigcap L = EM \bigcap IM = (E \bigcap I)M = 0$. Since M is faithful module then $(E \bigcap I) = 0$. Since E is ann- essential ideal then we get $Ann(I) \leq_e R$, then $ann(IM) \leq_e R$, then $ann(L) \leq_e R$. Thus, N is ann- essential sub module of M.

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Green Synthesis and Characterization of ZnO Nanoparticles using Neem Leaf Extract and its Antibacterial Activity

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Abstract

In this paper an environmentally friendly, and simple approach for the green synthesis of zinc oxide nanoparticles using (Azadirachta Indica) neem leaf extract. In these different parts of neem tree such as leaves, bark, twigs and fruits are used for synthesis ZnO nanoparticles mainly by two methods: one by soaking and another by boiling. It also provides an unconventional and fresh approach which shows that it is a reliable, non-toxic in nature, eco-friendly and also low-cost method. The synthesized Zinc oxide nanoparticle was then characterized by using X-ray diffraction technique, Ultra violate (UV) technique. It also shows the synthesized nanoparticle are in crystalline in nature. The green synthesized method can be used as an alternative to the existing chemical and physical methods. The antioxidant activity of ZnO NPs was calculated by DPPH assay, with varying concentrations. Furthermore, the anti-bacterial efficacy of the green synthesized ZnO NPs against four foodborne pathogenic bacterial strains was examined using the disk diffusion assay, on Staphylococcus aureus bacteria.

Key Words: Neem Leaf, Zinc Nitrate.

1. Introduction

Recently, research in the field of nanotechnology has grown very rapidly. Particles sizes of nana material are in the range of 10^{-9} m. The nanomaterials are being manufactured by controlled manipulation in the size and shape of particles. It is a multi-disciplinary science dealing with various disciplines subject like physics, chemistry, and biology. Due to their unique and significant physical and chemical properties of nanomaterials, of several metal oxides are being produced [1,2]. Metal oxide NPs are can be applied in various fields such as clinical concern, consumer products, and in other industrial uses [3]. Metal oxide nanoparticle are effectively used as antibiotic for pathogenic bacteria and viruses which show resistance towards the existing commercially available antibiotics. Due to its low toxicity, biocompatibility, and biodegradability, they are widely used in the industries of biomedicines and personal care products [4].

2. Experimental

Green synthesis of ZnO NPs

Zinc oxide (ZnO) nanoparticles were synthesized by using leaf (*Azadirachta indica*) neem leaf extracts using zinc nitrate as a precursor. The leaves were washed in running tap water to remove dirt and dust and dried for 2 days. The leaves were dried in oven at 30 ºC for 3-4 days. After complete drying, the leaves were ground to powder using motor pester and powdered leaf sample was stored separately in air tight bottle.

After that 10-gram powdered leaf sample was extracted with 100 ml distilled water with the ratio 1:10 and boiled for 35-50 minutes with constant stirring and filtered. Take 10 ml of 10 per cent neem leaf extracts in two different beakers and boiled on a hot water bath. When the leaf extract started boiling, 1 gram zinc nitrate was added with constant stirring. The mixture was boiled till paste was obtained. The obtained paste was transferred to silica crucible and calcinated by using muffle furnace at 400 ºC for two hours. A white colour zinc oxide nanoparticle obtained. The green synthesized zinc oxide nanoparticles were characterized for their size, shape and stability.

3. Characterization of ZnO NPs

3.1 UV –spectroscopy

UV-spectrophotometer analysis was done for green synthesized ZnO nanoparticles for primary confirmation. A small amount of synthesized ZnO NPs was dispersed in water by ultrasonication for 30 minutes. Dispersed sample was fed to UV- visible spectrophotometer and absorption peak of the sample was recorded with help of connected PC and the software SP-UV5.

UV-spectrophotometer analysis was done for preliminary confirmation of green synthesized nanoparticles. Absorbance peak of green synthesized ZnO NPs obtained in UV-wavelength range (280-375 nm), which confirmed their size in nano range.

In UV-spectroscopy, zinc oxide nanoparticles synthesized from neem plant extracts showed difference in their absorbance peaks (Figure 1). ZnO NPs synthesized using neem extract exhibited absorbance peaks at 359 nm and that of neem was at 368 nm. ZnO NPs synthesized from neem extract exhibited their absorption peak at the lower wavelength was supposed to have a smaller size than that synthesized from neem. When the size of bulk molecules gets reduced to nano range, their absorption peak gets shifted towards UV range from visible range. So, nanoparticles exhibiting absorption peak at lower wavelength have smaller size than the particles exhibiting absorption peak at higher wavelength.

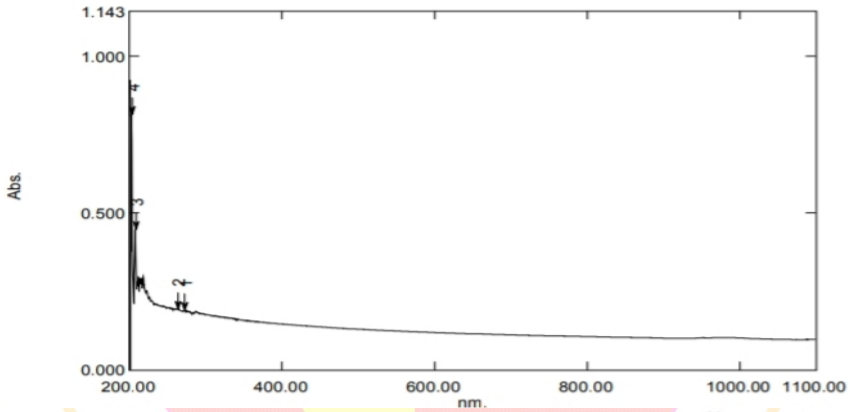


Figure 1. UV Absorption of ZnO

3.2. X-Ray Diffraction

The ZnO samples was characterize by using X-ray diffraction method as shown in figure 2. A definite line broadening of the XRD peaks indicates that the prepared material consists of particles in nanoscale range. From the XRD patterns analysis, we determined peak intensity, position and width, full width at half maximum (FWHM) data. XRD analysis showed a series of diffraction peaks at 2θ that can be assigned to (100), (002), (101), (102) and (110) planes respectively. These diffraction peaks have been keenly indexed as hexagonal wurtzite phase of ZnO [5,6] with lattice constants a=b=0.324nm=3.2494Å and c=0.520nm=5.2038Å (JPCDS card number:89-7746) and confirms the synthesized nano-powder was confirmed. The average particle size of ZnO nanoparticles was found to be 18.59 nm**.** using Scherrer's formula.[7]

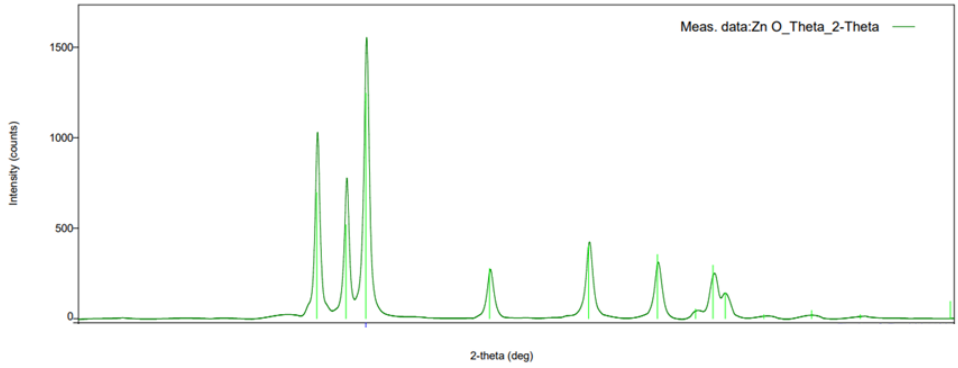


Figure 2. X- Ray diffraction of ZnO

4. Result and Discussion

4.1 Anti-bacterial Activity of ZnO NPs

Herein, Agar Well Diffusion Method was used to assess the antibacterial activity of synthesized nanoparticles. The antibacterial test was carried out in two stages, namely the stage of making agar medium and the stage of antibacterial testing. For this purpose, bacteria Staphylococcus aureus (gram positive) was employed as test organism.

Stage-1) Agar medium preparation

Initially, the nutrient agar medium was prepared. Then the plate was sterilized using autoclave at 120°C and 15 lbs pressure for 15 minutes then cooled down. Then, 20 ml of nutrient agar was poured into sterile petri dich plate. The plates were allowed to solidify. The test of pure culture bacteria was inoculated on NA plates by spread plate technique.

Stage-2) Antibacterial testing

1 gram of ZnO nano crystalline powder was dispersed in 10 ml of Dimethyl sulfoxide (DMSO) solvents then vortexed until completely mixed. Sterile cork borer was to make the wells in plates. About 100 µl of prepared solution was poured into the well and the cup was tightly closed then allowed to stand in an incubator at 37°C for 24 hours. Thereafter, antibacterial activity was measured based on the diameter of the clean zone produced.

4.2. Antibacterial studies on Staphylococcus aureus bacteria

It has been found in studies that the activity depends upon crystallite size, morphology, composition, specific surface and phase of the crystalline material. [5] The smaller size of nanoparticles facilitates easy entry into the microbial cell membrane and enables inhibition mechanisms to occur inside the cell. ZnO nanoparticles generate hydrogen peroxides which chemically interact with membrane proteins and lipid bilayers [6,7]. The ZnO nanoparticles may distort and damage the bacterial cell membrane, causing leakage of intracellular contents leading to cell death.[8].

The prepared nanoparticles were screened for antibacterial activity by well diffusion method. It was observed that for prepared nanoparticles has antibacterial potential against pathogenic bacteria. Inhibition of microbial growth in terms of inhibition zones around the test wells in a bacterial lawn was observed [9]. The zone of inhibition for ZnO NPs solution in DMSO is 1:10 for gram-positive bacteria Staphylococcus aureus were calculated by measuring the diameter and it is found to be 11 mm for the inhibited growth around the wells. The antibacterial activities of ZnO nanoparticles against the studied pathogenic strains are shown in figure 3.



Figure 3. Anti-bacterial activity of ZnO NPs

5. Conclusion

In this study, we successfully synthesized ZnO nanoparticles by using a green synthesis method from *Azadirachta indica* (neem) leaf extract. A white coloured ZnO powder was obtained. The XRD analysis was used to confirm the formation of ZnO nanoparticles by green synthesis method. The synthesized ZnO nanoparticles has an average particle size is 18.59 nm and shows hexagonal structure. The concentration of synthesize particle seems to be more active on the inhibition of bacterial growth (Figure 3). The enhanced antibacterial bioactivity of smaller particle probably is attributed to the higher surface area to volume

ratio [10]. According to the results, it can be concluded that ZnO nanoparticles are effective antibacterial agents both on Gram-positive and Gram-negative bacteria and for staphylococcus aureus with the zone of inhibition of about 11 mm.

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Study of Molecular Interactions in Ternary Liquid Mixture of Alcohol + TEA + Acetic Acid through Internal Pressure, Enthalpy and Nissan Parameter

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Abstract:

The Density, Viscosity and Ultrasonic Velocity have been measured in Ternary Liquid Mixture of ***Alcohol + TriEthyl Amine + Acetic Acid*** *at three different temperatures30deg, 35deg and 40deg. From above parameters internal pressure, excess internal pressure, enthalpy and Nissan Parameter have been calculated. The ultrasonic velocity was measured at 2MHz by using Ultrasonic Interferometer. The results are discussed in terms of molecular interactions present in the ternary liquid mixture.*

Keywords: *Ternary liquid mixture, internal pressure, excess internal pressure, enthalpy and Nissan Parameter*

Introduction:

The study of molecular interaction in binary and ternary liquid mixtures plays an important role in the study of development of molecular sciences. Thermodynamic and transport properties of liquid mixtures have been used since long to study the departure of real liquid mixture behavior from ideal one[1-4]. Acoustical parameters are important to understand different kinds of association, the molecular packing, molecular motion and various types of intermolecular interactions and their strength. Excess properties of liquid systems, such as molar volumes are useful for testing the theories of solutions, development of separation techniques and equipment and for other industrial applications[5]. The sign and magnitude of the nonlinear deviation from their ideal values of velocity, adiabatic compressibility, freelength, internal pressure and other thermodynamic parameters of liquid mixture with composition and temperature are generally ascribed to the difference in molecular size and strength of interaction between unlike molecules[6-8]. This decides whether or not there are molecular interactions or whether these interactions are strong or weak.

Theory: The molecules in a liquid are so close together that the various interactions such as Vander Waal's forces, electronic fields and ionic interactions assume considerable importance. Since these factors are not that easy to evaluate, it is expedient to heavily rely on experimental information in characterizing liquids. The measurement of internal pressure is important in the study of the thermodynamic properties of liquids. The internal pressure is the cohesive force, which is a resultant of force of attraction and force of repulsion between the molecules. The internal pressure, (πi) can be calculated by using equation;

$$\Pi i = bRT\,[K\eta/U]^{1/2}[\rho^{2/3}/M^{7/6}]$$

Where, K is a dimensionless constant independent of temperature and nature of liquids. Its value is 4.281×10^9.

The Excess pressure πi^E for the ternary mixture were calculated by using following equation,

$$\pi_i^E = \pi_{imix} - (\pi_{i1}f_1 + \pi_{i2}f_2 + \pi_{i3}f_3)$$

Enthalpy is a measurement of energy in a thermodynamic system. It is the sum of the internal energy added to the product of pressure and volume of the system. It can be calculated from the following relation

$$H = \pi_i V_m$$

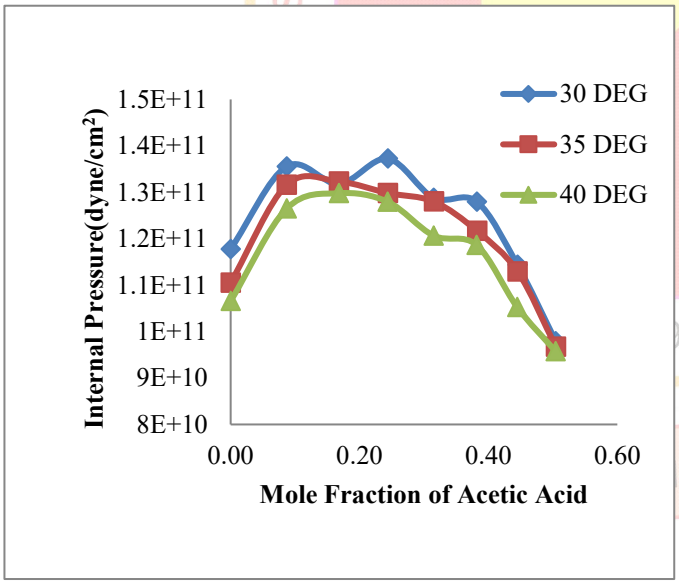
Where H – Enthalpy, Π_i - internal pressure and V_m - Molar volume

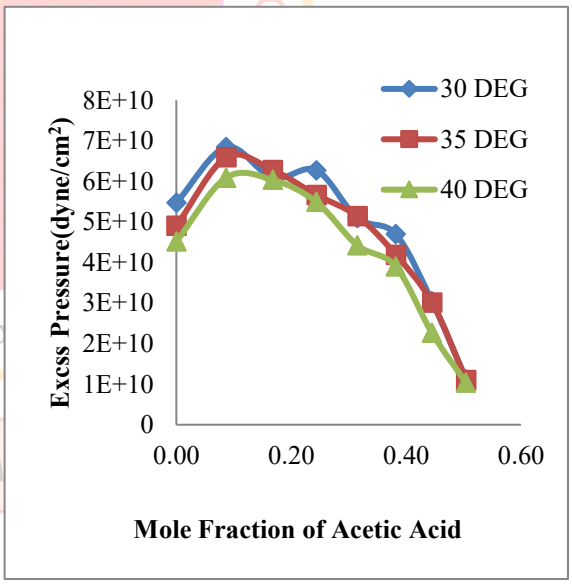
The interaction parameter d, in the Grunberg and Nissan equation, is a measure of the strength of interaction between the mixing components. The Nissan parameters were calculated by using following formula

$$d = \ln\eta^E/x_1x_2x_3$$

Experimental Methods: In the present work density was measured by using density bottle (corning made certified 10 ml). Stopper is used in order to avoid evaporation of chemicals. Weight of bottle was taken by monopan balance (model no. K15) supplied by K-Roy and Company, Varanasi with sensitivity of 0.01 mg. Density measurements were taken at three different temperatures 30Deg, 35Deg and 40Deg. For the measurement of viscosity Ostwald viscometer was used. In the present work ultrasonic velocity was measured by ultrasonic interferometer. The ultrasonic velocity determined by interferometer method which is considered as more reliable and precise as compared to other methods reported in the literature for computing ultrasonic study of liquids. The liquids used for the work were of BDHAR grade. For the present work the chemicals used viz Alcohol tri-ethylamine(TEA), and acetic acid were procured SD fine Mumbai and from E Merk chemicals Ltd India. Samples of different concentrations were prepared by mixing the component liquids in volume proportion.

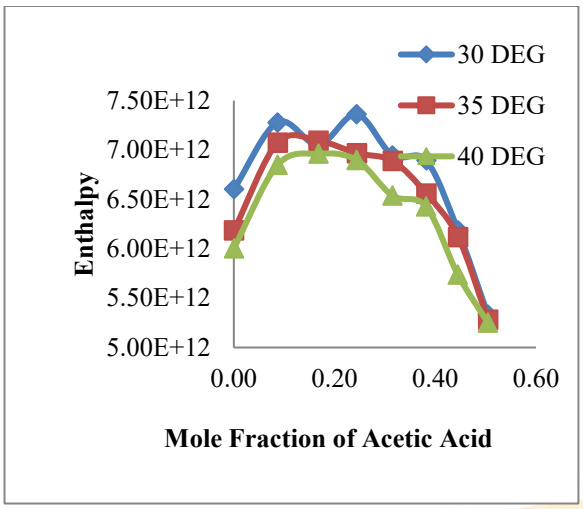
Result and Discussion: Suryanarayana[9] suggested that the liquid properties could be studied effectively by studying the internal pressure of the liquids. This suggests that the internal pressure of liquid mixture could possibly be influenced by the presence of hydrogen bond. From figure it is evident internal pressure is low at small mole fractions of carboxylic acid, becomes maximum and decreases again at high mole fractions of carboxylic acid. This may be associated to the possibility of hydrogen bonding or complex formation[10]. The rapid fall of π_i values with mole fraction of acid may be indication of weak interactions. Increase in internal pressure suggests the close packing of the molecules, which may be taken as the increasing strength of interaction. Such type of variation was also observed by J.B.Thakare and P.J.Thakare[10] in ternary liquid mixture of Benzene + TEA + Caprylic acid at various temperatures. The donor acceptor type of interaction was suggested to be responsible for such variation.

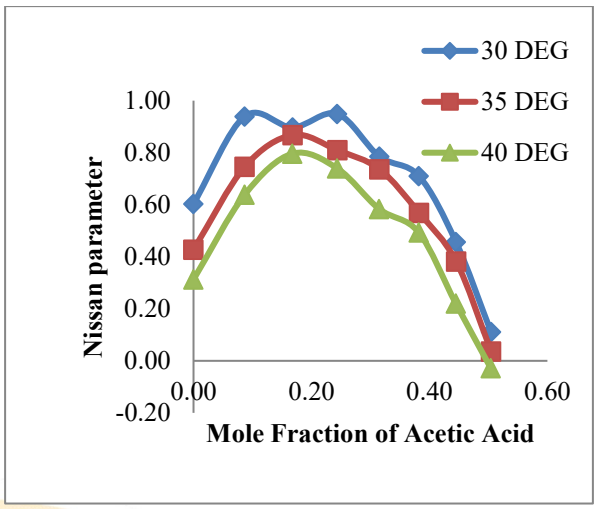




When the mole fractions of both the component all near about equal the values of excess internal pressure is positive. The values of excess pressure are almost positive showing close association.

Enthalpy in a liquid mixture is a calculation of intermolecular forces between the component molecules. It is found that enthalpy increases at low concentration, attains a maximum value and decreases at higher concentration of carboxylic acids. Increase in enthalpy suggests that stronger molecular interactions are present at intermediate concentration and decreasing values of enthalpy indicate that a molecular repulsive force dominates at lower and higher mole fraction of carboxylic acid.





The present investigation suggest that positive 'd' values indicate specific interaction arising out of existing hydrogen bonds in associated compounds of the mixture and the new formation bonds between acids and amines. The addition of either amine or acid to alcohol causes dissociation and hence structural changes due to presence of weak molecular forces and dispersion forces .The complexation between acid amine is favored more than the complexation between alcohol and amine. This becomes clear from the enthalpy of bond formation between amine and acid and alcohol and amine[63].

Conclusion:

From the experimental values of density, viscosity and ultrasonic velocity, internal pressure, excess pressure, enthalpy and Nissan parameter (d) have been evaluated. The trends in the variation of acoustical parameters shows the non linear behavior, which confirms the molecular interactions are present in the ternary liquid mixture of Alcohol, Tri-ethyl amine and Acetic acid mixture. It may be concluded that the strong molecular interactions are due to H-bonding between acceptor amine and donor carboxylic acid molecules are present in the mixture.

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Vacuum Ultraviolet (VUV) and UV Spectroscopic Properties of Red Emitting Eu^{3+}-Doped (Y,Gd)VO_4 Phosphor

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Abstract:
The red emitting $_{0.01}Eu^{3+}$-doped ($Y_{0.49}$, $Gd_{0.50}$) VO_4 Phosphor was synthesised by low cost, time saving re-crystallisation method. The crystal structure of the sample was characterized using X-ray diffraction (XRD) and spectroscopic properties under VUV and UV excitation were investigated. In the excitation spectra, broad band (From 125 nm to 350 nm) observed under the excitation of 621 nm. In the emission spectra, the intense red emission at about 621 nm was observed both under UV excitation of 315 nm and VUV excitation of 147 nm and 172nm. The CIE color coordinates shows that the color purity under VUV add UV excitation.
Keywords: *Inorganic compounds; Chemical synthesis; X-ray diffraction;Luminescence; Phosphors.*

1. Introduction

Rare earth (RE) ion doped phosphors play an important role in the field of display and lighting due to their many applications, such as field emission displays (FED), cathode ray tubes (CRT), plasma display panels (PDP), and light emitting diodes (LED) [1,2].

Yttrium vanadate (YVO_4) attracts researcher's attention for more than five decades owing to its ability to host the trivalent rare-earth elements and produce outstanding photoluminescence (PL) properties [3]. Within the YVO_4 structure, the trivalent RE elements substitute the Y ion and acts as an activator for the strong photoluminescent emission. The color of the emission light depends on the RE ion, enabling the phosphors to be used in various optoelectronic and catalyst devices [4-6]. M.R. Dolgos *et al*. and J. Shao *et al.* have been explained the mechanism of photoluminescence in trivalent RE doped YVO_4 phosphors. The mechanism can be shortly described in three steps. In the first step, the host materials strongly absorb UV photon energy within the VO_4 structure motif, in second step this energy is transferred to doping ion, and in last sept, excitation and subsequent de-excitation of the dopant ion causes the characteristic f-f transition for strong emission [7,8].
The present work planned to studied the PL properties of $_{0.01}Eu^{3+}$-doped ($Y_{0.49}$, $Gd_{0.50}$) VO_4 Phosphor was synthesised by re-crystallisation method. The aim to incorporation of Gadolinium ions in the host material to check the emission intensity of the synthesised material. The main advantages of the synthesis method employed in this study are it low cost and that, it does not require any other agent for initiation of synthesis. Moreover, the synthesized phosphor exhibits high PL intensity, which is the main aim of the present work.

2. Experimental Procedure

$_{0.01}Eu^{3+}$-doped ($Y_{0.49}$, $Gd_{0.50}$) VO_4 Phosphor was prepared for the first time by using the slow evaporation or re-crystallization method. This method can be employed at relatively low temperatures and affords high controllability over particle size and homogeneity. The starting chemicals Y_2O_3, Gd_2O_3 (99.99%, AR grade) and Eu_2O_3 (99.90%, AR grade) were mixed together in a china clay basin. A small quantity of deionized water was added to get a thick paste into which HNO_3 was added dropwise. The mixture was heated under observation at 50°C until the paste dissolved completely. The resulting solution was considered as Y,Gd$(NO_3)_3$:Eu. To this solution, NH_4VO_4 (AR grade) dissolved in double distilled water was then added dropwise. The entire homogenous solution was then placed on a hot plate at 60°C to allow slow evaporation of water. Finally, after complete evaporation of water, the dried precursor obtained was crushed and calcinated at 900°C to obtain white crystalline powder, $_{0.01}Eu^{3+}$-doped ($Y_{0.49}$, $Gd_{0.50}$) VO_4.

3. RESULTS AND DISCUSSION

3.1 X-Ray Diffraction (XRD) Characterization:

The formation of the $_{0.01}Eu^{3+}$-doped ($Y_{0.49}$, $Gd_{0.50}$) VO_4 Phosphor in the crystalline phase prepared by re-crystallization method was confirmed by XRD pattern as shown in Fig. 1. The XRD pattern of $_{0.01}Eu^{3+}$-doped ($Y_{0.49}$, $Gd_{0.50}$) VO_4 phosphor agreed well with the standard data from ICDD file (YVO4, 01-072-0274). From the XRD pattern, the high intensity peaks at 2θ position whose values are 25.06, 33.68, and 49.92 and these peaks corresponding to diffracting planes which are defined by Miller indices (200), (112),) and (312) respectively. Also, the XRD show that the formed material is completely crystalline and in Tetragonal single phase, where a = b = 7.1224 and c = 6.1923 A°.

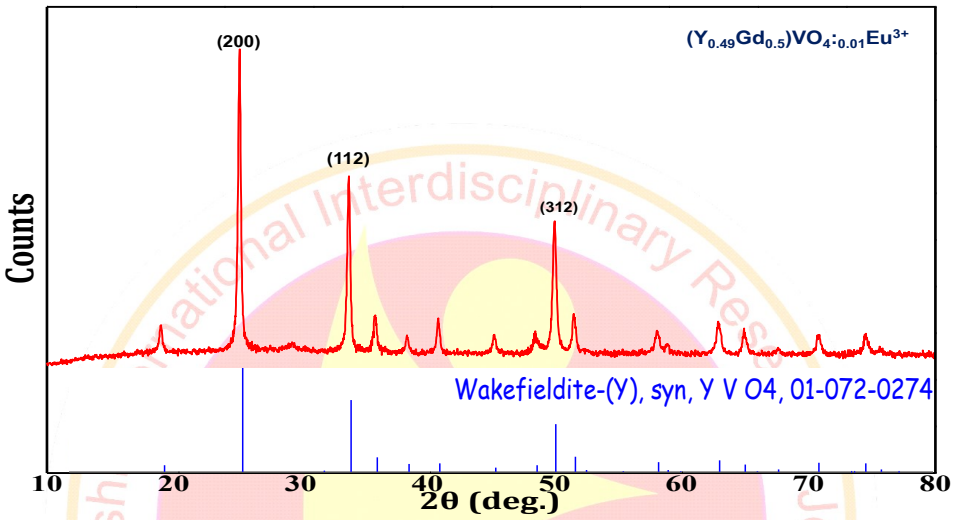


Fig. 1: Shows the XRD Pattern of $_{0.01}Eu^{3+}$-doped ($Y_{0.49}$, $Gd_{0.50}$) VO_4 Phosphor

3.2 VUV and UV Spectroscopic Properties:

The PL excitation spectra of $_{0.01}Eu^{3+}$-doped ($Y_{0.49}$, $Gd_{0.50}$) VO_4 Phosphor is shown in Fig. 2.

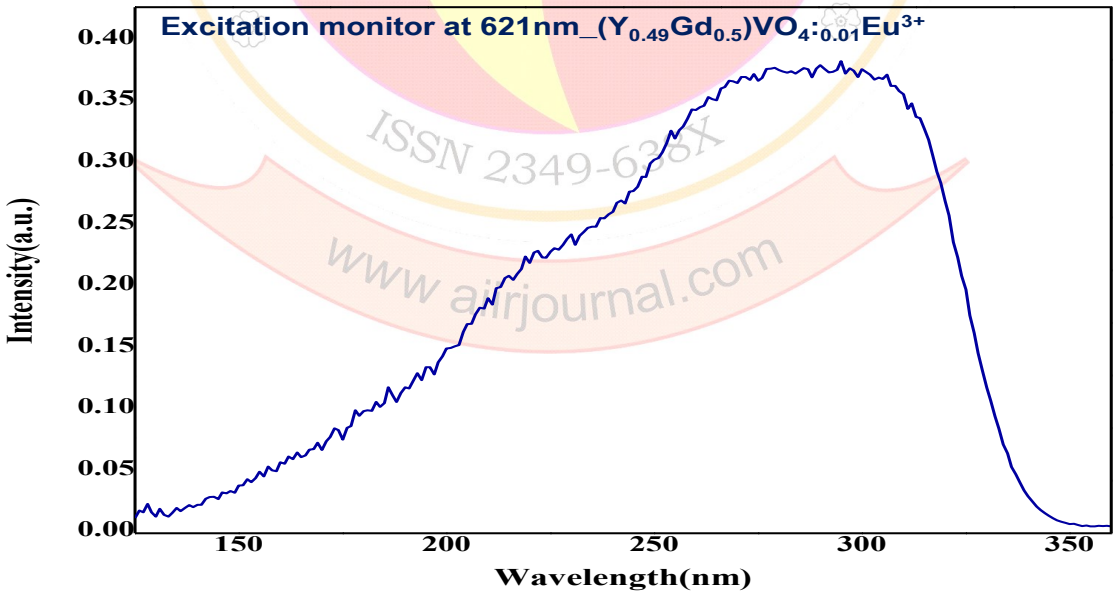


Fig. 2: Shows Excitation Spectra of $_{0.01}Eu^{3+}$-doped ($Y_{0.49}$, $Gd_{0.50}$) VO_4

The excitation spectra were monitored at 621 nm wavelength. There are broad excitation spectra peaking optimum at about 315 nm as shown in fig 2.

Figs. 3a and 3b shows typical emission spectra of $_{0.01}Eu^{3+}$-doped ($Y_{0.49}$, $Gd_{0.50}$) VO_4 Phosphor monitor under VUV radiation of wavelength of 147 nm, 172 nm and UV radiation of 315 nm respectively. The emission is in the form of lines around 593 and 621 nm corresponding to the transitions $^5D_0$ to $^7F_1$ and $^5D_0$ to $^7F_2$ of Eu^{3+}.

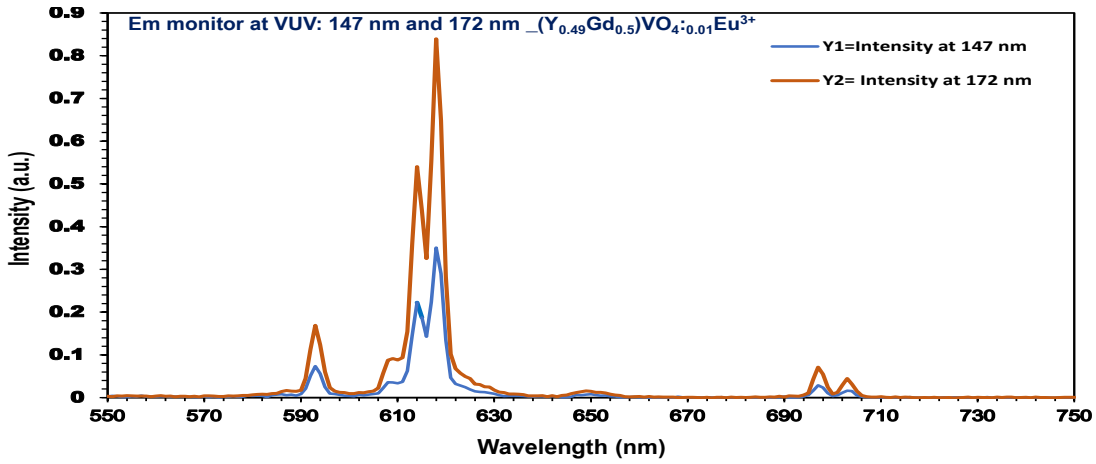


Fig. 3a PL emission spectra of $_{0.01}Eu^{3+}$-doped ($Y_{0.49}$, $Gd_{0.50}$) VO_4 monitor at 147 nm and 172 nm wavelengths recorded on Beijing Synchrotron Radiation Facility (BSRF), China.

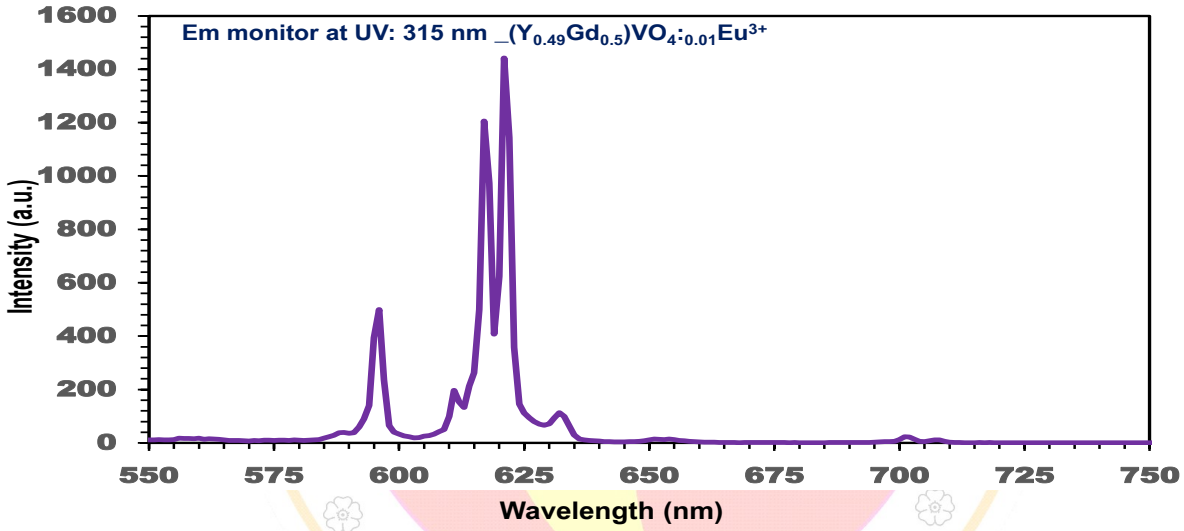


Fig. 3b PL emission spectra of $_{0.01}Eu^{3+}$-doped ($Y_{0.49}$, $Gd_{0.50}$) VO_4 monitor at 315 nm wavelength recorded on FL-7000 fluorescence spectrometer

3.3. CIE Co-ordinates:

The colour excellence of the phosphor will be generally measure by CIE chromaticity synchronize (X, Y). As per the PL emission spectra of $_{0.01}Eu^{3+}$-doped ($Y_{0.49}$, $Gd_{0.50}$) VO_4, the chromaticity coordinates of the material are found to be (x= 0.5759, y= 0.3329). The fig. 4 shows the CIE 1931 chromaticity diagram.

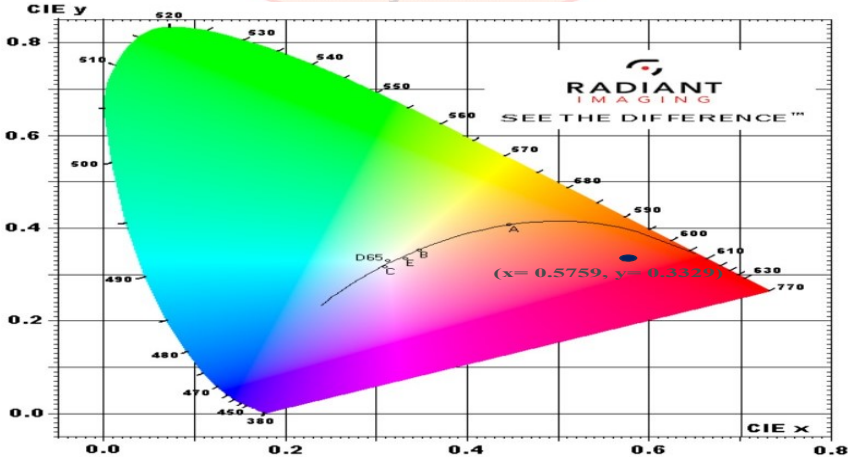


Fig 4: CIE 1931 XY Coordinates from Spectral Power Distribution (SPD) under the excitation of 315 nm wavelength.

Conclusion:

$(Y_{0.49}, Gd_{0.50})$ VO_4: Eu^{3+} doped red emitting Phosphor was synthesised by low cost, time saving re-crystallisation method. The crystal structure of the sample was characterized using X-ray diffraction (XRD) with found to tetragonal single phase and spectroscopic properties under VUV and UV excitation were investigated. In the excitation spectra, broad band (From 125 nm to 350 nm) observed under the excitation of 621 nm. In the emission spectra, the intense red emission at about 621 nm was observed both under UV excitation of 315 nm and VUV excitation of 147 nm and 172nm. The CIE color coordinates shows that the radish color purity under VUV add UV excitation.

Acknowledgements

The authors are appreciative of the scientists and researchers at Beijing Synchrotron Radiation Facility (BSRF), China for providing remote access to the facility to record the VUV emission and excitation spectra on the 4B8 beamline.

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Application of Sumudu Transform to Integral Equations

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Abstract :

Nowadays integral transforms are most appropriate techniques for finding the solution of typical problems because these techniques convert them into simpler problems. F. M. Belgacem , A. A. Karabali and Shyam L. Kalla established analytic investigation of the Sumudu transform and its application to integral production equations. In this paper, we have studied the solution of some integral equations by using Sumudu transform.

Keywords : *Sumudu transform, Inverse Sumudu transform, Abel's integral equation, Convolution theorem.*

Introduction :

Integral transforms play the important role to determine the solutions of advance problems of mathematics, physics, medical science, agriculture & statistics. The most attractive feature of these transforms is providing the exact solution of the problem without large computational work. Many researchers [4-7] applied different integral transforms (Laplace transform, Fourier transform, Kamal transform, Elzaki transform, Mohand transform, Sumudu transform etc.) for solving many problems of science & engineering.

Watugula [8-9] derived a new integral transform and named "Sumudu transform" to it. Sumudu transform may be used to solve problems without resorting to a new frequency domain. Due to its simple formulation and consequent special and useful properties, the Sumudu transform has shown much promise. Aggarwal and Gupta [1] applied Sumudu transform for the solution of Abel's integral equation. Aggarwal et al. [2-4] used different integral transformations and determined solution of Abel's integral equation.

The main aim of his paper is to determine the solution of Integral equation of convolution type and Abel's integral equation using Sumudu transform.

Sumudu Transform :

Over the set of functions

$$A = \{ f(t) \mid \exists\, M, \tau_1, \tau_2 > 0, |f(t)| < Me^{|t|/\tau_j}, \text{if } t \in (-1)^j \times [0, \infty) \}$$

The Sumudu transform of function $f(t)$ is denoted by $S[f(t); u]$ or simply $G(u)$ is defined as follows

$$G(u) = S[f(t)] = \frac{1}{u}\int_0^\infty e^{-\frac{t}{u}} f(t)dt \quad , u \in (-\tau_1, \tau_2)$$

Basic Sumudu Transform Properties :

i) Duality with Laplace transform :

If $L[f(t)] = F(s)$ and $S[f(t)] = G(u)$ then $G(u) = \frac{F(1/u)}{u}$, $F(s) = \frac{G(1/s)}{s}$

ii) Linearity property :

$$S[af(t) + bg(t)] = aS[f(t)] + bS[g(t)]$$

iii) Convolution theorem for Sumudu transform :

If $S[f(t)] = G(u)$, $S[g(t)] = H(u)$ then

$S\left[\int_0^t f(x)g(t-x)dx\right] = uG(u)H(u)$ or $S[f(t) * g(t)] = uS[f(t)]S[g(t)]$

where $f(t) * g(t) = \int_0^t f(x)g(t-x)dx$

iv) Second scale preserving property :

If $S[f(t)] = G(u)$ then $S\left[t\frac{d(f(t))}{dt}\right] = u\frac{dG(u)}{du}$

Sumudu transform of elementary functions :

S.N.	$f(t)$	$S[f(t)] = G(u)$
1	1	1
2	t	u
3	t^2	$2!\,u^2$
4	$t^n, n \in N$	$n!\,u^n$
5	$t^n, n > -1$	$\Gamma(n+1)u^n$
6	e^{at}	$\frac{1}{1-au}$
7	$\sin at$	$\frac{au}{1+a^2u^2}$
8	$\cos at$	$\frac{1}{1+a^2u^2}$
9	$\sinh at$	$\frac{au}{1-a^2u^2}$
10	$\cosh at$	$\frac{1}{1-a^2u^2}$

Inverse Sumudu Transform :

If $S[f(t)] = G(u)$ then $f(t)$ is called the inverse Sumudu transform of $G(u)$ and it is defined as $f(t) = S^{-1}[G(u)]$ where S^{-1} is the inverse Sumudu transform operator.

Inverse Sumudu transform of elementary functions :

S.N.	$G(u)$	$f(t) = S^{-1}[G(u)]$
1	1	1
2	u	t
3	u^2	$\frac{t^2}{2!}$
4	$u^n, n \in N$	$\frac{t^n}{n!}$
5	$u^n, n > -1$	$\frac{t^n}{\Gamma(n+1)}$
6	$\frac{1}{1-au}$	e^{at}
7	$\frac{u}{1+a^2u^2}$	$\frac{\sin at}{a}$
8	$\frac{1}{1+a^2u^2}$	$\cos at$
9	$\frac{u}{1-a^2u^2}$	$\frac{\sinh at}{a}$
10	$\frac{1}{1-a^2u^2}$	$\cosh at$

Sumudu Transform for solving Integral Equation of convolution type:

The equation of type $Y(t) = F(t) + \int_0^t K(t-u)Y(u)du$

(1)

is called integral equation of convolution type which can be written as

$$Y(t) = F(t) + K(t) * Y(t)$$

Taking Sumudu transform on both sides assuming

$$S[Y(t)] = G(u), S[F(t)] = H(u), S[K(t)] = T(u)$$

$$S[Y(t)] = S[F(t)] + S[K(t) * Y(t)]$$

$$G(u) = H(u) + u\,T(u)G(u)$$

$$\therefore G(u) = \frac{H(u)}{1-u\,T(u)}$$

$$S[Y(t)] = \frac{H(u)}{1-u\,T(u)}$$

$$Y(t) = S^{-1}\left\{\frac{H(u)}{1-u\,T(u)}\right\}$$

Which is required solution of (1).

Abel's Integral Equation :

In 1823, Niel's Henrik Abel discussed the motion of particle on smooth curve lying on a vertical plane using Abel's integral equation in mathematical form as

$$G(t) = \int_0^t \frac{1}{\sqrt{t-x}} Y(x)dx$$

Here the kernel of integral equation , $K(x,t) = \frac{1}{\sqrt{t-x}}$ becomes ∞ at $x = t$, the function $G(t)$ is known function and the function $Y(x)$ is unknown function.

Aplications :

In this section, we present some numerical applications to explain the complete methodology.

Problem 1 **:** Consider the integral equation

$$Y(t) = 1 + t + \int_0^t e^{-2(t-u)} Y(u)du \qquad (2)$$

Taking Sumudu transform of both sides of (2), we have

$$S[Y(t)] = s[1] + S[t] + S\left[\int_0^t e^{-2(t-u)} Y(u)du\right]$$

$$\Rightarrow \quad G(u) = 1 + u + S[e^{-2t} * Y(t)]$$

Applying convolution theorem of Sumudu transform, we get

$$\Rightarrow \quad G(u) = 1 + u + u\,S[e^{-2t}]\,S[Y(t)]$$

$$\Rightarrow \quad G(u) = 1 + u + u\,\frac{1}{1+2u}G(u)$$

$$\Rightarrow \quad (1 - \frac{u}{1+2u})G(u) = 1 + u$$

$$\Rightarrow \quad \frac{1+u}{1+2u}\,G(u) = 1 + u$$

$$\Rightarrow \quad G(u) = 1 + 2u$$

$$\Rightarrow \quad S[Y(t)] = 1 + 2u$$

Taking inverse Sumudu transform on both sides, we have

$$Y(t) = S^{-1}[1 + 2u] = S^{-1}[1] + 2S^{-1}[u]$$

$$Y(t) = 1 + 2t$$

which is the required solution of (2).

Problem 2 **:** Consider the integral equation

$$\int_0^t Y(u)Y(t-u)du = 8[\sin t - t\cos t\,] \qquad (3)$$

Taking Sumudu transform of both sides of (3), we have

$$S\left[\int_0^t Y(u)Y(t-u)\,du\right] = 8\,\{\,S[\sin t] - S[t\cos t]\}$$

$$S[Y(t) * Y(t)] = 8\left\{\frac{u}{1+u^2} - S\left[t\frac{d\sin t}{dt}\right]\right\}$$

Applying convolution theorem of Sumudu transform, we get

$$u\,S[Y(t)]\,S[Y(t)] = 8\left\{\frac{u}{1+u^2} - u\,\frac{d}{dt}\left(\frac{u}{1+u^2}\right)\right\} \quad \text{since } S\left[t\frac{df(t)}{dt}\right] = u\frac{dG(u)}{du}$$

$$\Rightarrow u\,\{S[Y(t)]\}^2 = 8\left\{\frac{u}{1+u^2} - \frac{u(1-u^2)}{(1+u^2)^2}\right\}$$

$$\Rightarrow \{S[Y(t)]\}^2 = 8\left\{\frac{1}{1+u^2} - \frac{1-u^2}{(1+u^2)^2}\right\}$$

$$\Rightarrow \{S[Y(t)]\}^2 = \frac{16u^2}{(1+u^2)^2}$$

$$\Rightarrow S[Y(t)] = \frac{4u}{1+u^2}$$

Taking inverse Sumudu transform on both sides, we have

$$Y(t) = S^{-1}\left[\frac{4u}{1+u^2}\right] = 4\sin t$$

which is the required solution of (3).

Problem 3 **:** Consider the Abel's integral equation

$$\int_0^t \frac{1}{\sqrt{t-x}} Y(x)dx = 1 + t + t^2 \qquad (4)$$

Taking Sumudu transform of both sides of (4), we have

$$S\left[\int_0^t \frac{1}{\sqrt{t-x}} Y(x)dx\right] = S[1] + S[t] + S[t^2]$$

$$\Rightarrow S\left[t^{-1/2} * Y(t)\right] = 1 + u + 2u^2$$

Applying convolution theorem of Sumudu transform, we get

$$u\,S\left[t^{-1/2}\right]S[Y(t)] = 1 + u + 2u^2$$

$$\Rightarrow u\left(\sqrt{\pi}\,u^{-1/2}\right)G(u) = 1 + u + 2u^2$$

$$\Rightarrow G(u) = \frac{1}{\sqrt{\pi}}\left(\frac{1+u+2u^2}{u^{1/2}}\right)$$

$$\Rightarrow S[Y(t)] = \frac{1}{\sqrt{\pi}}\left[u^{-1/2} + u^{1/2} + 2\,u^{3/2}\right]$$

Applying convolution theorem of Sumudu transform, we get

$$Y[t] = \frac{1}{\sqrt{\pi}}\,S^{-1}\left[u^{-1/2} + u^{1/2} + 2\,u^{3/2}\right]$$

$$\Rightarrow Y[t] = \frac{1}{\sqrt{\pi}}\left\{S^{-1}\left[u^{-1/2}\right] + S^{-1}\left[u^{1/2}\right] + 2S^{-1}\left[u^{3/2}\right]\right\}$$

$$\Rightarrow Y[t] = \frac{1}{\sqrt{\pi}}\left\{\frac{t^{-1/2}}{\sqrt{\pi}} + \frac{t^{1/2}}{\frac{1}{2}\sqrt{\pi}} + 2\frac{t^{3/2}}{\frac{3}{2}\frac{1}{2}\sqrt{\pi}}\right\}$$

$$\Rightarrow Y[t] = \frac{1}{\pi}\left\{t^{-1/2} + 2t^{1/2} + \frac{8}{3}t^{3/2}\right\}$$

which is the required solution of (4).

Problem 4 **:** Consider the Abel's integral equation

$$2\sqrt{t} + \frac{8}{3}\,t^{3/2} = \int_0^t \frac{1}{\sqrt{t-x}} Y(x)dx \qquad (5)$$

Taking Sumudu transform of both sides of (5), we have

$$2\,S\left[t^{1/2}\right]+\frac{8}{3}S\left[t^{3/2}\right]=S\left[\int_0^t \frac{1}{\sqrt{t-x}}Y(x)dx\right]$$

$$\Rightarrow\ \sqrt{\pi}\,u^{1/2}+2\sqrt{\pi}\,u^{3/2}=S\left[t^{-1/2}*Y(t)\right]$$

Applying convolution theorem of Sumudu transform, we get

$$\Rightarrow\ \sqrt{\pi}\,u^{1/2}+2\sqrt{\pi}\,u^{3/2}=u\,S\left[t^{-1/2}\right]S[Y(t)]$$

$$\Rightarrow\ \sqrt{\pi}\,u^{1/2}+2\sqrt{\pi}\,u^{3/2}=u\left(\sqrt{\pi}\,u^{-1/2}\right)S[Y(t)]$$

$$\Rightarrow\ S[Y(t)]=1+2u$$

Taking inverse Sumudu transform on both sides, we have

$Y(t)=S^{-1}[1+2u]=S^{-1}[1]+2S^{-1}[u]$

$\Rightarrow Y(t)=1+2t$

which is the required solution of (5).

Conclusion :

In this paper, we have successfully discussed application of Sumudu transform for the solution of Integral equation of convolution type and Abel's integral equation. The results shows that Sumudu transform is a powerful integral transform for finding the solution of these integral equations without large computational work and spending a very little time.

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Synthesis And Characterization of CuS Nanoparticles By Chemical Co-Precipitation Method

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Abstract :
Present study investigates the chemical composition and Particle size of produced copper sulphide nanoparticles on the basis of Fourier Transform Infrared Spectroscopy (FTIR) and X- Ray Diffraction (XRD). The Copper Sulphide nanoparticles were synthesized by simple chemical co-precipitation method. The reaction mixture using copper chloride and thiourea as a precursor in presence of highly encourage ecofriendly deionised water. Synthesized particle were characterized by XRD and an average particle size of synthesized nanoparticle was estimated to be 25.03 nm.
Keywords: Copper Sulphide Nanoparticles, Characterization

1.Introduction:

Nowadays due to wide variety of potential applications of nanomaterials due their high aspect ratio, lighter weight and higher strength, researchers find out number of new techniques to synthesises of nanomaterials [1]. Among the different categories of transition metal nanocompounds the copper based nanocomposites shows attractive applications in solar cells [2], cosmetics, bio-engineering and nano-fabrics[1]. Copper sulphide are P- type semiconducting materials received tremendous attention due to different crystalline phase with variable band gap in photovoltaic, ion storage , photocatalysis and chemical sensing [3 – 5]. The copper sulphide nanoparticles has interesting chemical and physical properties depending on their size and shape. Single phase copper sulphide nanoparticles with hexagonal crystal structure shows The optical band gap energy in the range of 2.05 – 2.34 eV with good absorbance to solar radiation in the visible range 530 – 600 nm [6]. Copper sulphide nanomaterials are synthesised by different methods as Hydrothermal [7], Solvothermal [8], Chemical bath deposition [9] and co-precipitation method [10].

In the present study among these synthesis technique, CuS nanoparticles were synthesised by Chemical co- precipitation Technique which is unique and affordable method of its ease of synthesis, controllability to particle size and requirement of lower temperature less than 90^0 [11] but the agglomeration of nanoparticle is the biggest problem in chemical coprecipitation method. The copper sulphide nanoparticles were characterised by UV visible spectroscopy, powder X-ray Diffraction and Fourier Transformed Infrared Spectroscopy (FT-IR).

2 : Materials And Method.

2.1 Materials:

Simple chemical coprecipitation method was utilized for the synthesis of CuS NPs. All chemical were analytical reagent grade, Copper Chloride ($CuCl_2$) and Thiourea (CH_4N_2S) were purchase from SD Fine Chemical Mumbai.

2.2. Method:

Preparing a clear stock solution of 0.1 M $CuCl_2$ and CH_4N_2S in different beaker with 100 ml deionised water separately. Take 100 ml DI water add 20 ml $CuCl_2$ stir continuously for 15 minutes, then add 20 ml of CH_4N_2S drop by drop with vigorous stirring for 20 minutes till the precipitate obtained in the beaker. Synthesized Solution was filtered by whatman filter paper and resulted precipitate double washed with de-ionised water and allowed to heated at 100 ^{0}C for two hours in Muffle Furnace. The obtained solid, crushed by Mortar paster then milled it to obtained nanosized particles of CuS material.

3 : Results And Discussions.

Figure 1 shows XRD spectrum of synthesized powder sample of CuS NPs in the range of 10^0 - 90^0.The spectrum clearly shows the formation of nanoparticles. The typical peaks at 12.53, 13.97 and 29.95 in the XRD spectra corresponding to the planes (110), (101) and (103) are in good agreement with the Hexagonal structure of CuS by comparing with JCPDS card (JCPDS -78-2391). The observed broadening in peaks implies the size of nanoparticles is small. Using the Debye-Scherer formula, the mean particle size of CuS particles was 25.03 nm.

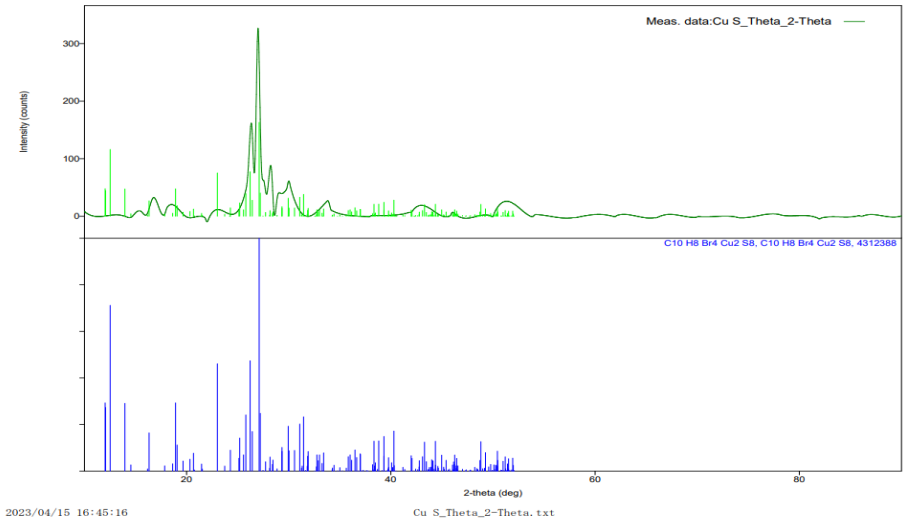


Fig. 1 XRD of CuS nanoparticles

The FT-IR spectrum of CuS NPs was recorded and shown in figure 2. Fourier Transform Infrared Spectroscopy (FTIR) spectra were measured for synthesised sample in the frequency range 4000 – 400 cm-1. FTIR spectra drown by computer with wavelength (cm-1) along x-axis and transmission along y- axis.

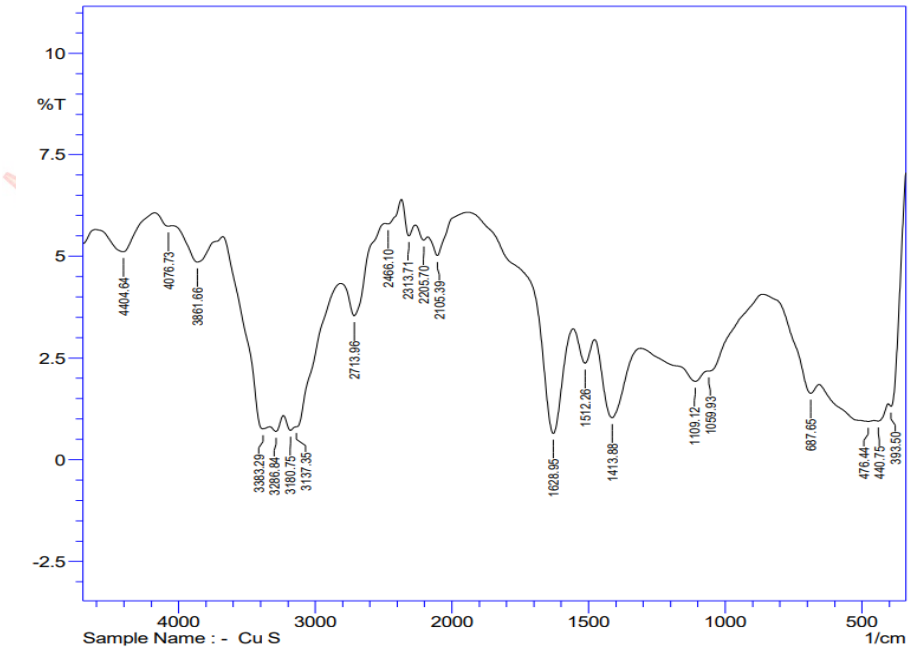


Fig. 2: FTIR Spectra of the synthesized CuS Nanoparticles

N-H stretching is found at the peak 3383 cm^{-1}, the paek at 1628.95 cm^{-1} is attributed to O-H stretching, C-H bending is obtained at the peak 1413.88 cm^{-1}, C-O and C-S stretching is found to be at 1060 cm-1-1110 cm^{-1} and 687 cm^{-1}.

4.Conclusion:

CuS NPs were successfully synthesized using low cost simple co-precipitation method in an aqueous route. Structural study were performed by XRD and confirmed the formation of crystal structure . Average particle size was found to be an around 25.03 nm. Conventional thermal treatment is applied for formation of nanosize particle. FT-IR spectra confirms the presence of functional groups associated with CuS.

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Temperature Distribution in A Hollow Cylinder Using Hankel Transform Technique With Different Boundary Conditions

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Abstract:

Thermoelastic problems in hollow cylinders are of paramount importance in various engineering applications, where thermal and mechanical stresses coexist. This paper presents an analytical approach for solving boundary value problems (BVP) of the first and second kinds in a hollow cylinder using the Hankel transform technique. The Hankel transform simplifies the governing partial differential equations in cylindrical coordinates, enabling the derivation of temperature distribution and stress fields. The temperature distribution, which arises due to both internal and external boundary conditions, is used to compute radial and hoop stresses within the cylinder. The method is validated through comparison with existing analytical solutions and provides valuable insights into the behavior of cylindrical structures under thermal loading. This research contributes to the accurate prediction of thermoelastic stresses in hollow cylinders, which is crucial for the design and safety of pressure vessels, pipelines, and other cylindrical structures exposed to thermal gradients.

Key Word*: Hollow Cylinder, Hankel Transform, Thermoelastic Problems etc.*

1. Introduction

Heat conduction in cylindrical geometries plays a vital role in various engineering and industrial applications, such as heat exchangers, pipelines, reactors, and thermal insulation systems. A hollow cylinder is a common geometry in these applications, where understanding the temperature distribution is crucial for optimizing the design and improving the thermal efficiency of these systems. The study of transient heat conduction is especially important as it allows engineers to predict how temperature evolves over time, which has direct implications for material properties, safety, and energy efficiency.

The governing equation for heat conduction in cylindrical coordinates is a partial differential equation (PDE) that accounts for radial symmetry. Solving this PDE for the temperature distribution in hollow cylinders can be complex, particularly when dealing with transient conditions and varying boundary conditions. Analytical methods provide precise solutions under specific conditions and are essential for gaining insights into the underlying physical processes.

Several studies have addressed heat conduction in cylindrical and spherical geometries using integral transform methods, with applications spanning multiple fields. **Carslaw and Jaeger** et al [1]provided a foundational treatment of heat conduction in solid materials, which includes solutions for cylindrical geometries. **Ozisik**et al [6]extended the analytical methods to a variety of boundary conditions, including time-dependent heat conduction problems. **Debnath**et al [2]also provided a comprehensive treatment of integral transform techniques, including Hankel transforms, which have been applied extensively in heat transfer studies.

More recently, researchers such as **Yang et al.** et al [12] and **Ghandehari and Hashemi**et al [3] have used the Hankel transform in thermal studies related to hollow cylinders, focusing on both steady-state and transient heat conduction. Their work highlighted the versatility of the Hankel transform in providing analytical solutions that complement numerical approaches. Similarly, **Qi and Qian**et al [7]explored heat conduction in composite hollow cylinders, where different boundary conditions were applied, further demonstrating the importance of boundary condition choice in influencing the thermal behavior of cylindrical structures. **Sierakowskiand Navlekar, A. A., and Khobragade, N. W.** et al [8, 4] studied the direct problems of an exact solution to the elastic deformation of a finite length hollow cylinder is considered. **Timoshenko, S. P., &Goodier, J. N.** et al [10] studied on the fundamentals of elasticity theory, including thermal effects on elastic deformations, making it foundational for thermoelastic stress analysis in materials such as steel. **Nowacki, W. .**

et al [5] in this book offers a detailed discussion of the field of thermoelasticity and covers the derivation of stress-strain-temperature relations, providing the basis for the analysis of axial stress and displacement under thermal loads ND **Wu, X., & Hu, Z.** et al [11] worked on "Thermoelastic Coupling in Steel Components for Advanced Engineering Applications.

In this paper, we build on these foundational studies by deriving an exact analytical solution for the transient heat conduction in a hollow cylinder using the Hankel transform. We explore both first and second kind boundary conditions and discuss the physical interpretation of the results. This solution is expected to have applications in thermal engineering, especially in cases where hollow cylindrical structures are subjected to time-varying thermal loads.

2. Result required

The finite Hankel transform over the variable r and its inverse transform defined in [9] as,

$$\mathcal{H}\{f(r)\} = \tilde{f}(k) = \int_0^\infty rJ_0(kr)f(r)dr \qquad (2.1)$$

Where: $J_0(kr)$ is the Bessel function of the first kind and order 0,

k is the transform variable.

3. Formulation of the problem

Consider a hollow cylinder of length $2h$ occupying the space $D: a \le r \le b$, $-h \le z \le h$. The thermoelastic displacement function as in [9] is governed by Poisson's equation

$$\nabla^2\phi = \left(\frac{1+\nu}{1-\nu}\right)a_t T \qquad (3.1)$$

with $\phi = 0$ at $r = a$ and $r = b$. (3.2)

where $\nabla^2 = \frac{\partial^2}{\partial r^2} + \frac{1}{r}\frac{\partial}{\partial r} + \frac{\partial^2}{\partial z^2}$

ν and a_t are the Poisson's ratio and the linear coefficient of thermal expansion of the material of the cylinder and T is the temperature of the cylinder satisfying the differential equation

$$\frac{\partial T}{\partial t} = \alpha\left(\frac{1}{r}\frac{\partial}{\partial r}\left(r\frac{\partial T}{\partial r}\right)\right) \qquad (3.3)$$

Where α is the thermal diffusivity.

subject to the boundary conditions

$T(r_i, t) = T_i$ at the inner boundary $r = r_i$ is constant T_i. (3.4)

$T(r_n, t) = T_n$ at the outer boundary $r = r_n$ is constant T_n. (3.5)

$\frac{\partial T}{\partial r}(r_i, t) = q$ gradient at $r = r_i$ is constant q. (3.6)

$\frac{\partial T}{\partial r}(r_a, t) = q_v$ gradient at $r = r_a$ is constant q_v. (3.7)

The displacement function $u(r, t)$ due to thermal expansion is given by

$$u(r,t) = \frac{\alpha_T(1+\nu)}{E(1-2\nu)}\int_0^r \left(r'T(r',t)\right)dr' \qquad (3.8)$$

The radial stress $\sigma_r(r, t)$ is given by:

$$\sigma_r(r,t) = \frac{E}{1-\nu^2}\left(\frac{du(r,t)}{dr} - \frac{\nu u(r,t)}{r}\right) + E\alpha_T T(r,t) \qquad (3.9)$$

The axial stress $\sigma_z(r, t)$ under plane strain conditions, we have:

$$\sigma_z(r,t) = \frac{\nu E}{1-\nu^2}u(r,t) + E\alpha_T T(r,t) \qquad (3.10)$$

In cylindrical coordinates, thermoelastic relations link temperature $T(r, t)$ to mechanical displacements and stresses for an isotropic, homogeneous material. The key parameters are:

- Young's Modulus (E)
- Poisson's Ratio (ν)
- Coefficient of Thermal Expansion (α_T)

Given a temperature distribution $T(r,t)$, the displacement function $u(r,t)$, radial stress $\sigma_r(r,t)$, and axial stress $\sigma_z(r,t)$ can be derived.

The equations (3.1) to (3.10) constitute the mathematical formulation of the problem under consideration.

4. Solution of the problem

On applying the finite Hankel transform defined in Eq. (2.1) to Eq. (3.3), one obtain

$$k^2\tilde{T}(k,t) = -\frac{\partial \tilde{T}}{\partial t} \quad (4.1)$$

where $\overline{T}$ is the Hankel transform of T.

On solving Eq. (4.1) under the conditions given in Eq. (3.4) and Eq. (3.7), one obtains

After solving $\tilde{T}(k,t)$, apply the inverse Hankel transform to obtain the temperature distribution:

$$T(r,t) = \int_0^\infty kJ_0(kr)\tilde{T}(k,t)dk \quad (4.2)$$

Determination of Displacement

Substituting the values of $T(r,z)$ from Eq. (4.3) in Eq. (3.1) one obtains the themoelastic displacement function $u(r,t)$ as

$$u(r,t) = \frac{\alpha_T(1+\nu)}{E(1-2\nu)}\int_0^r \left(r'\int_0^\infty kJ_0(kr')\tilde{T}(k,t)dk\right)dr' \quad (4.3)$$

Differentiating $u(r,t)$ with respect to :

$$\frac{du(r,t)}{dr} = \frac{\alpha_T(1+\nu)}{E(1-2\nu)}\left(T(r,t) + r\frac{dT(r,t)}{dr}\right)$$

Substitute the displacement function $u(r,t)$ and temperature (r,t) :

$$\frac{du(r,t)}{dr} = \frac{\alpha_T(1+\nu)}{E(1-2\nu)}\left(\int_0^\infty kJ_0(kr)\tilde{T}(k,t)dk + r\int_0^\infty kJ_1(kr)\tilde{T}(k,t)dk\right)$$

So, the radial stress $\sigma_r(r,t)$ becomes:

$$\sigma_r(r,t) = \frac{E}{1-\nu^2}\left(\frac{\alpha_T(1+\nu)}{E(1-2\nu)}\left(\int_0^\infty kJ_0(kr)\tilde{T}(k,t)dk + r\int_0^\infty kJ_1(kr)\tilde{T}(k,t)dk\right) - \frac{\nu u(r,t)}{r}\right) + E\alpha_T\int_0^\infty kJ_0(kr)\tilde{T}(k,t)dk \quad (4.4)$$

Substitute the displacement function $u(r,t)$ and temperature $T(r,t)$in eq.

$$\sigma_z(r,t) = \frac{\nu E}{1-\nu^2}\frac{\alpha_T(1+\nu)}{E(1-2\nu)}\int_0^r\left(r'\int_0^\infty kJ_0(kr')\tilde{T}(k,t)dk\right)dr' + E\alpha_T\int_0^\infty kJ_0(kr)\tilde{T}(k,t)dk \quad (4.5)$$

The equations (4.3), (4.4) and (4.5) the displacement function $u(r,t)$, radial stress $\sigma_r(r,t)$, and axial stress $\sigma_z(r,t)$ to the Hankel-transformed temperature distribution $\tilde{T}(k,t)$.

Special Case and Numerical Results

Using typical steel body of the cylinder having properties: Young's Modulus: $E = 210 \times 10^9$Pa , $\nu = 0.3$, $\alpha_T = 12 \times 10^{-6}$°C^{-1}

For a uniform temperature of 20°C, if the reference state is 20°C, there will be no thermal stresses due to temperature change. However, for a temperature change $\Delta T = T(r,t) - 20°C$, we can compute stresses and displacements.

$$u(r,t) = 8.57 \times 10^{-14} \int_0^r r'T(r',t)dr'$$

$$\sigma_r(r,t) = 230 \times 10^9 \left(\frac{du(r,t)}{dr} - \frac{0.3u(r,t)}{r}\right) + 2.52 \times 10^6 T(r,t)$$

$$\sigma_z(r,t) = 69 \times 10^9 u(r,t) + 2.52 \times 10^6 T(r,t)$$

These equations will provide specific values for displacement, radial stress, and axial stress when $T(r,t)$ is defined.

Concluding Remarks:

In this paper, we have discussed the steady-state thermoelastic problem for a finite length hollow cylinder on upper plane surface where as arbitrary heat is applied on the upper surface and lower surface of the cylinder.

The peak axial stress $\sigma_2(r,t)$ occurs in regions where both temperature and displacement are maximized.The thermal term contributes a constant factor of $2.52 \times 10^6 T(r,t)$, which means that for every degree increase in temperature, the axial stress increases by 2.52×10^6Pa.

The combined effect of displacement and temperature on the axial stress is non-linear.

The axial stress depends strongly on both mechanical deformation (displacement) and thermal expansion (temperature).

The finite Hankel transform technique is used to obtain the numerical results. The thermoelastic behavior is examined such as unknown temperature, displacement and stresses that are obtained can be applied to the design of useful structures or in engineering applications. Also any particular case of special interest can be derived by assigning suitable values to the parameters and functions in the expressions [4.3], [4.4] and [4.5].In real-world applications, changes in temperature would lead to varying axial stresses in steel components, with higher stress concentrations where both displacement and temperature are high.

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Study of Electrical Behaviour and Spectral Emission of Molecules in The Interface of Solid and Liquid

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Abstract:

Measurement of the intensity of radiation emitted by dc glow discharge as a function of discharge current carried out for the different electrolytes along with V-I characteristics. The voltage-ampere characteristics during a glow discharge in the atmospheric pressure gas using an electrolytic solution as the anode and metal electrode like tungsten as a cathode were carried out. Under the study of glow discharges of various elements, a monochromatic light at various wavelengths generated. Few species shows a change in the color of the glow when discharge current increased. Investigated the negative resistance of different electrolytic solutions. This behavior investigated as tunneling behavior of electrolytic solution using DC glow discharge. The dc glow discharge spectrometry is the most essential part of the electrical and spectral emission studies of the molecules, atoms and ions in the interface of solid and liquid.

Keywords: *Monochromatic, tungsten, negative resistance, emission, metal, discharge*

Introduction:

Phenomenon of discharge of electricity through the study of property of ionized gases has proved to be fruitful for the investigation. DC glow discharge with liquid electrodes have wide practical applications due to its simple technique. Electrical and spectral characterization of the glow discharge[1-7] of the material helps in studying the chemical composition of the material. The neutral atoms, ionized atoms and molecules are excited and they emit characteristic spectrum and hence atomic, ionic or molecular species may be identified. Spectral study of the glow discharge [3, 4, 7,] of the material helps in studying the chemical composition of the material. The plasma parameters in DC glow discharge may be generated by a current source [8].The method is very low cost and quick results may be obtained and therefore has wide applications. When electric discharge is passed to a conducting solution from an electrode, which is placed in the gas space above the liquid surface, reactions take place in the liquid phase and the process is referred to as "Glow Discharge Electrolysis (GDE)". Traditionally [9] dc-glow discharge optical emission spectroscopy is mainly applied in the materials sciences where it is used for bulk and surface analysis, pellets containing the adsorbed liquid and direct analysis of the liquid samples by use of adequate sample introduction techniques. With this background of dc glow discharge system, in this paper a little attempt has been made to study the electrical and spectral characterization of dc glow discharge of the material at the interface of solid and liquid which helps in studying the chemical composition of the material.

Material and Methods:

The experimental arrangement used for the investigation of dc glow discharge is simple and. It is inexpensive arrangement and it is very much cost effective as shown in figure 1. It consists of tungsten electrode of length 40 mm and diameter 3mm fused in glass capillary tube and suspended axially in a hollow slotted stainless steel cylinder, of length 6 cm and internal diameter 2.54 cm. The depth of immersion of the tungsten electrode in electrolyte solution could be adjusted with the help of micrometer adjustable stand. In this way the solution itself acts as another electrode.

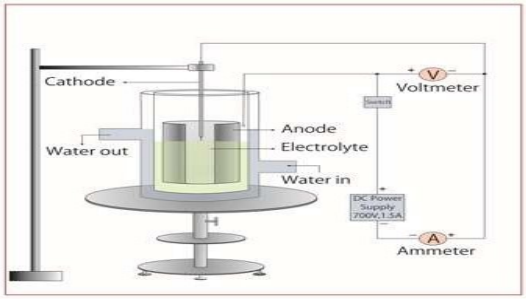


Fig. 1: Experimental arrangement

Result and Discussions:

Variation of electrolytic current with the applied dc-voltage during glow discharge in atmospheric pressure gas using 28 electrolytic solutions as the anode and cathode were carried out. The colors emitted on the glow are observed and listed in table 1. As an example we consider the electrolytic aqueous solution of 0.5N Cd $(NO_3)_2.4H_2O$ as the anode, the electrolytic process leading to a luminescent glow is best depicted by the standard voltage-current curve as shown in figure 2. In the region AB the curve is almost linear, the Ohms law is satisfied and conventional electrolysis found with tiny bubbles of gas around both material electrodes-tungsten electrode and stainless steel electrode. At the voltage corresponding to point B in curve, a smooth evolution of gas bubbles is disturbed and layer of steam is seen at the tungsten cathode. In the region between B and C, the pointer of voltmeter and ammeter widely fluctuates. In this region the characteristics like current passing through the electrode and voltage applied found as unstable. The behavior of region BC,CD and DE can be explained as follows. Because of increase in the applied dc voltage, the rate of gas evolution is increased with the formation of large size gas bubbles at a fast rate. This decreases the rate of migration of the ions and charge transfer process at the electrodes. When voltage is further increased more fluctuations are obtained in both voltage and current readings with fall in current. This unstable decreased current is shown by line BC. In the neighborhood of point C it is found that fluctuation rate decreases and now hissing sound occurs. When the applied dc voltage reaches to the point C, there is intermittent sparking. The formation of gas bubbles around the tungsten electrode has now stopped. After increasing the applied dc-voltage to a still higher value the formation of movable thin vapor film around the tungsten cathode takes place, which at times produces the vortex motion and visible glow spark of greenish-blue color is found in the gap between cathode and solution phase. Due to vortex motion, electrolyte periodically touches to the tungsten cathode surface. This produces local heating at the tungsten cathode surface and visible glow spark of bluish-green color. Due to the local heating process there produces the vapor jet and nearby liquid molecules tried to take its place. The region CD of V- I characteristics shows this situation. Thus the region B to C represents the negative slope as seen in the curve. When the electrolyte current decreases to the corresponding point D, the violent gas evolution stops and slope of the curve changes Sign from negative to positive. After the point D, with the applied dc voltages the current starts increasing and thereby producing a stable superheated insulating layer around the cathode (tungsten electrode). At this situation a continuous bluish-green glow is developed at the cathode surface. For a further increase in applied dc voltage, the intensity of the glow increases continuously with the increase in current also as shown in figure 2. Thus the region beyond D i.e. along DE appears to be true glow discharge. This happens due to the discharge of accumulated ions through the insulating layer. This situation produces intense glow of bluish-green color and it sometimes can be pictured as corona discharge. Thus under the observation, it is quite obvious that the superheated insulating layer around the cathode is the governing factor responsible for the bluish-green glow.

Thus the resistance offered by the electrolyte within the negative-resistance section of its characteristic (shown in figure as shaded) during glow discharge is the reciprocal of the slope of V-I characteristic in this region.

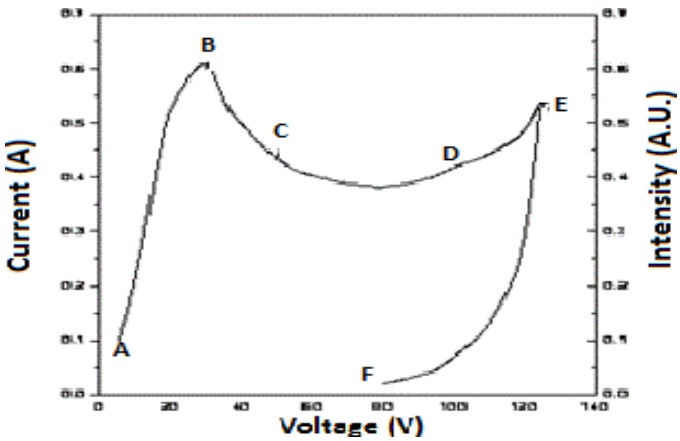


Fig.2:V-ICharacteristicsof0.5N Solution of Cd (NO3)2.4H2O

Conclusion:

DC Glow discharge using electrolytic solution as the anode and the metallic electrode as the cathode for the study of glow discharge in the atmospheric pressure gas which leads to the investigation of phenomenon of spectrometry shows that, a sensitive and inexpensive technique for the elemental analysis of electrolytic solutions.

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Synthesis and Characteristics Study of Nano-Sized (CaO)

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Abstract:

Inorganic CaO nano-powders were synthesized by citric acid sol-gel The prepared samples were characterized by X-ray powder diffraction (XRD) for structural studies and the average particle size was calculated by Debye-Scherrer formula and it's found to be 32.1nm indicate very good cubic structure of CaO nano particles. In XRD spectral corresponding to the plane 111, 200, 220,311,222 nm by citric acid sol-gel method respectively, when nano powder absorbed UV radiation at 200 nm. However, the spectra show clearly an intense band to band absorption in the ultraviolet region citric acid sol-gel method respectively.

1.Introduction

Nanomaterials have emerged as an amazing class of materials that consists of a broad spectrum of examples with at least one dimension in the range of 1 to 100 nm. Exceptionally high surface areas can be achieved through the rational design of nanomaterials. Nanomaterials can be produced with outstanding magnetic, electrical, optical, mechanical, and catalytic properties that are substantially different from their bulk counterparts [1]. Carlos Loyo and *et al* describes the antimicrobial and photodegradation properties of CaO nanocomposites [2]. Mehdi Ranjbar and *et al* reported in his article that first time, calcium oxide (CaO)/polylactic acid nano scaffolds synthesized by co-precipitation assistant reverse micelles method. The physical and chemical (physicochemical) properties of the structures as dental resin composites were also studied [3]. As per the literature studied, in this article we are trying to synthesized nano sized CaO powder and study the structural and optical properties.

2.Experimental Procedure

Citric Acid Sol – Gel Method: The citric acid sol – gel method is a variation of the sol – gel method that involves the use of citric acid as a gelatine agent to form a metal – citrate complex. Here is a general overview of the citric acid sol -gel method for synthesizing calcium oxide:

Material needed:

1. Calcium chloride ($Cacl_2$)
2. Citric acid ($C_6H_8O_7$)
3. Ethanol (C_5H_5OH)
4. Heat source (e.g. hot plate, furnace)

Procedure:

1. Dissolve calcium chloride in distilled water to create a clear solution.
2. Add citric acid to the solution and stir until homogeneous mixture is obtained.
3. Heat the solution on hot plate to evaporate excess water and create a viscose gel.
4. Add ethanol to the gel and stir until a homogeneous mixture is obtained.
5. Heat the mixture at low temperature (e.g. 80° C) to evaporate excess ethylene glycol and promote gelation.
6. Heat the gel at high temperature (e g. 600°C- 800°C) in furnace to promote the formation of calcium oxide. The heating process should be slow to prevent cracking or wrapping of the substrate.

Flow chart for synthesis of CaO by citric acid sol gel method is shown in fig-1.

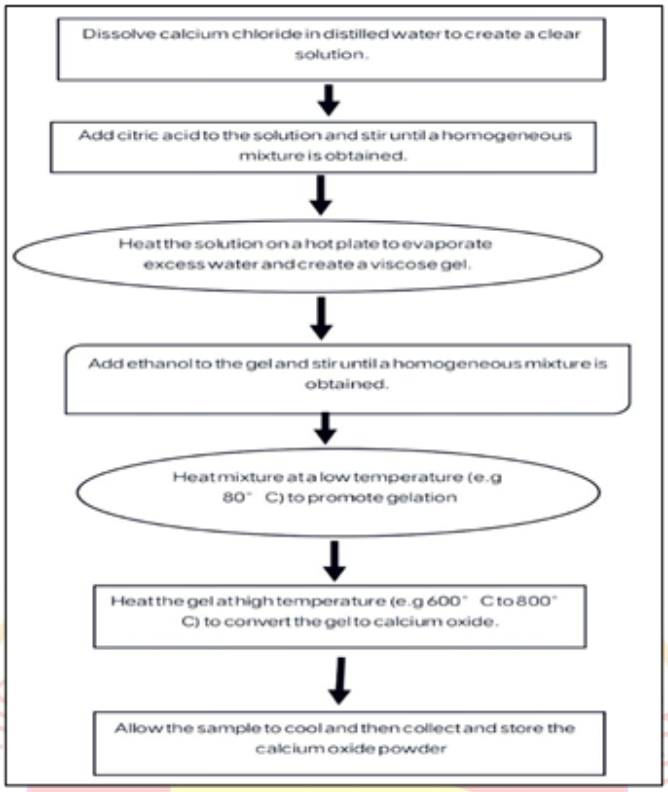


Fig.-1: Flow chart for synthesis of CaO by citric acid sol gel method

3.Result And Discusions

3.1 X-Ray Diffraction (Xrd) Analysis:

X-ray diffraction pattern of synthesized Cao sample is showing the cubic structure. The typical peak 35, 35.5, 55, 65, 65.5 in the XRD spectral corresponding to the plane (1 1 1), (2 0 0), (2 2 0), (3 1 1), (2 2 2), (4 0 0), (3 3 1) are in the good agreement with the cubic structure with a=4.899 b=4.899 c=4.899 d=4.899 of CaO comparing with ICCD card No.01-084-1263 as shown in fig. 2. The broadening of peak was observed which implies that the size of nano particles is small. The size of NPs was calculated using Debye Scherrer formula using peak (200) and it is found to be 32.1 nm.

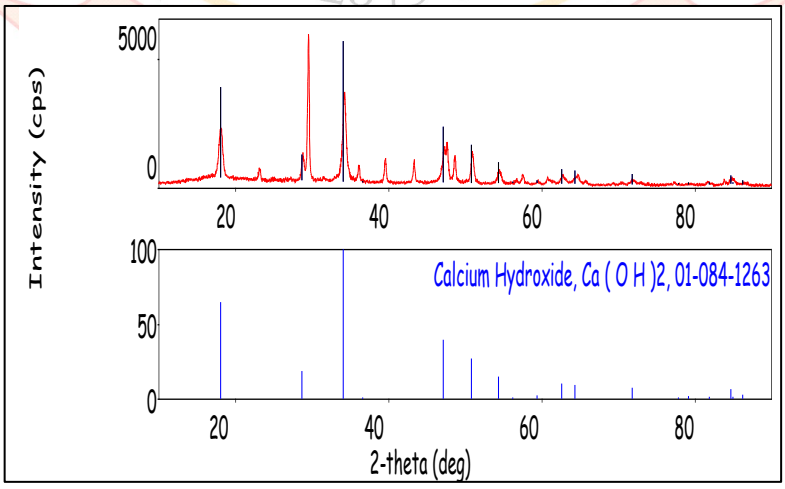


Fig.2: XRD pattern of the nano sized calcium oxide (CaO) powder synthesized by citric acid sol-gel method.

3.2 UV–Visible Analysis

UV–visible absorption spectrum of calcium oxide (CaO) by citric acid sol-gel method as shown in fig.-3. The spectra show clearly an intense band-to-band absorption in the ultraviolet region. The UV–Visible spectrum shows absorption at about 200 nm wavelength as shown in fig 3a. The band gap value was determined by

extrapolation of the linear portion of (α h ν) plotted versus the photon energy (h ν) in electron volt (eV) shown in fig 3b. The band gap from the graph was found to be E.g. = 5.4 eV by citric acid sol-gel method. The value obtained very much supports the semiconducting behaviour of the material. It shows that the band gap of nano-sized CaO powder citric acid sol-gel method increases with decreasing the particle size.

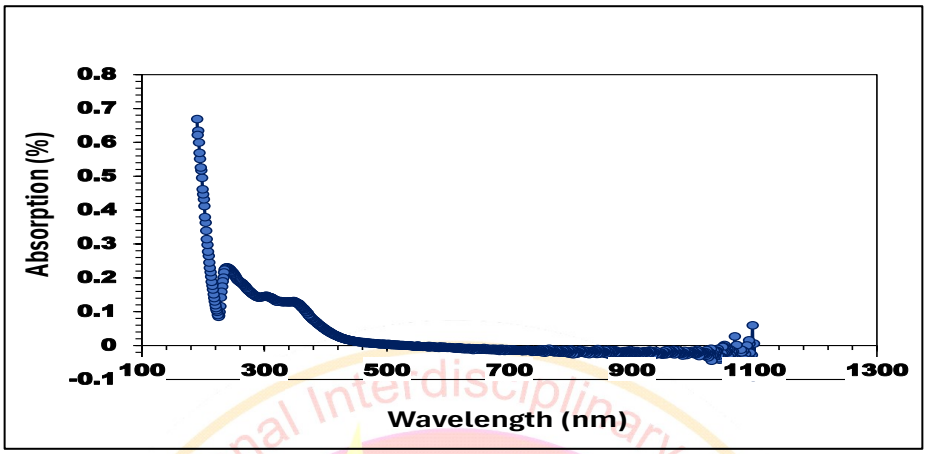


Fig.3a: UV-visible spectra of nano-sized CaO powder synthesized by citric acid sol-gel method

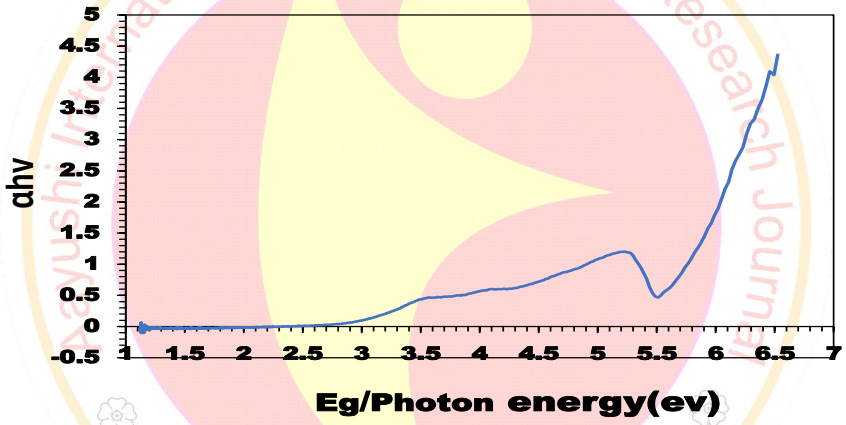


Fig. 3b: Graph between absorption ν|/s wavelength

4.Conclusion:

CaO nanoparticles are successfully synthesized by citric acid sol-gel method. Identify the average participle size and crystal structure using the x-ray diffraction pattern and the particle size is found to be 32.1 nm indicates very good cubic structure of CaO nano particles. The material exhibits a good UV absorption at 200 nm and the band gap from the graph was found to be 5.4 eV. The prepared material may possibly find applications as ceramic, sensing, and biocompatible materials.

Acknowledgments:

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Modernizing Financial Crime Detection: An in-Depth Review of Machine Learning Techniques For Unauthorized Transactions And Money Laundering

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Abstract.

The detection of unauthorized financial transactions and identification of money laundering activities have become critical challenges in the financial industry. This review paper investigates the existing methodologies for detecting such activities and explores how advanced data mining along with machine learning models can be employed to enhance detection accuracy. By analyzing the strengths and weaknesses of traditional methods, this paper identifies gaps and proposes a novel approach that integrates machine learning techniques to develop a more robust detection system. Furthermore, the paper evaluates the proposed model against existing techniques and discusses its potential for real-time deployment in financial institutions. The focus is on the application of supervised learning models, including Random Forests as well as Support Vector Machines, in conjunction with anomaly detection algorithms. Through a comprehensive analysis, this paper contributes to the ongoing efforts to combat financial fraud and money laundering by offering insights into the creation of more powerful and efficient detection systems.

Keywords: Money Laundering, Machine Learning, Crime detection, Anomaly Detection.

1 Introduction

In the modern financial landscape, the detection of unauthorized transactions and the identification of money laundering activities have emerged as significant challenges. With the rapid advancement of financial technologies and the increasing complexity of financial transactions, traditional detection methods, primarily rule-based systems and statistical models, have struggled to keep pace. These conventional approaches often generate numerous false positives, lack adaptability, and fail to address emerging fraud tactics effectively. The rise of digital banking and online financial services has exacerbated these issues, as the volume and diversity of transactions continue to grow. Consequently, financial institutions are facing unprecedented risks related to fraud and illicit activities. Money laundering, in particular, poses a severe threat by enabling the concealment of illegal activities, which undermines the integrity of the global financial system. To address these challenges, there is a pressing need for innovative solutions that leverage advanced technologies.

2 Literature Review

A variety of approaches and techniques have been explored in the literature to counter money laundering and terrorism financing. Labib et al. [1] conducted an extensive an overview of machine learning used in anti-money laundering (AML) techniques to counter terrorism financing. Their work provided a comprehensive overview of various machine learning methods, effectiveness of these approaches in identifying suspicious activities was analyzed. Liu et al. [2] proposed a suspicious transaction detection model based on scan statistics, aimed at enhancing AML efforts in financial institutions. This model was designed to identify anomalous patterns within financial transactions, and its effectiveness in real-world scenarios was evaluated. Kute et al. [3] reviewed the use of explainable artificial intelligence (XAI) and deep learning methods in money laundering detection. The critical aspects of how these advanced AI techniques could improve detection accuracy and transparency in AML processes were discussed, emphasizing the role of XAI in making the decision-making process more interpretable.

Wang, Zhao et al. [4] investigated the impact of soft information in expert ratings on curbing information asymmetry, particularly within the contexts of crowdfunding and Initial Coin Offerings (ICOs). Their findings provided insights into how non-traditional data could be leveraged to detect financial discrepancies in emerging financial technologies. Fletcher et al. [5] explored the regulatory implications of cryptocurrency, particularly Bitcoin, in countering money laundering and terrorist financing. The risks

associated with the anonymity of cryptocurrency transactions. A wide array of research has been conducted on the detection and prevention of money laundering and terrorism financing, focusing on both traditional and advanced technological approaches. The concept of "Regulatory Technology" (RegTech) in preventing money laundering within both Islamic and conventional banking sectors was explored by Turki et al. [6]. Their study underscored the critical role of RegTech in enhancing compliance and mitigating risks associated with financial crimes.

Rocha-Salazar et al. [7] employed neural networks coupled with an abnormality indicator to detect money laundering and terrorism financing. The financial repercussions faced by institutions penalized for violating anti-money laundering were examined by Gowin et al. [8]. Their research provided empirical evidence of the negative impact on firm value, thereby highlighting the importance of strict regulatory adherence. Giudici et al. [9] utilized classification tree models to detect money laundering transactions. Machine learning techniques for early detection of money laundering schemes were investigated by Jullum et al. [10]. Their study demonstrated the effectiveness of various ML algorithms in enhancing the detection capabilities of AML systems, thereby contributing to the field's understanding of algorithmic applications in financial security. Çemberci et al.

Table 1. Comparative analysis.

Author Names	Title	Methods/Innovation	Challenges
Labib et al. [1]	Survey of Machine Learning Approaches of Anti-money Laundering Techniques to Counter Terrorism Finance	Extensive survey of machine learning approaches in AML;	Complexity of integrating diverse machine learning methods into existing AML systems
Liu et al. [2]	A Scan Statistics Based Suspicious Transactions Detection Model for Anti-money Laundering (AML) in Financial Institutions	Proposed a detection model using scan statistics to identify anomalous patterns in financial transactions	Real-world applicability and scalability of the scan statistics model
Kute et al. [3]	Deep Learning and Explainable Artificial Intelligence Techniques Applied for Detecting Money Laundering–A Critical Review	Reviewed deep learning as well as XAI techniques for AML; discussed improvements in detection accuracy and transparency	Implementing XAI for better interpretability while maintaining detection accuracy
Wang, Zhao et al. [4]	Does soft information in expert ratings curb information asymmetry?	Investigated impact of soft data in professional evaluations on curbing information asymmetry;	Applying findings to diverse and evolving financial technologies
Fletcher et al. [5]	Countering money laundering and terrorist financing: A case for bitcoin regulation	Explored regulatory implications of cryptocurrency in AML;	Mitigating risks associated with the anonymity of cryptocurrency transactions

2.1 Objectives

1. **Investigate existing methods**: The first objective is to explore and critically analyze the current methodologies employed for unauthorized financial transaction detection and money laundering

identification. This involves understanding the limitations of traditional rule-based systems and the challenges they face in the evolving financial landscape.

2. **Develop a data mining and machine learning model**: The second objective is to propose the development of a sophisticated data mining along with machine learning model designed in order to identify illicit transactions as well as potential money laundering activities. The focus will be on using machine learning techniques that are able to get knowledge from historical data and improve over time.
3. **Evaluate performance and accuracy**: The third objective is to assess the performance and accuracy of the proposed model by comparing it with existing methods. This involves conducting rigorous testing and validation using real-world financial data.

2.2 Importance

The importance of detecting unauthorized financial transactions and identifying money laundering cannot be overstated in today's global economy. With the rise of digital banking and online financial services, financial institutions face increasing risks of fraud and illicit activities. Money laundering, in particular, is a significant threat as it facilitates the concealment of illegal activities, including drug trafficking and terrorism financing, undermining the integrity of the financial system.

2.3 Motivation

The motivation behind this review paper stems from the growing concern over the inadequacy of traditional methods in detecting unauthorized financial transactions and identifying money laundering activities. As financial crimes become more sophisticated, Innovative strategies that can keep up with the ever-evolving techniques used by con artists are desperately needed. The increasing volume of financial transactions, especially in the digital space, has made it challenging for conventional rule-based systems to identify anomalies effectively.

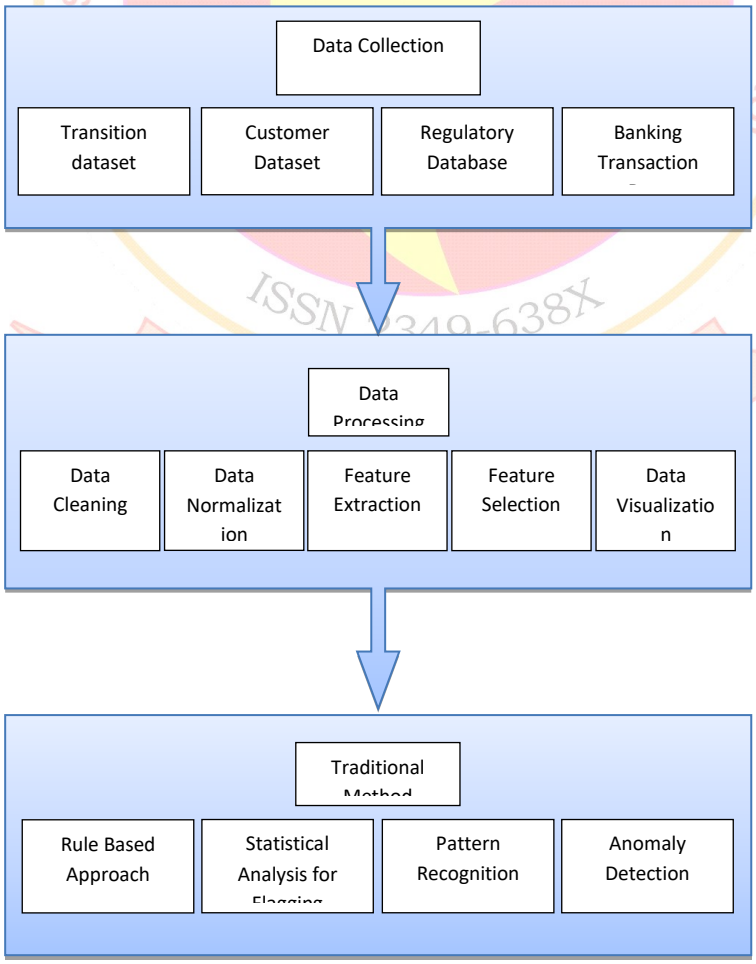


Fig. 1. Flow Diagram of Proposed Architecture.

The provided flowchart outlines a comprehensive process for detecting unauthorized financial transactions and potential money laundering activities. It begins with Data Collection, involving various datasets including transaction, customer, regulatory databases, and banking transaction data. Next, Data Processing occurs, encompassing data cleaning, normalization, feature extraction, selection, and visualization to prepare the data for analysis. The next stage is Traditional Methods, which include rule-based approaches, statistical analysis for flagging, pattern recognition, and anomaly detection.

2.4 Traditional Methods Implementation

Traditional methods for detecting unauthorized financial transactions and money laundering primarily rely on rule-based systems and statistical models. These methods, while foundational, have significant limitations in their ability to adapt to innovative along with evolving patterns of financial crime.

1.Rule-Based Systems:

- Rule-based Systems are made to identify and flag transactions that match specific predefined criteria, including transactions exceeding a specific amount either occurring in high-risk regions.
- Limitations: These systems are inflexible and can generate excessively high false positive rate, which causes inefficiency in detection process.

2.Statistical Models:

- Statistical models utilize historical transaction data to identify outliers or anomalies that deviate from normal behavior.
- Limitations: They often struggle with the dynamic nature of financial transactions and may not account for new types of fraud.

3.Manual Audits:

- Manual audits involve human analysts reviewing flagged transactions to determine if they are indeed suspicious.
- Limitations:This procedure is labour-intensive, time-consuming, and susceptible to human error.

These traditional methods, while useful in the past, have become increasingly inadequate in addressing the complexities of modern financial transactions. As criminals develop more sophisticated techniques, the need for more advanced, adaptive, and intelligent systems becomes apparent.

2.5 Types of Machine Learning Models Used

In response to the limitations of traditional methods, several models for machine learning have been developed and implemented for detecting unauthorized financial transactions and identify potential money laundering activities. These models leverage historical data to increase the precision of detection and decrease false positives.

1. *Supervised Learning Models:*
   - **Random Forests:** A technique for ensemble learning that constructs several decision trees and combines them to get predictions that are more reliable and accurate.
     Advantages: High precision and capacity to manage big datasets.
     Challenges: Can be computationally intensive, risk of overfitting.
     Support Vector Machines (SVMs): A model that determines the ideal hyperplane to divide various classes of transactions.
     Advantages: Effective in high-dimensional spaces, robust to outliers.
     Challenges: Requires careful tuning of parameters, can be slow in large datasets.
2. *Unsupervised Learning Models:*
   Anomaly Detection Algorithms: Models that identify transactions that significantly deviate from the norm.
   Advantages: Useful in detecting new types of fraud, less dependent on labeled data.
   Challenges: High sensitivity to the definition of "normal," risk of false positives.
3. *Semi-Supervised Learning Models:*
   Self-Training Algorithms: A method where the model iteratively retrains itself with its own predictions as additional training data.

Advantages: Can improve detection performance with limited labeled data.
Challenges: May propagate errors in predictions, leading to model drift.

4. Advantages

1 **Improved Accuracy:** Machine learning models, especially ensemble added with deep learning methods, greatly increase the precision of detecting fraudulent transactions compared to traditional methods.

2 **Real-Time Detection:** These models can operate in real-time, providing immediate alerts to suspicious activities, which is critical in preventing unauthorized transactions.

3 **Scalability:** Machine learning models can easily scale to handle substantial amounts of transaction data, making them appropriate for large financial institutions.

5. Challenges

1 **Data Quality:**
Both the quantity and quality of the training data have a significant impact on how well machine learnin g models function., which can be a significant challenge.

2 **Computational Complexity:** Some models, particularly deep learning networks, require substantial computational resources, making them expensive to implement.

3 **Interpretability:** Many machine learning models, especially neural networks, function as black boxes, making it challenging to interpret their decisions.

6. Features

1**Anomaly Detection:** Machine learning models can effectively detect anomalies in transaction data, which is crucial for identifying unauthorized transactions.

2**Continuous Learning:** These models can continuously learn from new data, improving their detection capabilities over time.

3**Pattern Recognition:** Machine learning models possess a strong ability to identify intricate patterns in transaction data, which is essential for detecting sophisticated fraud schemes.

Conclusion

The evolution of financial crime detection necessitates a departure from traditional rule-based and statistical methods toward advanced machine learning techniques. Traditional approaches, including rule-based systems and statistical models, have proven insufficient in addressing the intricacy and fluidity of modern financial transactions. They often suffer from limitations including inflexibility, high false positive rates, and slow adaptation to emerging fraud patterns. In contrast, machine learning models—encompassing supervised, unsupervised, semi-supervised, and deep learning methods—offer significant advantages in detecting unauthorized transactions and money laundering. These models improve accuracy, enable real-time detection, and adapt to evolving fraud tactics, making them indispensable tools for contemporary financial institutions.

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Synthesis of ZnO Nanoparticles by Sol-Gel Method

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Abstract: -
In this study, Zinc Acetate dihydrate $Zn(CH_3COO)_2.2H_2O$ and NaOH were used as raw materials to synthesize ZnO nanoparticles by sol-gel method. The synthetic process and properties of nano-powder ZnO was studied by X-ray diffraction, Thermogravimetric Analysis and Transmission Electron Microscopy. The product was sphere-shaped particle with good dispersity.
Keywords - *ZnO , Sol-gel Method , XRD ,TGA, TEM*

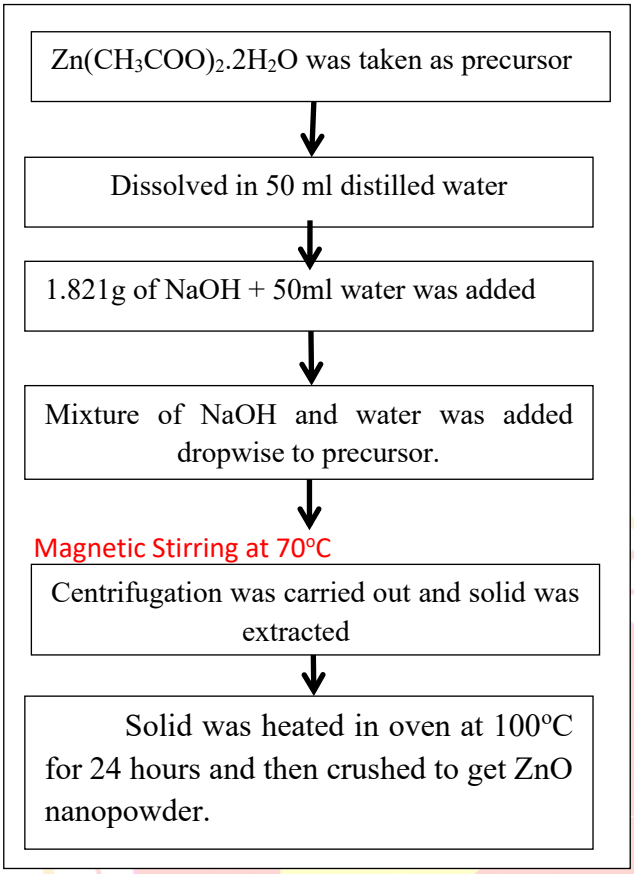
Introduction

Due to novel properties like high refractive index, binding energy, high thermal conductivity, antibacterial and UV protection of ZnO, it could be used in many materials and products.[1] ZnO crystallizes in the typical wurtzite hexagonal structure where oxygen and zinc atoms are spatially arranged in a way that O atoms are arranged in a closed hexagonal structure, while the Zn atoms occupy the centre of the distorted tetrahedron structure [2].

One of the biggest advantages of the sol-gel method is that it doesn't require high temperatures for synthesis. The other advantage of this method is it can easily shape materials into complex geometries in a gel state. It can produce high purity products as the organometallic precursor of the desired ceramic oxides can be mixed, dissolved in a specified solvent, and hydrolyzed into a sol and then into a gel [3].Zinc oxide has high biocompatibility and fast electric transfer kinetics, such phenomena encourage the use of this material as a biomimic membrane to immobilize and modify the biomolecules [4] The ZnO is insoluble in water and ethanol but is soluble in dilute mineral acids and is a fine powder, white or slightly yellow. In large quantities and high purity it is recommended for use in the pharmaceutical, food and cosmetic industries [5].Semiconductor zinc oxide (ZnO) nanoparticles have attracted much attention because of their interest in fundamental study and also their applied aspects such as in solar energy conversion, varistors, luminescence, photocatalysis, electrostatic dissipative coating, transparent UV protection films, and chemical sensors[6-9]. Various methods such as thermal decomposition, chemical vapor deposition, sol gel, spray pyrolysis, and precipitation have been developed for the fabrication of nanosized ZnO particles with uniform morphology and size [10-14]

Experimental Details / Analysis

Every chemical used was of analytical grade. A certain amount of Zinc Acetate dihydrate $Zn(CH3COO)_2.2H_2O$ was dissolved in 50 ml distilled water. Then about 1.8 g of NaOH was dissolved in 50ml distilled water and stirred using magnetic stirrer for half hour. Mixture of NaOH and water was added dropwise to precursor with constant stirring at 70°C. After that a solid creamy white coloured solid was obtained and it was then centrifuged 3 times in water for 10 minutes each. The solid was then extracted from the solution and then was placed in oven for 24 hours at 100°C and then crushed to obtain a fine powder.



X-ray Diffractometry (XRD) Analysis

Fig 1 shows XRD pattern of synthesized nano-powder after combustion. The peaks were observed at 31.72°, 34.34°, 36.36°, 51.23°, 56.54°, 62.84°, 66.592° and 68.276°. The crystalline size calculated according to debye scherrer formula was found out to be 8.528908072 nm.

It can be seen that the XRD data is agreeable with the standard diffraction chart of ZnO in JCPDS 00-036-1451, indicating the ZnO phase has good crystalline structure but some impurities were observed.

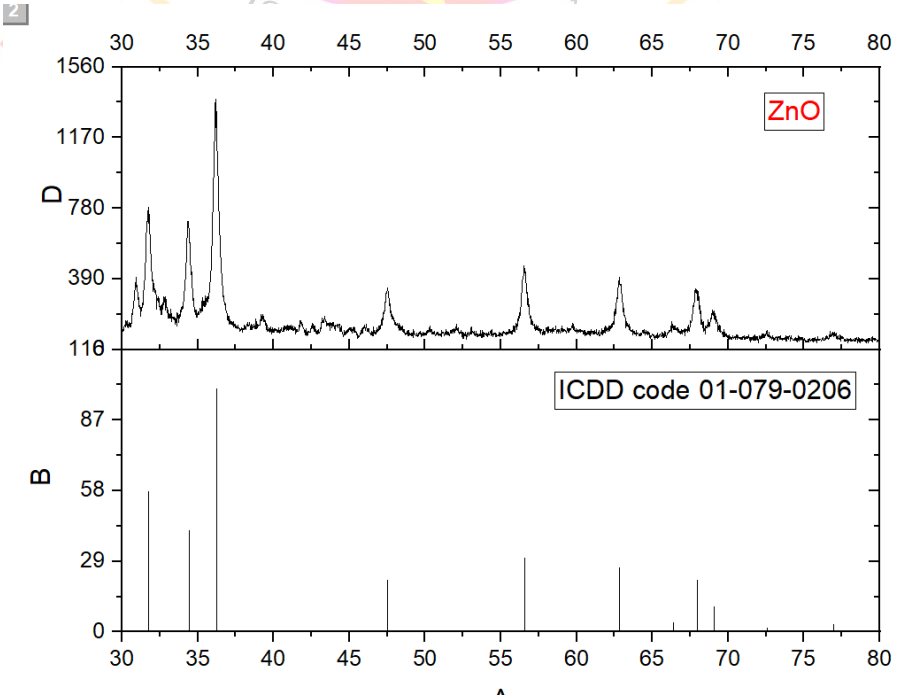


Fig 1 - XRD pattern of synthesized ZnO nano-powder after combustion.

TEM Analysis

TEM analysis was carried out to confirm the actual size of the particles, their growth pattern and the distribution of the crystallites. Figure 2 shows the as synthesized TEM image of sphere-like shaped of ZnO nanoparticles.

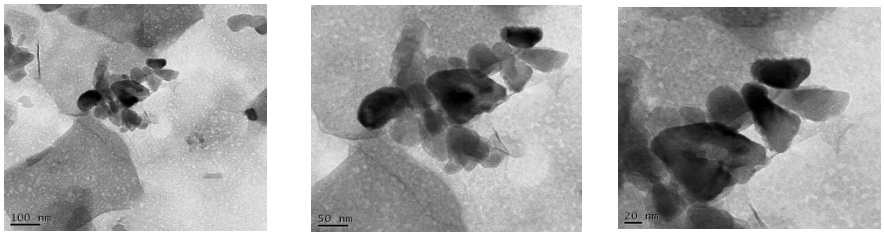


Fig 2 - TEM images of the as-prepared ZnO nanoparticles.

TGA Analysis

Figure 3 shows TGA thermogram as a function of temperature in the range from 30ºC to 900ºC of ZnO nanoparticles.

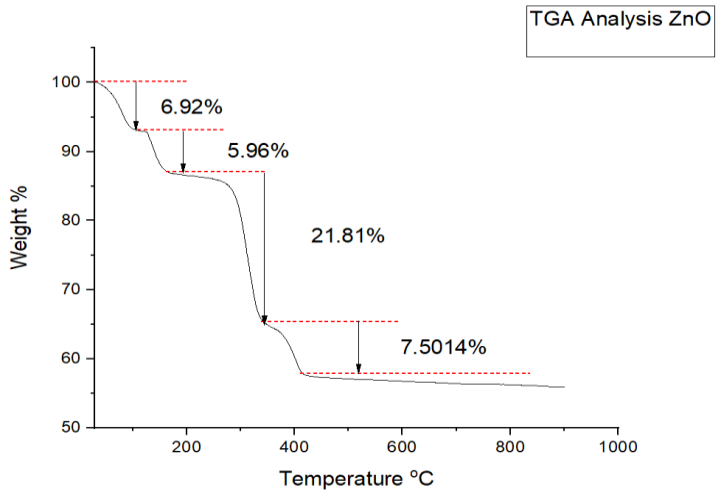


Fig 3 - TGA Analysis of ZnO nanoparticles

It is clear from Figure 9 that all samples have three steps of de- composition. The lower values of percentage weight loss, in the first decomposition the evaporation of moisture. The second de- composition region in TGA curves which cover a wider temperature range including the melting point of ZnO have a percentage weight loss (5.96%) . The latter process in TGA curves which is the main decomposition step have a more significant percentage weight loss.(21.81%).

Conclusion-

In the present study, it is found that sol gel can be a good method for the synthesis of zinc oxide nanoparticles.. The obtained ZnO was characterized through XRD, TEM and TGA analysis.It can be observed that the ZnO nanoparticles have an almost-spherical shape with small agglomeration.The average crystalline size was 8.52 nm. The thermal analysis results of the ZnO nanoparticles indicate that they possess thermal stability up to a temperature of 300ºC.

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Topological Data Analysis and Detection of Brain Anomalies Using Machine Learning

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Abstract-

The detection of brain anomalies, such as tumours or neurodegenerative disease markers, is a critical challenge in medical imaging and diagnostics. Traditional machine learning methods often struggle to capture the complex, multi-scale structures present in brain imaging data. This presentation demonstrates the application of Topological Data Analysis (TDA) to enhance machine learning models for brain anomaly detection in brain artery trees.. We leverage the power of TDA to extract topological features from brain scans, which improve model robustness and interpretability. Our study shows how TDA can detect subtle patterns in MRI, MRA,CT, and fMRI data that are often missed by conventional methods, leading to more accurate and reliable diagnostic tools.

Keywords: Machine Learning, Topological Data Analysis, Brain Artery Trees

1.Introduction-

The technique known as Topological Data Analysis (TDA) has shown promise in improving the identification of brain anomalies. TDA is a mathematical framework for studying the structure and form of data at various scales by utilizing ideas from algebraic topology. TDA offers a reliable, multi-scale representation of the data's underlying topological features, such as loops, voids, and connected components, in contrast to conventional feature extraction techniques. These characteristics can be used as distinguishing markers for aberrant brain structures when they are obtained via methods such as persistent homology. In order to enhance the identification of brain abnormalities in medical imaging, this research explores the integration of TDA with machine learning algorithms. Our proposal is a unique framework that blends the latest machine learning techniques with TDA-derived features to produce diagnostic tools that are easier to understand and more precise. We evaluate our method on

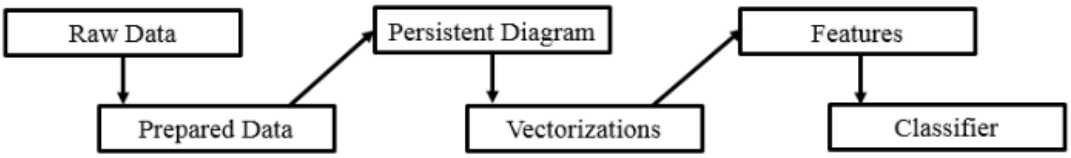


Fig1: General Topological pipeline

multiple datasets, such as MRA, fMRI, CT, and MRI images, to show its efficacy in detecting subtle patterns related to brain anomalies that are commonly missed by traditional techniques. The findings demonstrate how TDA may greatly improve model performance through increases in sensitivity, specificity, and overall accuracy, which makes it an invaluable tool for medical imaging and diagnostics.

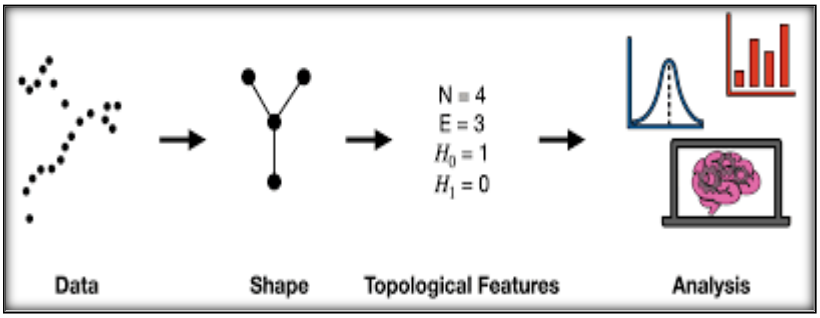


Fig2: Workflow for applying TDA

2.Point Cloud Data -

Persistent homology is a procedure for calculating topological characteristics of data with increasing spatial resolutions. A point cloud is used to represent the input data for the computation of persistent homology.

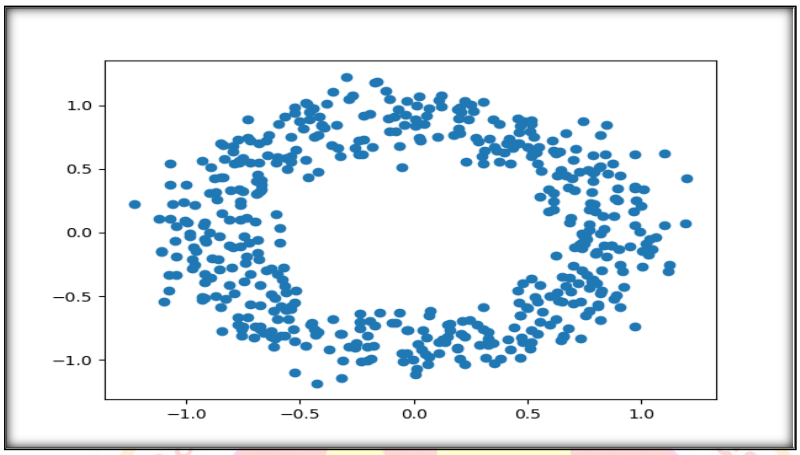


Fig 3 : Point Cloud Data

The result is a set of real number pairs (the birth and death times) that describe the spatial resolutions at which each topological feature first emerges (birth) and vanishes (death) . The pairings are typically represented as a set of lines known as barcodes, a collection of points in a 2D plane known as a persistence diagram, or a persistent landscape.

3.Persistent Homology for Point Clouds -

In topological data analysis (TDA), persistent homology is a technique used to examine the properties and shape of data, especially when it comes to point clouds. Persistent homology is a technique that can identify various spatial scales of topological features, including loops, voids, and related components, for a given point cloud. It accomplishes this by building a number of simplicial complexes at various distance thresholds, which are networks of points connected by triangles, edges, and higher-dimensional simplices. New topological features could emerge (birth) when the threshold rises, while already-existing features might combine or vanish (death). Persistence diagrams or barcodes, which graphically describe the important topological structures of the data, record the lifespan of these features. This method is particularly effective at capturing multi-scale patterns and structures in in complex, high-dimensional datasets, making it useful for applications like anomaly detection in brain imaging.

4.A Simplicial Complexes -

A simplicial complex is a mathematical structure used in algebraic topology to study the shape of data by decomposing it into simple building blocks called simplices. Formally, a simplicial complex K is a set of simplices that satisfies two conditions: **Closure under Faces**: If a simplex σ belongs to K, then every face of σ also belongs to K. A face of a simplex is any subset of its vertices The intersection of any two simplices $\sigma_1\sigma_2 \in K$ is either empty or a common face of both simplices.

A simplex is the convex hull of a finite set of points in a Euclidean space. For example:

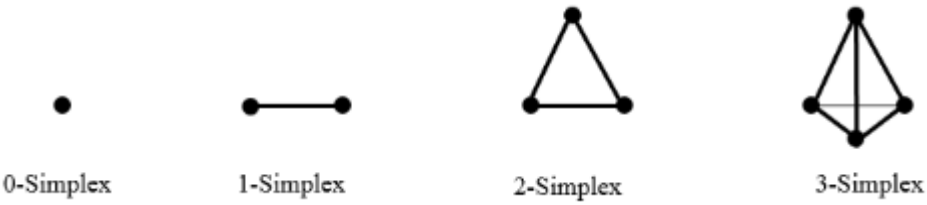
A 0-simplex is a vertex (point).

A 1-simplex is an edge connecting two vertices.

A 2-simplex is a triangle formed by three vertices.

A 3-simplex is a tetrahedron formed by four vertices, and so on.

A simplicial complex can be thought of as a collection of these simplices "glued" together along their faces to form a topological space. This structure allows us to use combinatorial methods to study topological properties, such as connectivity, holes, and voids, of more complex shapes.



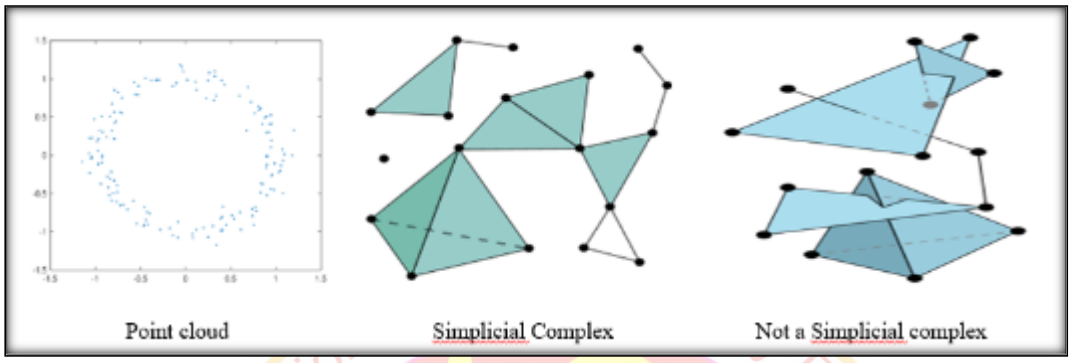


Fig 4: Simplicial Complex

Given a point cloud we construct a simplicial complex on top of it using the Vietoris -Rips construction. For X= $\{x_0, x, x_2 \dots x_k\}$ a point cloud in $\mathbb{R}^n$ its Vietoris-Rips complex of parameter r,denoted by VR(x,r) is the simplicial complex with vertex set $\{x_0, x, x_2 \dots x_k\}$ and where $\{x_0, x, x_2 \dots x_k\}$ spans a k-simplex if and only if $d(x_i, x_j) \leq r$ for all ,$0 \leq i, j \leq k$

5.Filtrations of Simplicial Complexes -

Following image demonstrates how the topology of a point cloud changes as we expand the radius in a Vietoris-Rips complex, and how persistent homology captures these changes, giving insight into the underlying structure of the data.

The image depicts a sequence of plots illustrating the evolution of a Vietoris-Rips complex (a type of simplicial complex) for a set of points in a 2D plane as the radius r of a ball centered at each point increases. The final plot on the right is a persistence diagram, summarizing the topological features (like connected components and loops) that appear and disappear throughout this process. Top Row (Radius r from 0.3 to 0.9): The points in 2D space begin with small radii (r = 0.3 , where each point is isolated. As r increases (from 0.5 to 0.9), small clusters of points begin to merge, forming connected components. Some small loops or holes start to appear. Bottom Row (Radius r from 1.1 to 3): At r = 1.1 and beyond, larger loops emerge, and more connections form between points, leading to a more interconnected structure.

By r = 1.5 , most of the points are connected, and the complex contains multiple loops. At = 3 r=3, almost all points are connected, and the complex becomes highly dense, with very few holes remaining.

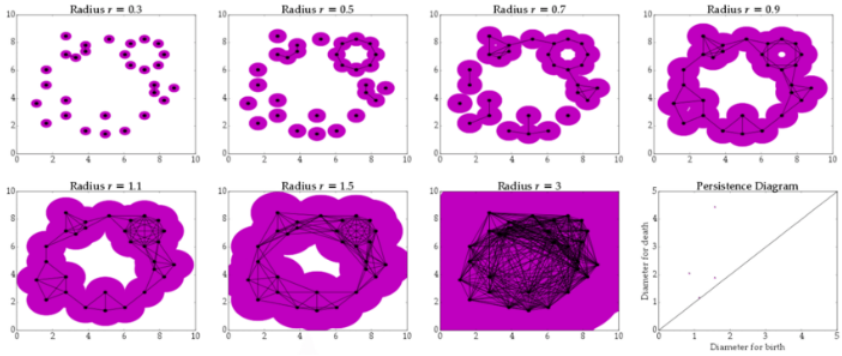


Fig5: Filtration of simplicial complexes

Persistence Diagram (right plot): The persistence diagram shows the "birth" and "death" of topological features (connected components and loops) as the radius increases. Each point represents a feature; its x-coordinate is the radius at which the feature appears (birth), and its y-coordinate is the radius at which it

disappears (death). Points farther from the diagonal indicate more "persistent" features, which can be more significant in understanding the underlying shape of the data.

6.Persistence Diagrams and Barcodes -

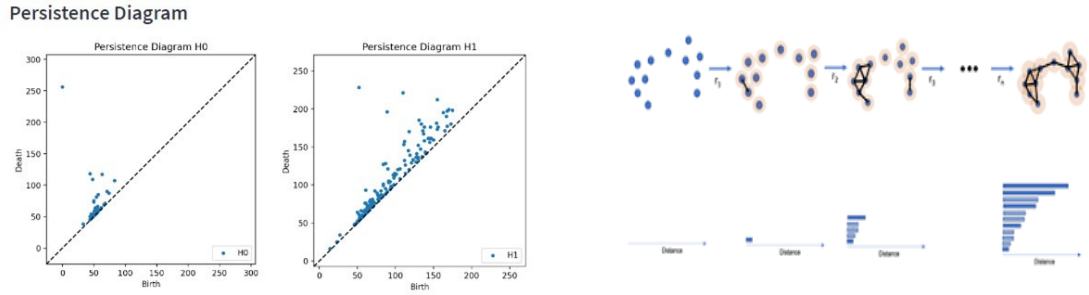


Fig 6 :Persistent diagram and barcode

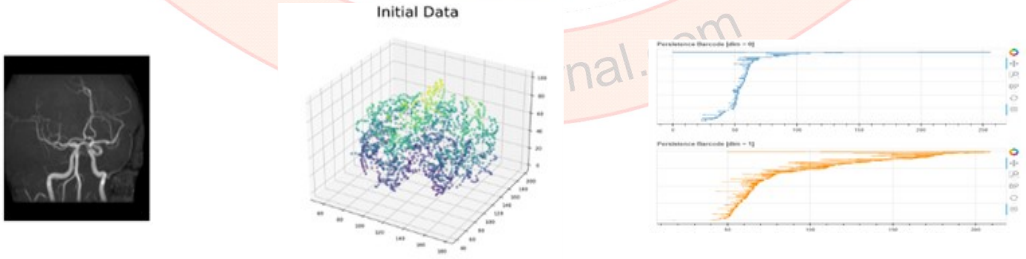
The output of TDA typically includes persistence diagrams or barcodes, which summarize the birth and death of topological features as the scale of the analysis changes. These diagrams provide a compact representation of the brain's shape, with longer-lived features indicating important structural characteristics, while shorter-lived features are considered noise.

7.Machine learning -

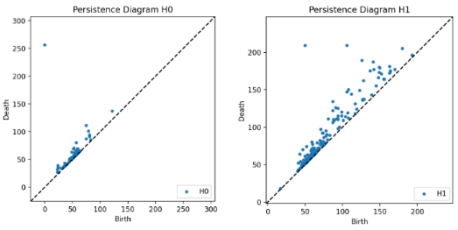
Machine learning plays a pivotal role in enhancing the detection of brain anomalies when combined with topological data analysis (TDA). By leveraging TDA's ability to extract topological features from complex brain imaging data, machine learning models can learn patterns indicative of abnormalities such as tumors, lesions, or neurodegenerative conditions. Supervised learning algorithms, such as Support Vector Machines (SVM), Random Forests, and neural networks, are trained on these topological features, enabling the classification of healthy and anomalous brain structures with high accuracy. Furthermore, unsupervised learning techniques like clustering can be employed to uncover latent structures in brain data, aiding in the discovery of previously unknown anomalies.

8.Methodology -

Neuroimaging data of MRA is collected from Imaging center . Noise reduction is applied like Gaussian smoothing or spatial normalization. Separate relevant brain structures such as gray matter, white matter, and cerebrospinal fluid for focused analysis using segmentation process. Dimensionality Reduction process is performed
by using Principal Component Analysis (PCA) to reduce the data dimensions, while retaining the most critical features.



Brain Artery Image **Point Cloud Data** **Persistent barcode**



Persistent diagram

Fig 7 :Brain Artery image,,point cloud data ,persistent barcode and persistent diagram

TDA is used to capture the shape and structure of brain data and its anomalies. The steps include: Construction of a Point Cloud: Represent the brain imaging data as a point cloud, where each point corresponds to a voxel/pixel or a feature vector of interest. Persistent Homology: Build a filtration from the point cloud, which is a nested sequence of topological spaces. Use persistence diagrams or barcodes to capture the evolution of topological features (connected components, loops, voids) across scales.

8.1 Feature Extraction from Persistent Diagrams -

Meaningful features are extracted from persistence diagrams, such as the lifespan of topological features or the number of persistent components.

1. **H0 Diagram (Connected Components):** H0 features represent connected components in the data. Each point in this diagram corresponds to a connected component that appears at a certain "birth" value and persists until its "death." The points near the diagonal (birth ≈ death) correspond to very short-lived connected components, which are typically considered noise. These components appear and disappear almost immediately.
   The components that are far from the diagonal (long lifespan) correspond to persistent connected components, which represent significant structures in the data. In the diagram, you can observe that the majority of the connected components die early (death ≤ 100), indicating that many small structures are quickly merged into larger ones.
   A few components have relatively high persistence, with one outlier that persists until about a death value of 250, suggesting the presence of one dominant connected component (likely representing the overall connected structure of the arteries).
2. **H1 Diagram (Loops)** :H1 features represent loops or cycles in the data, which can correspond to holes or circular structures in the topological space. Similar to the H0 diagram, points near the diagonal correspond to short-lived loops, which are considered noise. Points that are far from the diagonal represent persistent loops, which indicate significant circular structures in the data. In the H1 diagram, there are multiple loops with high persistence (points far from the diagonal), suggesting the presence of several persistent cycles or loops in the data, likely corresponding to circular or branching structures in the brain arteries. A few points with higher death values (above 150) suggest that some loops persist for a long range of scales, indicating significant circular features within the artery network.
3. **Voids (H2):**
   The current diagram does not show H2 features (which represent voids in higher dimensions), as this is a 2D analysis. If you were analyzing 3D data (such as from a 3D MRA scan), the H2 diagram would represent voids (enclosed empty spaces), but these are not present in this 2D analysis.

8.2 Machine Learning for Brain Anomaly Detection - Machine learning has revolutionized the field of medical imaging by enabling automatic classification and anomaly detection in complex datasets. Some commonly used ML techniques in brain anomaly detection include:

Convolutional Neural Networks (CNNs): CNNs are widely used in image processing tasks due to their ability to learn spatial hierarchies from image data. CNNs can detect features related to tumors, lesions, and other brain anomalies.

Support Vector Machines (SVMs): SVMs are useful for classification tasks, and can classify normal versus abnormal brain scans when provided with feature-rich data.

Random Forests: Random forests are a powerful ensemble learning technique, often used for brain image classification based on traditional image features like texture and intensity.

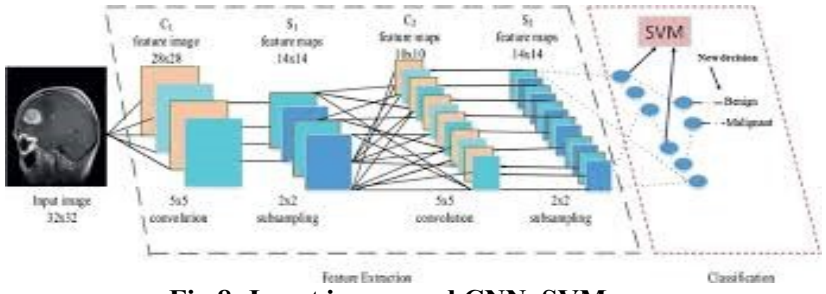


Fig 8: Input image and CNN, SVM process

A Confusion Matrix is an essential evaluation tool in machine learning, particularly when studying problems like the detection of brain anomalies using Topological Data Analysis (TDA) and other algorithms

such as Convolutional Neural Networks (CNNs) and Support Vector Machines (SVMs). The confusion matrix is a table with four main components:

	Predicted Positive (Anomalous)	Predicted Negative (Healthy)
Actual Positive (Anomalous)	True Positive (TP)	False Negative (FN)
Actual Negative (Healthy)	False Positive (FP)	True Negative (TN)

From the confusion matrix, several performance metrics are derived, each of which highlights different aspects of model performance:

1.Accuracy : Measures the overall proportion of correct predictions but can be misleading in imbalanced datasets. Accuracy = (TP+TN)/ TP+TN+FP+FN

2.Precision: Measures the accuracy of positive predictions (i.e., how many predicted anomalies are correct). Precision = TP/(TP+FP)

3.Recall: Indicates how well the model detects actual anomalies (critical in medical contexts to minimize missed diagnoses).Recall = TP/(TP+FN)

4.Specificity; Measures how well the model identifies healthy cases (important for minimizing false positives). Specificity = TN/(TN+FP)

5.F1 score: The harmonic mean of precision and recall, useful when you need a balance between both metrics. F1 Score = 2*[(Precision *Recall)/ (Precision +Recall)]

9.Benefits of TDA-ML Integration - The combination of TDA and ML offers several advantages:

i. Improved Anomaly Detection: TDA captures shape-based features that traditional feature extraction methods miss, leading to better identification of brain anomalies.

ii.Multi-Scale Feature Analysis: TDA's ability to analyze features at multiple scales helps in identifying both large and subtle anomalies.

iii.Noise Robustness: TDA is less sensitive to noise in the data, leading to more stable feature extraction.

10.Challenges and Limitations -

1. One of the main challenges of using TDA in brain anomaly detection is the computational complexity of persistent homology, particularly when applied to high-dimensional brain data. Efficient algorithms and optimized implementations are required to make TDA feasible for large datasets.
2. Medical imaging data, particularly annotated datasets for brain anomaly detection, are often scarce. This limits the ability to train and validate ML models effectively. Collaborative efforts to create large-scale, publicly available datasets could address this issue.
3. While the integration of TDA and ML has potential, there are no standardized workflows or protocols. Researchers and practitioners need to develop best practices for combining topological features with traditional ML pipelines.

11.Conclusion -

The integration of Topological Data Analysis (TDA) with Machine Learning (ML) has presented a promising approach for the detection of brain anomalies. TDA has enabled the extraction of shape-based features that enhance the ability of ML models to detect subtle structural changes in the brain, which can indicate the presence of tumors, lesions, or degenerative diseases. While challenges remain in terms of computational complexity and data availability, the potential benefits of this combined approach are significant. Future work have focused on optimizing the integration process and expanding the available datasets to facilitate more widespread use of TDA-ML systems in clinical practice.

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A Comprehensive Review of Various Algorithms in Image Processing

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Abstract

Numerous algorithms have been created to improve, analyze and understand photographs in image processing, an important field in computer science and engineering. The numerous image processing algorithms are reviewed in-depth in this work and are divided into three categories: classical, advanced and specialized techniques. We examine methods in the spatial and frequency domains, machine learning strategies and deep learning models, along with their practical applications. The paper also addresses the field's future goals and present difficulties.

We review the fundamentals, benefits, drawbacks and uses of these algorithms while analyzing their effectiveness and task-specific applicability. The goal of this review is to be a useful tool for practitioners and researchers who want to learn about and use image processing methods efficiently.

1. Introduction

To enhance an image's quality or extract useful information, image processing entails modifying and evaluating visual data from images. Applications such as computer vision, remote sensing and medical imaging depend heavily on this field.

The objective of this review is to provide an overview of significant image-processing algorithms, highlighting their methodologies, advantages, limitations and applications.

2. Image Processing Fundamentals

2.1 Definition and Goals

The techniques used to execute operations on images, such as enhancement, filtering and modification, are referred to as image processing techniques. Enhanced image quality, feature extraction and relevant analysis are the main objectives.

2.2 Fundamental Concepts

Pixels: The basic unit of an image, representing the smallest element of the visual information.

Image Representation: Images can be represented in various color models such as RGB, HSV, and YUV.

Common Tasks: Include filtering (smoothing and sharpening), enhancement (contrast and brightness adjustment) and segmentation (partitioning the image into meaningful regions).

3.Classical Algorithms

3.1 Spatial Domain Techniques

Image Enhancement: By distributing the intensity levels, methods like histogram equalization modify the contrast of an image.

Filtering: Common filters include the Gaussian filter for blurring and noise reduction, the median filter for removing salt-and-pepper noise and edge detection filters like Sobel and Canny.

3.2 Frequency Domain Techniques

Fourier Transform: Transforms an image from the spatial domain to the frequency domain, enabling operations like filtering, noise reduction and image compression.

Wavelet Transform: Provides a multi-resolution analysis of the image, useful for compression and denoising.

4. Advanced Algorithms

4.1 Machine Learning Approaches

Supervised Learning: Algorithms such as Support Vector Machines (SVM) and k-Nearest Neighbours (k-NN) classify images based on labelled training data.

Unsupervised Learning: Techniques like k-means clustering group images into clusters based on feature similarities without predefined labels.

4.2 Deep Learning Approaches

Convolutional Neural Networks (CNNs): These networks, such as LeNet, AlexNet, VGG, and ResNet, have revolutionized image classification and object detection by learning hierarchical feature representations and using convolutional layers to extract features and pooling layers to reduce dimensions.

Generative Adversarial Networks (GANs): GANs, including models like DCGAN and StyleGAN, generate high-quality synthetic images and enhance image resolution, style transfer.

4.3. Image Registration

Align images from different sources or time points. Matches and aligns images using transformation models. Useful in Medical imaging and satellite imagery.

5. Specialized Algorithms

5.1 Image Segmentation

Techniques such as thresholding, region-based methods like region growing and splitting, separating objects from the background by intensity values, and watershed transformation treat image gradients as topographic surfaces and segment regions based on "water" flow. Partition images into distinct segments to identify objects or regions of interest.

5.2 Feature Extraction

Algorithms for detecting and describing key points, such as SIFT (Scale-Invariant Feature Transform), SURF (Speeded-Up Robust Features), and ORB (Oriented FAST and Rotated BRIEF) are critical for object recognition and matching, Real-time image processing tasks and Real-time feature extraction and matching.

5.3 Object Detection and Recognition

State-of-the-art methods include YOLO (You Only Look Once), R-CNN (Regions with CNN features), and SSD (Single Shot Multi-Box Detector) which localize and identify objects in images with high accuracy and also for detecting and classifying objects within images.

5.4. Histogram Equalization

Adjusts the intensity distribution of the image to make it more uniform.for enhancing the contrast of an image. Contrast improvement is beneficial in medical images, and satellite imagery.

6. Evaluation Metrics : Evaluating image processing algorithms involves metrics such as:

Classification Metrics: Accuracy, precision, recall, and F1 score.

Image Quality Metrics: PSNR (Peak Signal-to-Noise Ratio) and SSIM (Structural Similarity Index) measure the quality of processed images.

7. Applications

7.1 Medical Imaging : Algorithms are used in MRI, CT scans, and X-rays for diagnosis and treatment planning.

7.2 Computer Vision : Applications include facial recognition, autonomous vehicles, and augmented reality.

7.3 Remote Sensing : Satellite and aerial imagery processing techniques assist in environmental monitoring and geographical analysis.

7.4. **Robotics :** Image processing for robot navigation and object manipulation.

8. Challenges and Future Directions

8.1 Current Limitations

The difficulties lie in the computational complexity, the requirement for extensive datasets, and the necessity to generalize across many image kinds. There are also problems with algorithm scalability, real-time processing, and managing a variety of image types.

8.2 Emerging Trends

Future research focuses on real-time processing, integration with other technologies, and advances in hardware and algorithms for improved performance and efficiency.

9. Conclusion

This review provides an overview of the various algorithms in image processing, covering classical methods, advanced techniques, and specialized approaches. The field continues to evolve with technological advancements, promising further improvements and new applications.

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Extracting Topological Features from Data using Machine Learning Algorithms and Persistent Homology

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Abstract:

In the modern age of data analysis, understanding complex datasets requires more than traditional methods. Topological Data Analysis (TDA), and more specifically, persistent homology, has emerged as a powerful tool for extracting topological features from high-dimensional data. This paper explores the intersection of machine learning and persistent homology for extracting meaningful topological features from complex datasets. By integrating machine learning algorithms with TDA, researcher propose a framework for automatically detecting patterns and structures in data, improving interpretability, and enhancing predictive performance in various applications.

Keywords: Topological Data Analysis, Persistent Homology, Machine Learning, Data Features, Dimensionality Reduction

1. Introduction

The term "topological data analysis" (TDA) describes statistical techniques used to identify structure in data. These techniques apply topological concepts, as their name implies. Frequently, the term TDA is restricted to a specific technique known as persistent homology (explained in Section 4). I adopt a more comprehensive viewpoint in this review: I refer to a broad category of data analysis techniques that make use of form and connectivity concepts as TDAs. The benefit of adopting this more expansive interpretation of TDA is that it gives newly created techniques additional context. (Wasserman, January 2018)

With the increasing size and complexity of datasets across disciplines, the need for advanced analytical techniques has become paramount. Traditional statistical methods often fall short in capturing the intrinsic structure of data. Topological Data Analysis (TDA), a branch of mathematics, offers a solution by analyzing the shape and structure of data. In particular, persistent homology has shown promise in revealing critical topological features, such as holes, voids, and connected components in high-dimensional data.

Machine learning (ML) algorithms have demonstrated remarkable success in identifying patterns, classifying, and predicting outcomes from large datasets. By integrating TDA, specifically persistent homology, with machine learning, we can create more robust data representations that retain topological features, allowing for improved model performance.

This paper aims to explore methods of extracting topological features from data using persistent homology, integrating them into machine learning algorithms to enhance data interpretation and predictive accuracy.

Objective

1. Extracting topological features from complex datasets using persistent homology.
2. Integrating these features with machine learning algorithms to improve model interpretability and performance.

2. Background and Related Work

2.1 Topological Data Analysis (TDA)

TDA provides a suite of tools for understanding the shape of data. The key concept in TDA is to study the connectivity of data points across different scales. Persistent homology is the most commonly used technique in TDA, which tracks the evolution of topological features (such as connected components, holes, and voids) as a thresholding parameter is varied.

2.2 **Persistent Homology**

Persistent homology captures multi-scale topological features by examining how data points cluster and connect across different scales. It is typically represented by persistence diagrams or barcodes, which encode information about when topological features appear and disappear. These features are inherently multi-dimensional and can be leveraged to understand the structure of complex datasets.

2.3 **Machine Learning and Topology**

Incorporating topological information into machine learning models has been explored in recent years. However, most approaches use TDA for feature extraction and dimensionality reduction, feeding these features into traditional ML algorithms (e.g., support vector machines, neural networks). Recent studies demonstrate the value of topological features in improving classification, clustering, and regression tasks.

3. **Methodology**

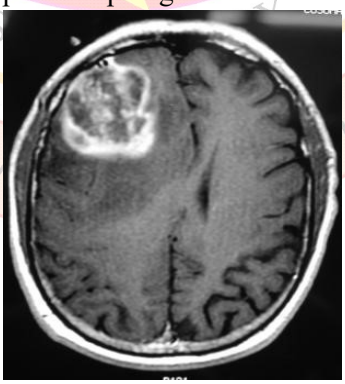
3.1 **Data Collection and Preprocessing**

To demonstrate the utility of our proposed framework, Researcher use a Kaggle of datasets, such as: Brain tumor Images, dataset undergo standard preprocessing techniques, such as normalization and noise reduction. Researcher use BRAVA Stramlit App for Analyise data set to extract topological features.

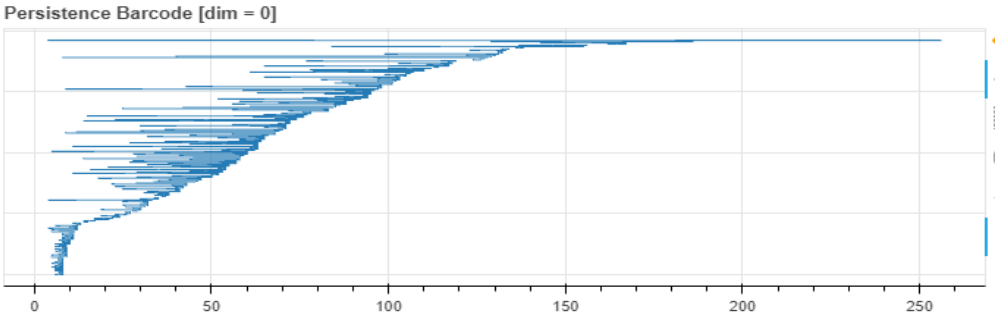
3.2 **Persistent Homology Pipeline**

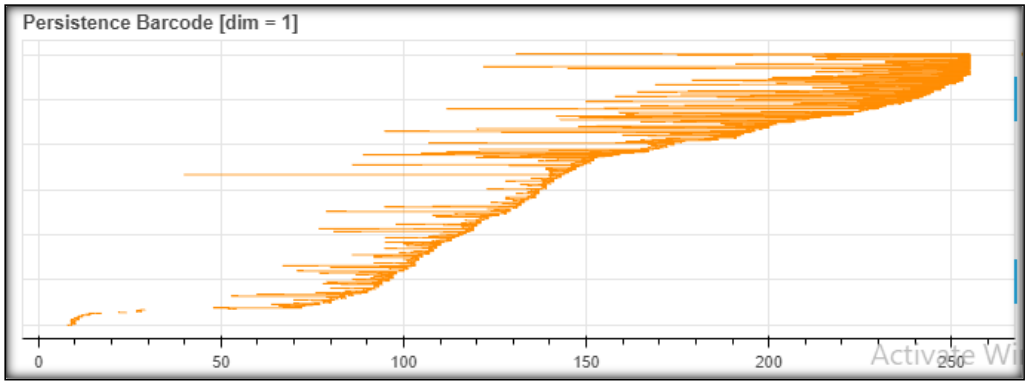


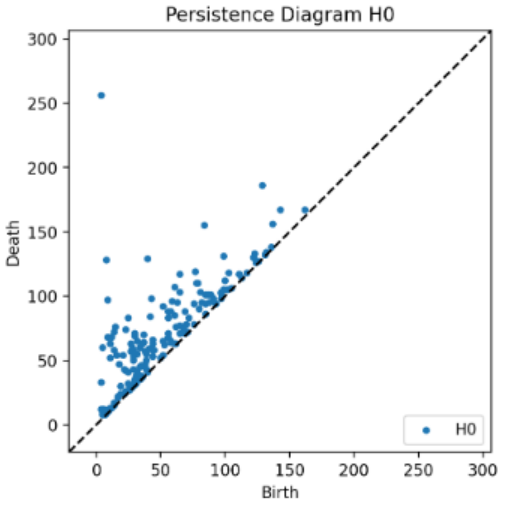
1. Point Cloud Construction: Each dataset is converted into a point cloud, with data points representing observations in high-dimensional space.
2. Vietoris-Rips Complex: A Vietoris-Rips complex is constructed from the point cloud to capture the underlying topological structure.
3. Filtration: A filtration process is applied, where the threshold parameter is varied, and topological features are tracked across multiple scales.
4. Persistence Diagrams/Barcodes: Persistent homology is computed, resulting in persistence diagrams and barcodes that summarize the lifespan of topological features.

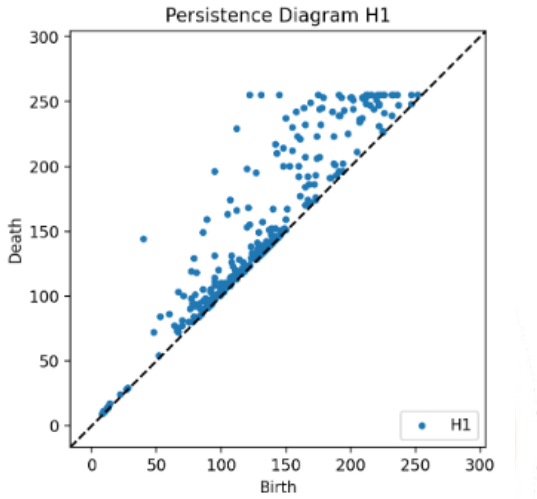


Brain Tumor Image









Persistence Statistics [dim = 0]

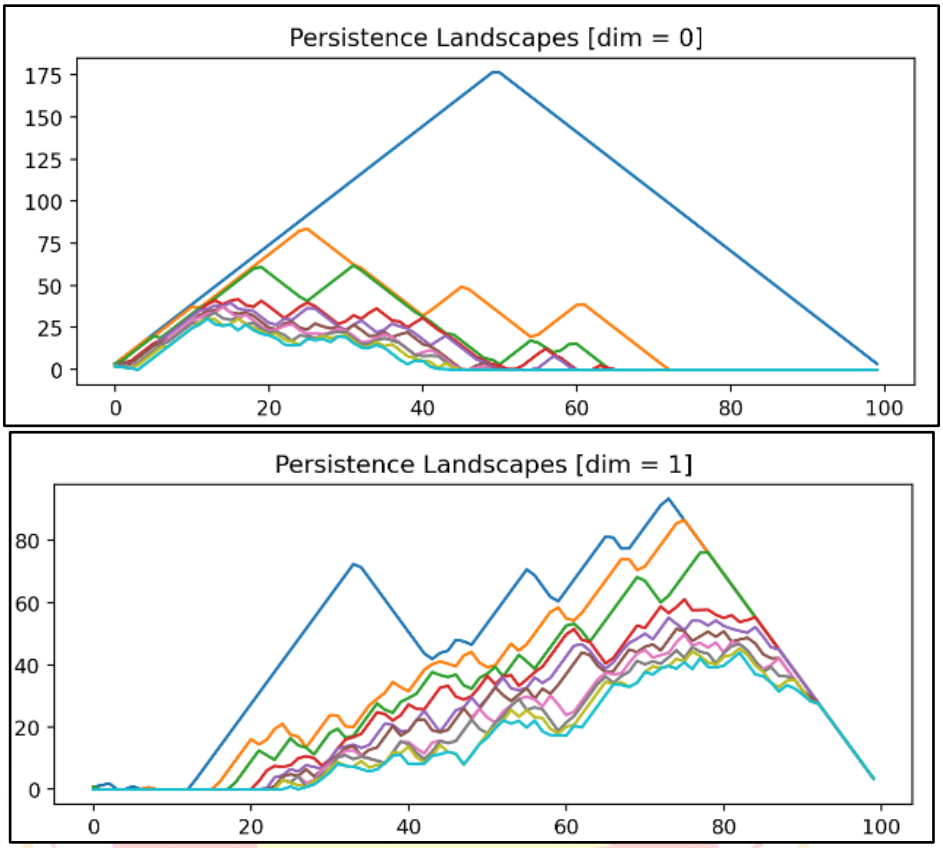
	Mean	STD	Median	IQR	Range	P10	P25	P75	P90
Births	44.3005	37.0983	34.0000	54.0000	158.0000	6.0000	11.0000	65.0000	99.0000
Deaths	61.1399	43.2869	58.0000	68.0000	248.0000	9.0000	24.0000	92.0000	117.8000
Midpoints	52.7202	38.2091	44.5000	56.0000	158.0000	8.0000	14.0000	78.0000	110.5000
Lifespans	16.8394	25.6969	7.0000	22.0000	251.0000	1.0000	2.0000	24.0000	41.8000

	Count	Entropy
Pd0	193.0000	4.5523

Persistence Statistics [dim = 1]

	Mean	STD	Median	IQR	Range	P10	P25	P75	P90
Births	131.2450	55.0920	128.0000	72.7500	244.0000	71.4000	95.0000	167.7500	212.9000
Deaths	150.5695	66.0680	137.5000	102.5000	246.0000	84.0000	104.2500	206.7500	252.9000
Midpoints	140.9073	59.5365	135.2500	88.0000	245.0000	78.0000	101.0000	186.2500	236.0000
Lifespans	19.3245	24.9372	7.0000	27.0000	132.0000	1.0000	2.0000	29.0000	55.9000

	Count	Entropy
Pd1	302.0000	5.0354



3.3 **Feature Extraction**

Key data features can be identified via autoencoders. In order to extract new, more powerful features, the autoencoder concept relies on learning from the coding of the original data sets. This is accomplished by forcing a neural network to find and use structures in the data through training it to replicate its input. By reducing dimensionality and extracting important features from the data, autoencoders help create machine-learning models that are more successful.

PCA, or principal component analysis: Large data sets' dimensionality is decreased while the greatest amount of information is preserved by using this feature extraction technique. Principal Component Analysis highlights variation while identifying significant trends and connections among the dataset's components. Bag of Words (BoW): BoW is a useful Natural Language Processing (NLP) technique that allows words (also known as features) to be retrieved from a text and categorized based on how often they are used. Every document is represented by a vector of word counts. Next, the word count is sent into machine learning algorithms as input.

This method turns text into a format that is simple to study. Its simplicity, nonetheless, also implies that more subtle details of structure or order are lost.

Term Frequency-Inverse Document Frequency (TF-IDF): An NLP feature extraction method that employs a numerical statistic to represent a word's importance to a document in a collection or corpus, TF-IDF is an extension of BoW. In contrast to BoW, it takes into account all of the other texts in the corpus in addition to a word's frequency in a single document. This makes up for the fact that some terms are used more frequently than others overall.

Image Processing Techniques: In order to recognize and isolate important features or patterns in a picture, image processing techniques analyze raw data. This could be extracting properties such as color, texture, and shape, or it could be recognizing corners and edges. Then, tasks like object detection, image segmentation, and image classification can be performed using these features.

The persistence diagrams or barcodes are transformed into topological feature vectors that can be input into machine learning models. Common techniques include:

- Vectorization: Transforming barcodes into finite-dimensional vectors.
- Statistics of Diagrams: Calculating summary statistics (e.g., average lifespan of features, number of features) from persistence diagrams.
- Kernel Methods: Using specialized kernels, such as the persistence landscape kernel, to incorporate topological features directly into ML algorithms.

3.4 **Machine Learning Integration**

The extracted topological features will be integrated into common ML algorithms, such as:

- Support Vector Machines (SVMs): For classification tasks.
- Convolutional Neural Networks (CNNs): For image data analysis, using topological features as additional inputs.
- Random Forests and Gradient Boosting: For regression and classification tasks, leveraging the extracted features to enhance decision-making processes.

3.5 **Performance Metrics**

Accuracy:

Accuracy measures the overall correctness of the model.

$$\text{Accuracy } \frac{TP+TN}{TP+TN+FP+FN}$$

Where TP=True Positive
TN= True Negatives
FP= False Positive
FN = False Negative

Precision : It measures how many of the predicted positives were actual positives.

$$Precision = \frac{TP}{TP + FP}$$

Recall: Recall or sensitivity measures how many actual positive were correctly identified.

$$Recall = \frac{TP}{TP + FN}$$

Mean Squared Error : $MSE = \frac{1}{n}\sum_{i=1}^{n}(y_i - y'_i)^2$

N= Number of data Points

y_i = Actual value for the ith data point

y'_i = Predicted value for the ith data point

MSE calculated the average of the squares of the errors, the difference between actual and predicated values.

4. **Results**

Preliminary results indicate that integrating topological features improves performance across various machine learning tasks. For example, in image classification tasks, CNNs enhanced with persistent homology features show a 5-10% improvement in accuracy compared to models without topological features. In time-series analysis, persistent homology has shown promise in identifying long-term trends and cycles that are otherwise missed by traditional ML models.

Further analysis shows that topological features provide a more interpretable model since they capture essential structural information about the dataset, which can be correlated to real-world phenomena.

5. **Discussion**

The results demonstrate the potential of combining TDA with machine learning for analyzing complex datasets. Persistent homology successfully captures significant topological information that, when fed into machine learning models, improves their performance and interpretability.

However, there are challenges to consider. One is the computational complexity of persistent homology, especially for very large datasets. Further optimization of the feature extraction process is necessary for practical applications in real-time systems. Additionally, determining the best method to integrate topological features with various machine learning algorithms remains an active area of research.

6. Conclusion

This research explores the novel combination of persistent homology and machine learning algorithms to extract and utilize topological features from complex datasets. By integrating topological insights with machine learning models, we achieve better performance and interpretability in various tasks. The proposed framework shows promise across a wide range of data types, from image data to time-series and sensor data.
Future work will focus on optimizing the persistent homology computation pipeline and expanding the framework's application to real-world problems, such as medical imaging and anomaly detection in sensor networks.

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On the Electronic Component Image classifier using Convolution Neural Network and Tensorflow's Network Architecture

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Abstract:

Although printed circuit boards (PCBs) contain various elements, only the major elements of and precious metals (e.g., Ag, Au, and platinum groups) contained within PCBs can be recycled. The recovery of these other elements would be beneficial for efforts to conserve scarce resources, reuse electric/electronic components (EECs), and eliminate environmental problems. To recover other elements from PCBs, the PCBs should be properly disassembled as the first step of the recycling process. The disassembling efficiencies were evaluated by using the ratio of grinding area (E_{area}) and the weight ratio of the detached EECs (E_{weight}).This paper presents a novel approach of segregation of EECs from wasted PCBs using advanced deep learning algorithm using Convolution Neural Network and Tensorflow's Network Architecture. In the proposed Computer aided technique, the efficiency is improved with an increase in accuracy and precision could be accomplished ultimately by 500 repetitive treatments (Epoch) at a training Log loss: 0.0156 and accuracy: 99.37 percent with validation Sparse Categorical Cross entropy: 0.3874 and validation accuracy of 96.67 percent. Through a series of computer assisted separations, groups of the EECs such as Capacitor, Diode, Resistor and Transistor could be sorted at a relatively high separation efficiency of about 96.67% or more. To evaluate the classification efficiency with regard to the Training phase, the 20% image samples were used for cross validation purpose. This result implies that the recyclability of the elements is highly feasible, efficient and reliable.

Keywords: *Convolution Neural Network, Classification accuracy, Electronics components, Machine learning, Sparse Categorical Crossentropy.*

Introduction:

Recent survey and studies conducted on in employment in electronics waste management and recycling process. It has been found that most of the employees in this field are unskilled and less knowledgeable. The main objective of the present work is to provide them computer assisted software tool using computer vision to identify the correct category of the electronics component which is being handled by them. Artificial intelligence (AI) can play crucial role in this regards. Artificial intelligence (AI) has been a growing trend lately. One of the tasks which can be achieved by AI is computer vision, which is the ability for computers to process and analyses images, aiming to mimic human vision. One of the main tasks of computer vision is image classification, which is the task of classifying an image into one of several predefined categories. In the proposed work images in Electronic Component dataset are labeled into four categories: Transistor, Resister, Capacitor and Diode. The dataset is also split into three equal subsets: train, validation, and test, each of which contains 1000 images. The aim of this project is to develop a convolutional neural network to automatically classify them.

It is a fundamental computer vision task that is critical to many other high-level tasks, such as semantic segmentation and object detection. Image classification is a challenging task due to various such as large intra-class variations and inter-class similarities. Traditional image class. Classification methods mainly rely on manual engineered features, which require considerable domain expertise while exhibiting poor generalization across different domains. In contrast, deep learning can exploit Convolutional Neural Networks (CNNs) to automatically learn multi-level representations from raw data through the use of multiple linear and non-linear layers. Deep CNNs are able to discover complex data structures without handcrafting features, they are thus applicable to many domains. Although deep CNNs have achieved significant success in many applications, they

rely on large-scale training datasets to learn discriminative features and achieve a satisfactory classification performance. One common way to execute image classification is through convolution neural networks, a technique implementing deep learning, which is a subset of machine learning, which is in turn a subset of AI. The dataset used in this thesis is Electronic Components images, capture by mobile.

Data Collection: The Electric/Electronics Component (EEC) Dataset categorized in 4most important classes and their annotated labels. This could be used for Image classification problem. The classes we have decided for experimentation are such as "Resistor", "Capacitor", "Diode", and "Transistor". The Dataset was annotated based on the classes. The Images Annotated here is from the custom dataset collected from basic electronics Laboratory in working department located in SGB Amravati University, Amravati, Maharashtra (INDIA).The EEC dataset contains images from four main object categories (e.g., "Resistor", "Capacitor", "Diode", and "Transistor" etc.) and a background category that contains the images from the Active and Passive component categories.

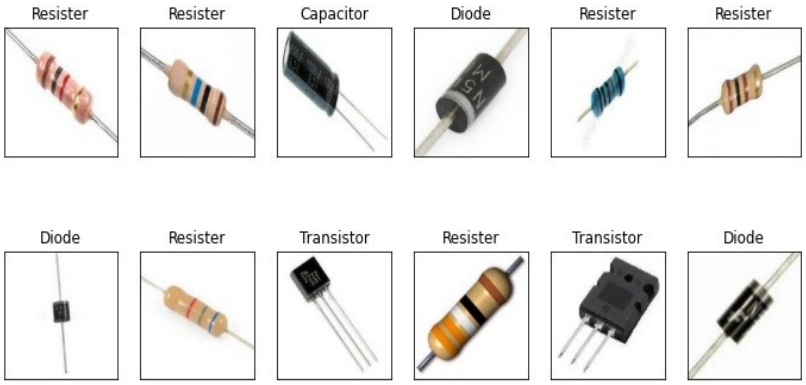


Figure 2: Random samples in the Discrete Electronics Component dataset

For each object category, the dataset contains about 100 random images, the resolution of the image is roughly about 200×200 pixels. All images were then resized to 128*128 *3 and converted to jpg format.

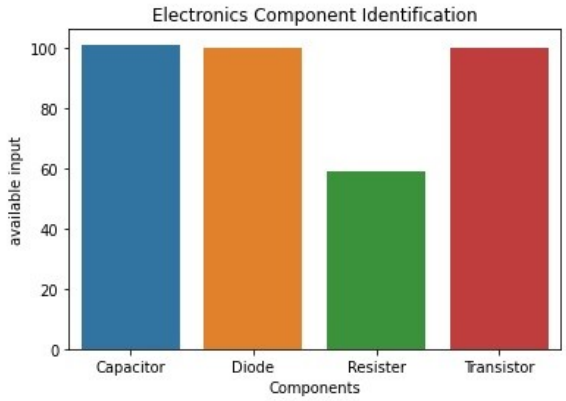


Figure 3: Graphical representation showing Numerical database for electronic components

Electronics Components are most diverse group of inventories with more than 4000varieties. These are identified based on several visual characters including their shape, color and head. It is difficult for the common people to directly identify these components found in the market. Classifying EEC types from images based on visual characteristics using computer vision and machine learning techniques is new domain for the researchers. Data is separated into train, test and valid directories. Additionally a csv file is included for generating Confusion Matrix along with Classification Report to summarize the performance of the trained convolution Neural Network. This article exhibits EEC: an image dataset of 4 different classes, captured by a single camera from Basic Electronics Laboratory in working department located in SGB Amravati University, Amravati, Maharashtra (INDIA).The dataset EEC are quite useful to compare various factors of classifiers such as learning rate, accuracy, Categorical Cross Entropy and their impact on the overall performance. Convolutional Neural Network (CNN) is one of the most widely used architectures for image classification based on visual features. A csv file is included that for each image file contains the relative path to the image file, the image file

class label and the dataset (train, test or valid) that the image file resides in. This is a clean dataset. If you build a good model you should achieve at least 95% accuracy on the test set. If you build a very good model for example using transfer learning you should be able to achieve 98%+ on validation set accuracy. If we wanted to build a high quality clean data set that was easy to use and no duplication between the train, test and validation data sets. Design for straight forward application of keras preprocessing functions like *Image.Datagenerator. Flowfromdirectory, Image. Data Generator.flowfromdataframe* or if you use the csv file. This dataset was carefully created so that the region of interest (ROI) in this case the sport occupies approximately 50% of the pixels in the image. As a consequence even models of moderate complexity should achieve training and validation accuracies in the high 90's.

Literature Review: Most object detectors contain two important components: a feature extractor and an object classifier. Shaoqing Ren (2017) has demonstrates and experimented that carefully designing deep networks for object classification with region-wise classifier networks that use shared, region-independent convolutional features and achieves nontrivial results on thought-provoking datasets including MS COCO.

Chunjuan Bo (2017) has developed an effective classification framework to classify a hyperspectral image (HSI), which consists of two fundamental components: weighted generalized nearest neighbor (WGNN) and label refinement. Both qualitative and quantitative results demonstrate that the proposed methods perform favorably in comparison to the other algorithms. In this study, a novel classification framework is developed to solve the HSI classification problem. Experimental results for several HSI classification benchmarks demonstrate that the proposed methods achieve better performance than competing methods. In the future, author assures that the will extend the proposed WGNN method to other classification problems.

Qiaoqiao Sun (2017) in his article, the spatial information and the spectral characteristics of HSI, a hybrid classification method combined DBN with principal component analysis (PCA) is proposed. Experimental results show that the PCA-DBN method has promising prospect in the HSI classification. The experiment results show that the proposed PCA-DBN method can help to improve the HSI classification. These promising results encourage us to extend our experiments on target detection and segregation in HSIs etc.

Gu Xiaoyun (2017) has studied, a method to rapidly determine living Chinese mitten crab freshness using an electronic nose (E-nose) and a Kernel-based technique. A novel kernel slow feature discriminant analysis (SFDA) as a nonlinear dimension reduction technique is adopted for feature extraction on the collected original data from E-nose to achieve the purpose of dimension reduction and denoising, In terms of support vector regression (SVR) learning technique, is used for modeling quality changes of crab during storage. Experiment shows that the regression model for crab TVB-N index, comparing with PCA and kernel PCA, kernel SFDA has higher accuracy with less training and testing. The experimental results demonstrate that when Kernel Slow Feature Discrimination Analysis (KSFDA) is used to extract the information of the original feature matrix, the classification accuracy of E-nose in predicting the classes of the crab freshness is higher than that of using PCA and KPCA. The proposed KSFDA may be more effective and applicable in crab freshness forecasting by E-nose in the future.

Michael (2018) has presented present a new classification method using Magnetic Induction Spectroscopy (MIS) to sort three high-value metals that make up the majority of the nonferrous fraction—copper, aluminum, and brass. Two approaches are investigated: the first uses MIS with a set of geometric features returned by a vision system, where metal fragments are matched to known test pieces from a training set. The second approach uses MIS only. An average precision and recall (purity and recovery rate) of around 92% was shown. The performance of the MIS-only classifiers were particularly promising, with around 92% precision and recall (equivalent to purity and recovery-rate). We have shown that, provided these key criteria are satisfied, good performance rates can be achieved, and a simple but effective classifier can be created distinctly well-suited to industry needs.

Yan-Jhih Wang (2018) Proposed to classify the package series of SMT components in current article. There are 19 features of the 2D pattern of electronic components to be used in this classification system. Through the experimental results, we got a 95.8% accuracy of classification. In this study, a Component

Package Classification System (CPCS) is proposed to improve efficiency and accuracy of the 2D-pattern classification based on BPNN. According to the experimental results, manual classification needs 23.57 seconds in average per 2D pattern, whereas the CPCS accurately classifies only in 0.31 seconds. Accuracy of the CPCS increases by 20.24% compared with manual classification.

Tisna Julian (2018) has examined that classification algorithm, Linear Discriminate Analysis (LDA), and the regression algorithm, Partial Least Square (PLS). It has been shown that MOS based electronics noses can be applied to classify and predict the concentration of dissolved nicotine in e-juice. In proposed work, it has been demonstrated through, Linear Discriminate Analysis LDA and Partial Least Square (PLS) models that electronic nose-based Metal Oxide Semiconductor (MOS) has the opportunity to be used as a predictor of dissolved nicotine concentration in unflavored e-juice. The response of the six sensors used showed significant differences between the dissolved nicotine and without nicotine samples. The differences are illustrated by the results of PCA analysis that has been done. It is also seen in the classification model with LDA. From the PLS model, the prediction model with regression parameter is 0.99 for training data and 0.97 for train data. This confirms the possible use of MOS-based e-nose predictors of nicotine levels in e-juice.

Xuejun Zhang (2019) has introduced a deep recurrent convolution neural network model for subjectivity classification of microblog text with the multi-features combination. In proposed model, the convolution neural networks to automatically learn classification features and use the recurrent neural networks to abstract and memorize the sequence semantic relations of microblog text. Experiments has been performed on six commonly used Twitter datasets. The experimental results demonstrate that proposed model outperforms the state-of-the-art approaches on several datasets. Compared with the baseline methods, the accuracy and the average F1-measure of our proposed model for subjectivity classification are improved by a minimum of 1.21% and 2.82%, respectively. The experimental results demonstrate that proposed model outperforms the baseline models in both the accuracies of subjectivity classification and F1-Measure values.

Xiaojin Zhao (2019) has presented a novel One-Dimensional Deep Convolutional Neural Network (1D-DCNN) with a multi-label-way-based algorithm for comprehensively and automatically extracting features and classifying mixture gases. The proposed implementation, based on one-dimensional convolution, is capable of automatically extracting features and distinguishing the individual component of binary mixture gases composed of ethylene, Carbon dioxide, and methane. Also the proposed 1D-DCNN algorithm applied in the mixture gases' recognition. Author emphasize that the proposed 1D-DCNN with multi-label way not only significantly reduces the label dimension but also quantifies the probability of each component in mixed gases. After comparing the proposed 1D-DCNN algorithm with the conventional pattern recognition algorithms including support vector machine, artificial neural network, k-nearest neighbor, and random forest, the proposed 1D-DCNN exhibits a higher recognition accuracy (96.30%) based on our extensive experimental results using ten-fold cross validation.

Nan Zhou (2019) has proposed a novel robust sparse PCA method based on Maximum Crossentropy Criterion (MCC) with high-order manifold constraints called the RHSPCA. After comparing the traditional PCA methods with the proposed RHSPCA, author suggested the number of benefits. Experimental results show that the proposed method can outperform the state of-the-art robust PCA methods on a variety of image processing tasks, including reconstruction, clustering, and classification, on outliers contaminated datasets. The computational complexity has been analyzed and the convergence property of the algorithm has been proved. Extensive experiments are conducted on outlier contaminated datasets to show the superiority of the proposed method over several state-of-the-art robust PCA methods on reconstruction, clustering and classification problems.

Rameshar (2019) investigates the impact of compression of X-ray images using PCA-based compression algorithm on the accuracy of fracture diagnostics. The accuracy of the classification system is assessed for X-ray images of both healthy and fracture bones when subjected to different levels of compression. Compression is achieved using principal components analysis. Results indicate that accuracy is only marginally affected under a level one compression but begins to deteriorate under level two compression. These results are potentially useful as the level one compression yields gains up to 94% with less than a 2% drop in classification

accuracy. The present investigation deals with the assessment of PCA-based compression on the accuracy of an X-ray image classification system. Results indicate that, on average, a level 1 compression ratio diminishes the classification accuracy by approximately 8.75% (for ANFIS based classification) and 1.67% (for SVM-based classification) while providing average compression ratios of approximately 75.7% for the test dataset.

Jason and Espanola (2019) were aims to optimize the extraction of features generated from a predetermined explosive-detecting electronic nose setup by using a genetic algorithm. A genetic algorithm (GA) is used to minimize the errors such as the mean error within explosive types, the mean error between explosive types and the classification error. The GA optimization program is implemented for each feature extraction technique, namely, principal component analysis (PCA) and linear discriminate analysis (LDA). The number of measurements size is varied to observe the behavior of the best fitness, average fitness, and elapsed program runtime.

Meo Vincent et al. (2019) has investigate the freshness and food spoilage inside the refrigerator using Principal Component Analysis – K Nearest Neighbors classifier. The system will gather data from MQ gas sensors and will be subjected to PCA and KNN. PCA is implemented to minimize data and for feature projection represented in form of graphs. Whereas, KNN is applied for clusters formed by the PCA transformation to classify the grouping of the food. The results from the combined approach produced an overall accuracy rate of 92%.

Cheng-Yaw Low (2020) has proposed a ridge regression-based S-DNN, dubbed Deep Analytic Network (DAN), along with its kernelization (K-DAN), are advised for multilayer feature relearning from the pre-extracted baseline features and the structured features. Experimental results show that DAN/K-DAN outperform the present S-DNNs and also the BP-trained DNNs, including multiplayer perception, deep belief network, etc., without data augmentation applied. S-DNN refers to a non-BP DNN assembled by means of aggregating nonlinear self-learnable building blocks, one after another, for a deep, feed forward construction. Author promised that DAN/KDAN also permits weight transferability like what BP-based DNNs do.

Ke Zhu (2020) has demonstrated, a new fault-classification technique by detecting decaying dc components in fault currents with magnetic sensing was proposed and verified. The dc component was extracted by the MM method from the current reconstructed by magnetic sensing. The feasibility of the method was validated both by simulation and experiment. The technique will be tested under different conditions (e.g., different fault times, fault distances, and locations, and network voltage) in a real on-site environment of a power system to validate its practical effectiveness in the future work.

Mihriban Gunay (2020) demonstrated that the Convolutional Neural Network (CNN) architecture, which is one of the deep learning architectures, is used to classify the basic circuit components drawn by hand. In the study, training for four classes is performed with CNN architecture. Based on the CNN architecture, four new CNN models are employed with different the number of layers. The training and validation results of these models are compared separately, the model with the highest training and validation performance is observed with four layer CNN model (CNN-4). This model obtained 84.41% accuracy rate at classification task. In presented article, 4 different CNN models are trained to put the resistor, inductor, capacitor and DC voltage source images into the correct classes. These models were tested on the data set created by the authors and the results were examined. In order to increase the performance of the CNN-4 model, author suggested to increase the amount of data and some parameters in the model can be changed to obtain better results.

Bharath Kurukuru (2020) has proposes a fault classification approach for power electronics converters (PECs) operating with the distributed generation systems. The proposed approach classifies and localizes the faults in PECs by adapting wavelet transforms and artificial neural networks. The numerical simulations are carried out for injecting various faults and degradation scenarios in both the legs of the inverter and developing the fault classifier in MATLAB integration. The results showed 97.4% training accuracy with component failure classifier and 94.2% training accuracy with the classifier trained for 50% degradation in power module. The results identified the efficiency of the developed approach in achieving efficient fault classification.

Yun-Jie (2020) has studied that the Printed Circuit Board (PCB) market is experiencing tremendous growth attributed to the proliferation of the Internet of Things. PCB producers require an efficient design

methodology to expedite production operations. The existing footprint design depends on skilled engineers, resulting in a protracted process. This study presents an approach for classifying PCB footprints by utilizing both footprint data and file name information to forecast package types and enhance accuracy.

Weiss in (2020) have proposed a novel, non-destructive scheme for testing the solderability of electronic leads by deep visual inspection (DVI) is introduced. It is evaluated by extracting micro-features through advanced supervised and unsupervised machine learning technique. The models learn using multiple images featuring distinct soldering leads from different angles and skill levels. The experimental results suggest that components within the same package may exhibit inconsistent solder ability, and while most of solder leads correspond with their apparent age, some have an apparent older age, which may lead to degraded soldering quality and reduced reliability. This technology offers continuous real-time screening of components with a classification accuracy above 97% and a processing timeline of approximately 7 milliseconds per component, facilitating a significant enhancement in production efficiency and consistency without the need for extra hardware or processing time.

Kuan-Chun Chen (2020) has introduces a new ECS-YOLO model for huge figure extraction and categorization in electronic component datasheets. The model is intended to accelerate PCB design preparation by identifying critical figure types and defining the figure types required for ECS library building. The model is trained and validated on multiple datasets, including the ICDAR-2013 and ICDAR-2017 datasets. The experimental results reveal that the proposed ECS-YOLO model consistently outperforms other models in figure extraction and classification from electronic component datasheets.

In (2021) Peng-Tai Huang stated that design of Printed Circuit Boards (PCBs) is critical due to the increasing rise of the Internet of Things and electrical device markets. Footprint design standards might differ between manufacturers, therefore studying PCB footprint libraries can assist identify new footprints. This research introduces a new classification approach that predicts package kinds by combining image classification with ensemble learning. Experimental results suggest that the model outperforms earlier approaches, and it can be enhanced further by fine-tuning parameters, selecting new base models, or increasing the depth of the ensemble learning model. The clustering method allows for extensive observation of design principles for various package kinds, which speeds up the design process.

Experimental Setup: The approach behind our classification model shown in figure 4 is Convolutional Neural Networks or CNN's

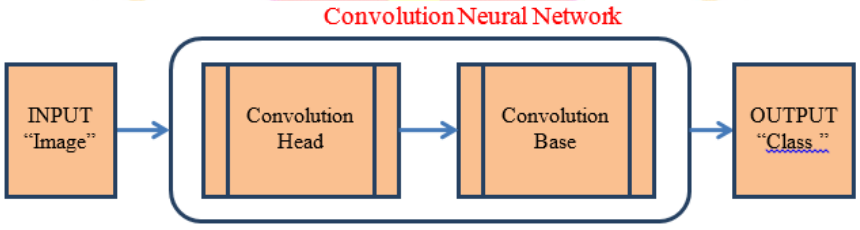


Figure 4: Building Blocks of Convolutional Neural Networks

A Convolutional Neural Network (CNN) is a *Deep Learning Neural Network mostly used for images* which can take in an input image, assign important (learnable weights and biases) to various objects in the image and be able to differentiate one from the other. The pre-processing carried out through rescaling to convert color image into Gray scale image. In addition to this data augmentation is achieved in the course of Random Horizontal Flip, rotation and zoom by 10% performed on each input image in a classification algorithms. While in primitive methods filters are hand-engineered, with enough training, CNN have the ability to learn these filters characteristics.

Convolution Layer 1: Importing the images into the network pipeline with input image size = WIDTH = HEIGHT = 96 and channel size = 3 i.e. RGB. A typical Convolution Head will include a conv2d layer with activation function = 'Relu', and a maxpooling2d Layer (could include layers like Dropout layers (regualarization), Padding layers, etc.) and a network can have many of such CNN layer stacks. Convolution Base (Dense Layer), After passing through the Convolutional Filters the images are flattened using Flattening

Layers and Passed on to the Fully Connected Layer which deals with an array of values. The last layer will typically be a Dense Layer with softmax function (multiclass classification) with the output size = 4.

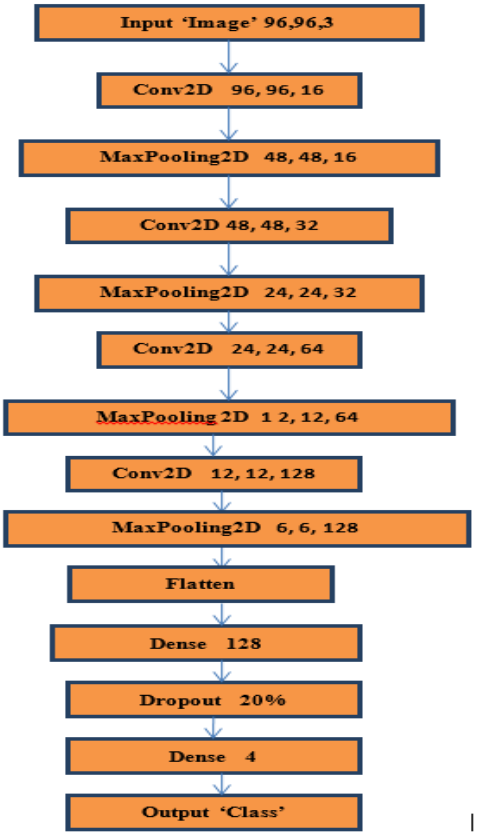


Figure 5: The Architecture of proposed Conv. Net model for Electronic Component Classification

Additionally, a CSV file is provided that has 360 rows and three columns i.e. image, label, category. The table contains the list of all the Image ID(s) with their corresponding label. We have tried to design the suitable CNN model in which using a Tensorflow Network to build a model and classify. Keras is just an API of Tensorflow 2.0 to make it highly approachable and easy for model building. There are two types of Architectures available while building a tensorflow model i.e. Sequential model and Functional model. We will be using a Sequential Model as shown in figure 5.

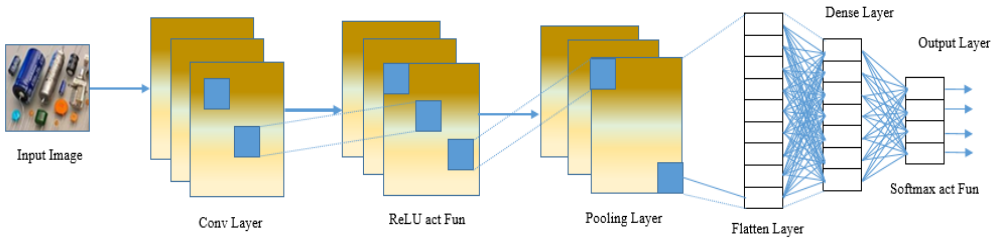


Figure 6: Sequential Model development

Results and Discussion: In this section, models developed based solely on Electronic discrete component images were tested to allow comparison to results obtained using 0: Capacitor, 1: Diode, 2: Resistor, 3: Transistor images. The motivation for training the models using electronic component images is due to the fact that discrete component are more readily obtained than Surface Mounted Device (SMD) images. For instance, they can be obtained from smartphones in individually, whereas SMD images are harder to acquire as they emanate from more sophisticated equipment. Table 1 shows a classification performance on the electronic component custom image dataset. Full sunshine images and images containing shadows (for instance, from different background) were selected in an attempt to challenge the robustness of each model.

Table 2 classification performance of Electronic Component Classification on custom dataset

	precision	recall	f1-score	support
0	0.95	1.00	0.98	21
1	1.00	0.96	0.98	24
2	1.00	1.00	1.00	10
3	1.00	1.00	1.00	17
accuracy			0.99	72
macro avg	0.99	0.99	0.99	72
weighted avg	0.99	0.99	0.99	72

Figure 4 illustrates examples of accurately classified and correctly predicted Electronic component images using custom CNN algorithm. A Column value in the confusion matrix corresponds to the ground truth value, whereas a row values represents the predicted value generated by the model. The Electronic component images are categories as shown in following table 2.

Table 3: categorization of Electronic Component for CNN algorithm development

Category	Electronic Component
0	Capacitor
1	Diode
2	Resistor
3	Transistor

Images that were correctly detected by the model are shown in Figure (diagonally). The model typically detected and classified them as correctly matched over 99.64% and classified as predicted positive values. This suggest the high level of performance of the proposed CNN algorithm for this custom dataset.

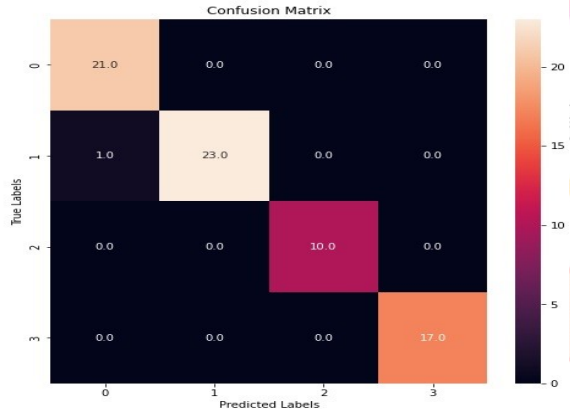


Figure 7: confusion matrix of CNN classification model

The performance of the proposed CNN model is shown in figure 7 terms of categorical cross entropy (Log loss) and Accuracy of the training and validation process.

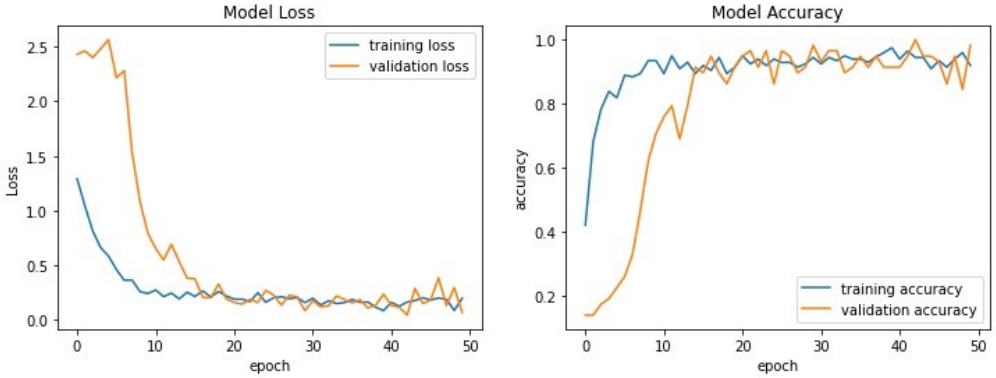


Figure 8: performance of the proposed CNN model

Numerical data and graphical representation shown above indicating for quantitative analysis purpose but it will be nice if results are shown in terms of real time images for better understanding that how our model perform on custom image data. The following figure 8 are the images actually predicted by our proposed deep learning model.

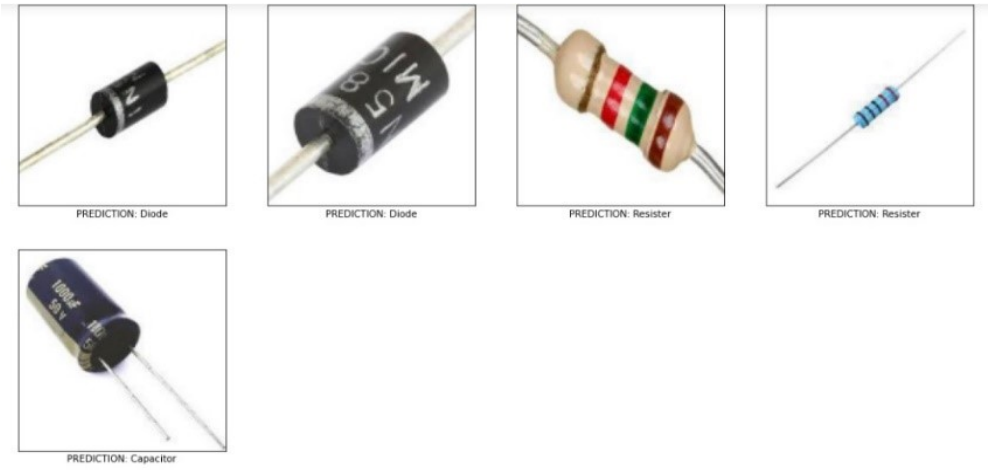


Figure 9: actually predicted Images by proposed deep learning model.

Conclusion:

This paper presents a novel and straightforward way of classifying discrete electronic components found on electronic prototypes using transfer learning and deep convolutional neural networks (DCNN). The goal of this study is to precisely classify images of electronic components into four classes: Resistor, Capacitor, Diode and Transistor. Custom CNN architecture is designed and used for the classification purpose. The results of the experiment showed that proposed DCNN architecture has the highest validation accuracy of 99.64% in classifying electronic components. By fine-tuning the parameters of the deep neural networks, average positive predictive value (Precision) of 98.75%, and average value of sensitivity (Recall) of 99.00%, and F-measure (F1-score) in an average of 99.00% were obtained for proposed DCNN, despite having a small dataset.

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Design And Analysis of Linear Array Transducer Using GUI field _II

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Abstract
Science past decades, ultrasound imaging technology has satisfied outstanding improvement in obtaining significant diagnostic information from patients in a fast, noninvasive approach. Although the technology has benefited from sophisticated signal processing technology and imaging system integration, much of this progress has been derived from the improvement of ultrasonic transducers. Ultrasonic arrays are used in various applications together with medical imaging. In this particular case is important to accomplish precise information regarding the magnitude and position of the peak pressure and intensity produced by the imaging probe. This paper presents the design of linear array transducers for ultrasonic measurements.
Keywords--*Ultrasonic, Linear array Transducer, medical imaging, Field-II GUI, TX/RX Fields.*

I) Introduction

For the period of the second half of 20th current century the medical imaging is grown through Ultrasound tool speedily. The part of novel technology is the use of computers to decide problems by simulating theoretical models (Numerical simulations) that has taken place alongside pure theory and experiment during the last few decades. These numerical simulations permit one to resolve problems that may not be accessible to direct experimental study or too complex for theoretical analysis. Computer simulations can link the gap between analysis and experiment **[1].**

These numerical simulations have emerged as a new branch in science and technology complementing both experiments and theory. A simulation can sometimes replace physical experiments, even though most often a simulation and an experiment are complementary. The results of scientific experiments are often explained by simulations and simulations are often calibrated by experiments. The experiments provide input for the simulations, which are viewed as experimenting with theoretical models. The feedback of numerical results into theoretical modeling and continues interaction with laboratory experiments and analytical theory makes computing a vital tool for science. Consequently the increased in computing power in both speed and storage has given computational electronics its significance. Improved computer capacity and the solution algorithms themselves, have a big outcome on the excellence of solution obtained. A numerical model can be used to understand measurements and observations enlarge existing analytical models into new parameter regimes and quantitatively test existing theories that can be done by comparing model predictions to experimental information.

The mutual weak point of both experiment and theory is cover up by the numerical simulations examination and experiment. A third dimension in ultrasonic measurements, of equivalent status and significance to experiment and analysis is nothing but the simulation determination **[1].** It has taken an everlasting place in every one aspect of ultrasonic measurements from basic research to engineering design.

A novel and potentially powerful tool is the computer experiment. One can resolve novel and uncertain aspects of usual process, by combining predictable theory, experiment and computer simulation **[1].** Such aspects could frequently neither have been understood nor reveled by analysis or experiments alone.

More than the last half century much development has been made in medical device technology. One particular medical technology that has enhanced speedily over the last 30 years is ultrasound. This advancement

in technology however has brought with it the rapid obsolescence of system design. The accomplishment of modern electronics is built on the possibility to precisely predict system performance by the use of simulation tools. This model can be extended to components such as piezoelectric transducers attached to the electronics [2]. The ability to simulate both piezoelectric transducer and electronics together renders possible efficient optimizations at system level, i.e. minimizing size, price and power consumption [3].

The systems for images processing in the medical field are very important calling for new techniques, much more superior and performing than they used to be, in order to provide a acceptable analysis and diagnosis. Amongst the medical techniques using computer sciences, it can be mentioned: scintigraphy, echography, tomography, radiography, quantitative microscopy, nuclear magnetic resonance. Ultrasound, widely used in many areas of medicine, provides a secure and efficient means for diagnosis and therapy. When the medium becomes complex solving the wave propagation formula becomes virtually not possible. Modeling becomes much more complex inside the body because the ultrasound propagation speed is different for each tissue and it is known that tissues are not a homogeneous medium for ultrasound wave propagation [4]. Therefore, it is important to know how the ultrasound wave is generated and the ultrasound wave beam shaped.

II) Spatial Impulse Theory

The pressure field generated by the aperture is found by the Rayleigh integral [5].

$$p(\vec{r}_1,t)=\frac{\rho_0}{2\pi}\int_s \frac{\partial v_n(\vec{r}_2,t-\frac{|\vec{r}_1-\vec{r}_2|}{c})}{|\vec{r}_1-\vec{r}_2|}ds \qquad (1)$$

Where the field point is denoted by $\vec{r}_1$ and the aperture by $\vec{r}_2$, is the velocity normal to the transducer surface. Using the velocity potential, and assume that the surface velocity is uniform over the aperture making it independent of $\vec{r}_2$, then: where the field point is denoted by $\vec{r}_1$ and the aperture by $\vec{r}_2$, is the velocity normal to the transducer surface. Using the velocity potential, and assume that the surface velocity is uniform over the aperture making it independent of $\vec{r}_2$, then:

$$\Psi(\vec{r}_1,t)=v_n(t)*\int_s \frac{\partial(t-\frac{|\vec{r}_1-\vec{r}_2|}{c})}{2\pi|\vec{r}_1-\vec{r}_2|} \qquad (2)$$

Where * denotes convolution in time. The integral in this equation

$$h(\vec{r}_1,t)=\int_s \frac{\partial(t-\frac{|\vec{r}_1-\vec{r}_2|}{c})}{2\pi|\vec{r}_1-\vec{r}_2|} \qquad (3)$$

Represent the spatial impulse response. The continuous wave field can be found from the Fourier transform of

$$p(\vec{r}_1,t)=\rho_0\frac{\partial v(t)}{\partial t}*h(\vec{r}_1,t) \qquad (4)$$

The impulse response includes the excitation convolved with both the transducers electro-mechanical impulse response in transmit and receive. The final signal for a collection of scatters is calculated as a linear sum over all signals from the different scatters [6-7].

III) Linear Array Transducer

The linear array is the fundamental type of multi-element transducer and it scans the region of interest by exciting the elements situated over the region. The field is focused on the region by introducing time delay in the excitation of the concerned individual elements, so initially concave beam is emitted. Here a Fig.1 shows

general design format of 16 element linear array transducer having height, width and kerf of individual element are taken as 5 mm, 0.2 mm and 0.02 mm respectively. The transducers are situated at the center of the coordinate system. To achieve focal length of 30 mm from the center of transducer the electronic focusing is included.

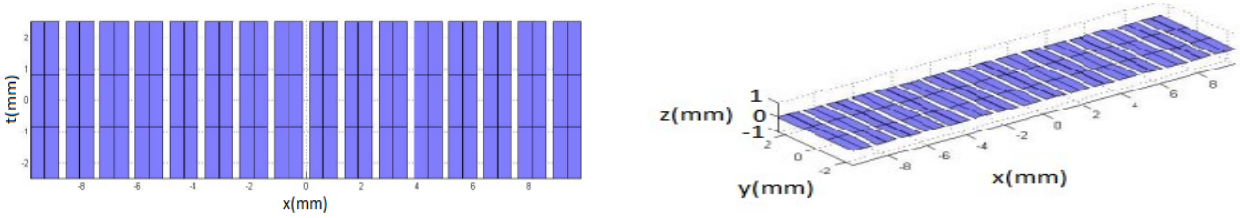


Fig. (1) **Design format of linear array transducer (Height=5mm, Width=0.25mm, Kerf=0.02mm)**

In this paper a linear array transducer of 16 elements is simulated using FIELD-II program with center frequencies 5MHz. For this specified linear array transducer, acoustic field generated is propagated through human body tissues and is observed at a focal distance i.e. (0, 0, 30)

IV) Result And Discussion

The calculation of the impulse response is facilitated by projecting the field point onto the plane of the aperture. In this way, the problem became two-dimensional and the field point is given as a (x, y) coordinate set and a height z above the plane. The spatial impulse response is, thus, determined by the relative length of the part of the arc that intersects the aperture [8]. Thereby it is the crossing of the projected ultrasonic waves with the edges of the aperture that determines the spatial impulse responses as a function of time. In this paper by using FIELD-II program created a 16 element linear array transducer with center frequency fo = 5*MHz*. The speed of sound in tissue is c=*f*0 = 1540*m/s*, The sampling frequency used was *fs* = 100*MHz*. The elements had a width and height of 0.25mm and 5mm respectively. The focal-point was set to 30mm.

Table: 1 shows the parameters for 16 element array transducer, excitation pulse and medium used for this centre frequency (f_0) used is 5MHz. Figs. (a-m) shows; Element impulse response for 16 element array, TX Field image for 16 element array, TX Axial waveform for 16 element array, TX Lateral beam plot for 16 element array, TX/RX Field image for 16 element array, TX/RX Axial waveform for 16 element array, TX/RX Lateral beam plot for 16 element array, K- space TX/RX field image for 16 element array, K-space axial slice for 16 element array, K-space lateral slice for 16 element array, Detected image for 16 element array, Detected image axial slice for 16 element array and Detected image lateral slice for 16 element array [8].

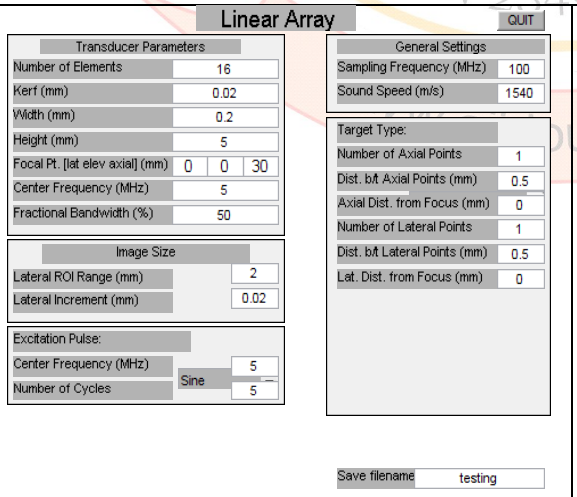


Table:1

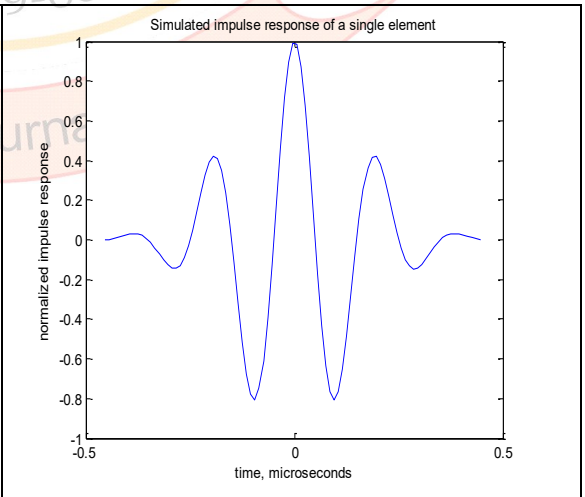


Fig.(a) Element impulse response

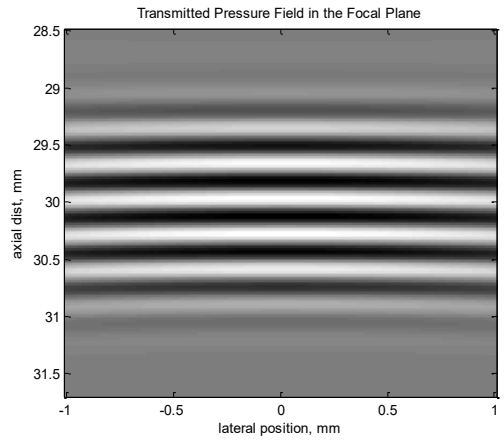


Fig. (b) TX Field image

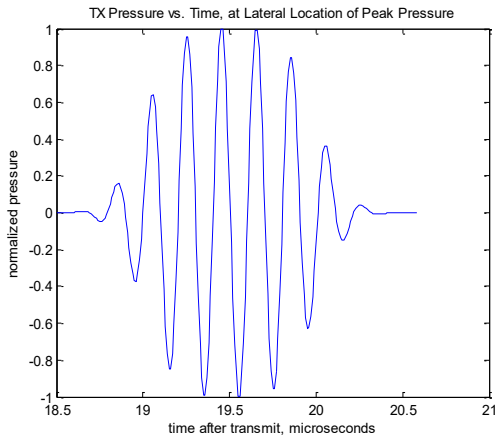


Fig. (c) TX Axial waveform

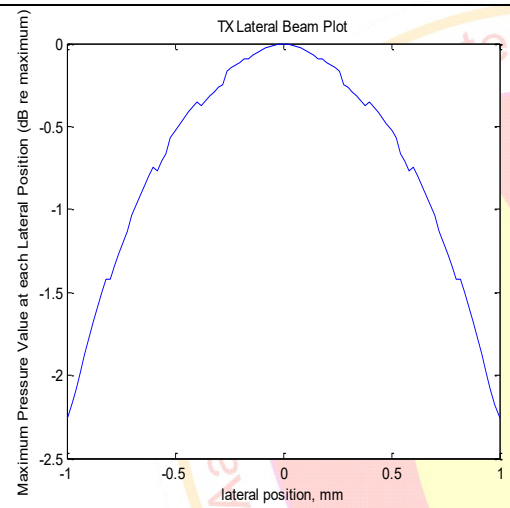


Fig. (d) TX Lateral beamplot

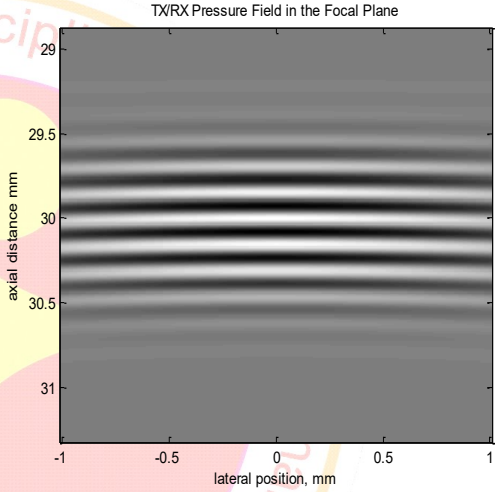


Fig. (e) TX/RX Field image

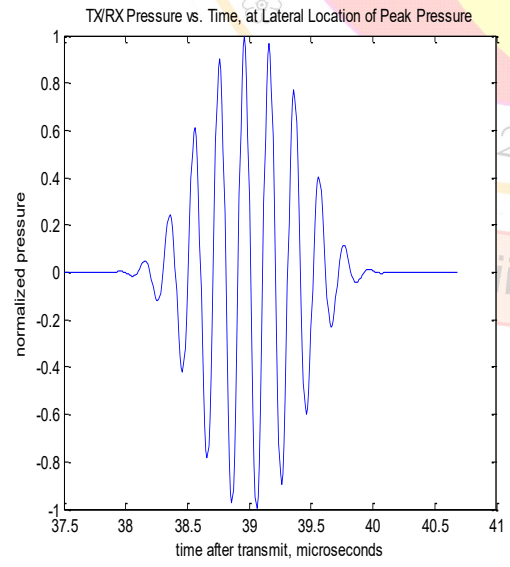


Fig. (f) TX/RX Axial waveform

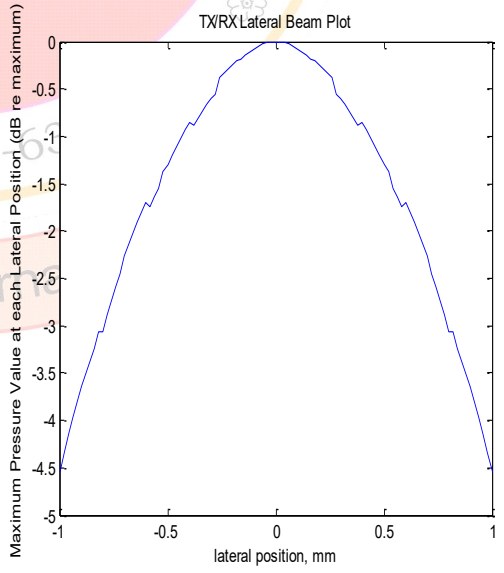


Fig. (g) TX/RX Lateral beam-plot

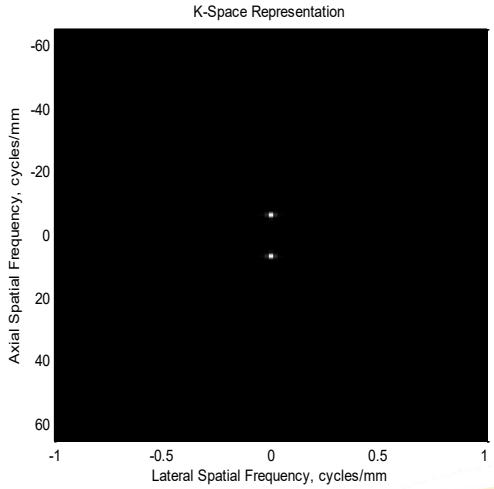


Fig. (h) K space TX/RX field image

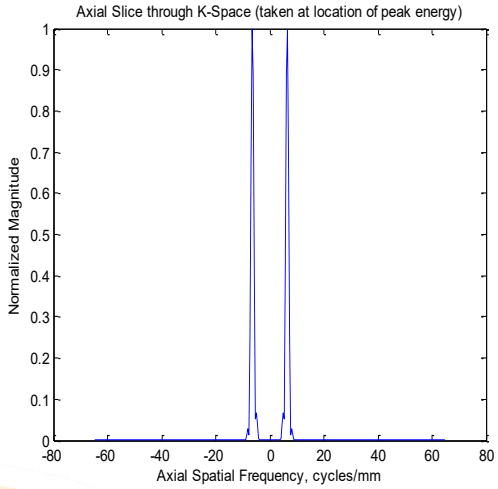


Fig. (i) K space axial slice

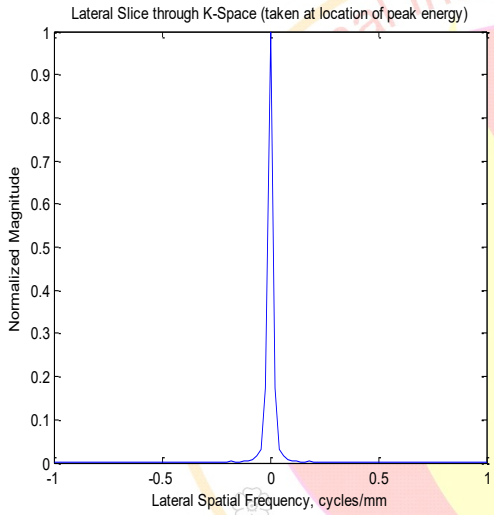


Fig. (j) K space lateral slice

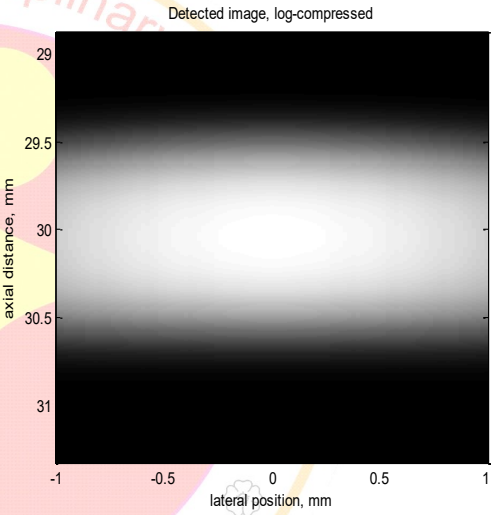


Fig. (k) Detected image

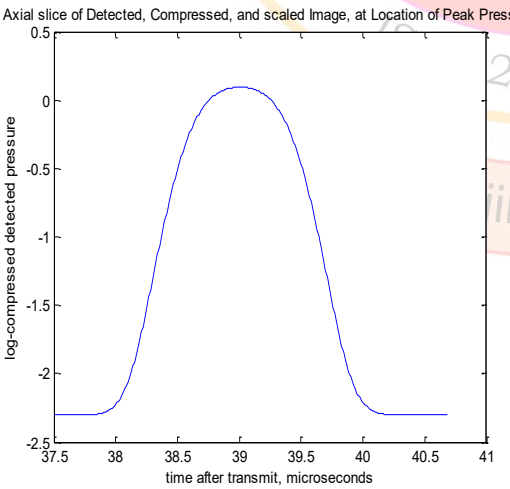


Fig. (l) Detected image axial slice

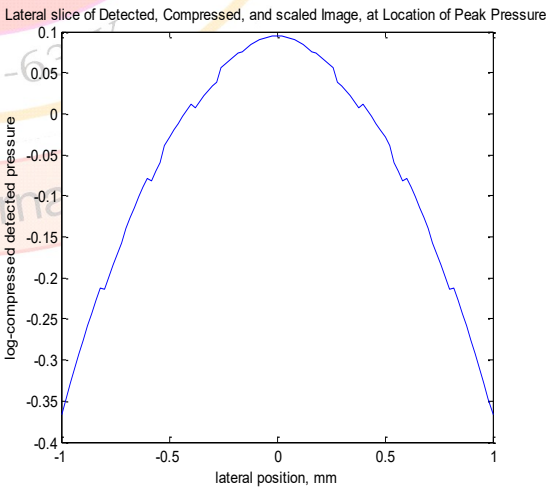


Fig. (m) Detected image lateral slice

V) Conclusion

The paper attempts to present a coherent analysis of the focusing strategies for 2-D array transducer design and properties, based on linear acoustics. The delays on the individual transducer elements and their relative weight or apodization are changed continuously as a function of depth. This yields near perfect focused

images for all depths and has increased the contrast in the displayed image, thus, benefitting the diagnostic importance of ultrasonic imaging.

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Effect of Sintering Temperature on Structural Properties and Magnetic Susceptibility of Lead Titanate

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Abstract:

Lead titanate $PbTiO_3$ nano-powders have been synthesized using wet chemical method. Effects of synthesis conditions annealing temperature (500°C - 700°C), annealing time (4 hr.) and on the phase formation, morphology and magnetic properties were studied. The produced lead titanate powders were investigated using X-ray diffraction (XRD), Transmission electron microscope (TEM) and hysteresis loop. The results obtained showed that pure single tetragonal $PbTiO_3$ phase was obtained for thermally treated precursors at 600°C with annealing time 4 hr. The crystallite size of the pure $PbTiO_3$ is in the range between 20.48 to 32.84 nm. TEM micrographs shows that sintering temperature have significant change in the morphology of the produced lead titanate powder.

The magnetic properties show decrease along with increasing sintering temperature. The magnetic properties of lead titanate have been confirmed on the basis of the hysteresis loop and the magnetic susceptibility of the material varied with the temperature.

Key words: Wet Chemical Route, $PbTiO_3$, XRD, Magnetic properties, Hysteresis loop.

Introduction:

Lead titanate, $PbTiO_3$, is one of the simplest and the most important members' of ferroelectric, pyro-electric and piezoelectric materials with perovskite structure ABO_3 where A is a monovalent or divalent cation with large radius, B is pentavalent or tetravalent cation with small radius and O is oxygen (1). Owing to their ferroelectric nature, $PbTiO_3$ show high spontaneous polarization (75-88 $\mu C/cm^2$), high dielectric constant and high Curie temperature of 490°C. At this temperature, the material undergoes a first order transition from high temperature para-electric phase with higher symmetry and then without spontaneous (Pm3m cubic perovskite structure) into a low temperature ferroelectric phase (P4 mm tetragonal perovskite structure). At room temperature, it exhibits a lattice parameter of c= 4.150 Å and a= 3.904 Å, thus giving a c/a as high as 1.063. Large c/a ratio in $PbTiO_3$ at low temperature confer tetragonal phase, it disintegrates into powder when cooled through the Curie point. Synthesis of $PbTiO_3$ by wet chemical methods offer advantages because of high-purity, good stoichiometry and controlled particle size.

Lead titanate ($PbTiO_3$) is a ferroelectric nano-crystalline powder that has not only been proved to be a technologically important material but also it is a significant component material in electronics such as capacitors, ultrasonic transducers, thermistors, and optoelectronics. These systems are due to their potential applications as ferroelectric materials. The conventional solid-state reaction has a tendency to produce a coarse $PbTiO_3$ powder with compositional in homogeneity and a degree of particle agglomeration if the processing parameters are not carefully optimized. Therefore, many chemistry-based processing routes, including co-precipitation, sol-gel synthesis, hydrothermal and citrate routes have been devised for the preparation of an ultrafine, sintering-reactive $PbTiO_3$ powder. Our method of synthesizing $PbTiO_3$ relies on the reaction between Lead Nitrate [Pb $(NO_3)_2$] and Titanium Isopropoxide [$C_{12}H_{28}O_4Ti$] at high temperature.

Experimentation:

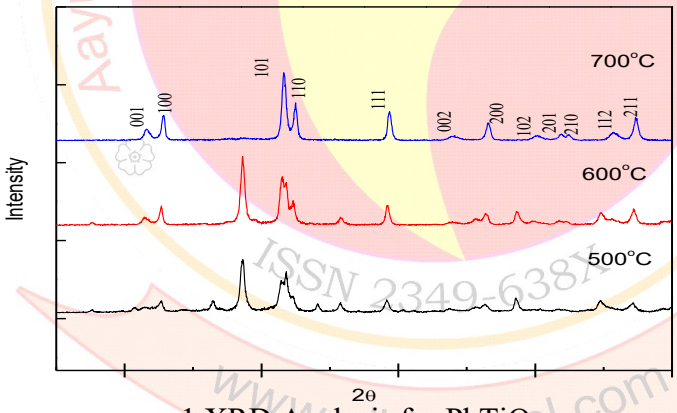
Molar proportions of $Pb(NO_3)_2$ (Lead Nitrate) is dissolved in Titanium Isopropoxide [$C_{12}H_{28}O_4Ti$] in liquid. The lead titanate were prepared by dissolving solid lead nitrate powder in pure water and stirred for 1 hr. at 100°C in reaction flask, when the lead nitrate was dissolved in water, then a stoichiometric amount of titanium Isopropoxide was added to the solution and the solution was refluxed at 100°C for 1 hr. and the solution was kept at 100°C for 4 hr. to get nanocrystalline powder. Nanocrystalline powders with various

crystallite sizes were obtained by calcining the powder at different temperatures at 500°C, 600°C, and 700°C. Structure and phase transformation analyses were investigated by XRD in the range of 10° – 90°. The average crystallite size was calculated from the full width at half maximum of the diffraction lines using Scherrer's relation.

Results And Discussions

X-RAY DIFFRACTION:

XRD pattern of the $PbTiO_3$ calcined at 500ºC, 600°C, and 700ºC is shown in Fig.1 at 500°C; the crystallization of tetragonal lead titanate phase began along with traces of impurity phase. At 500°C all peaks can be indexed to the $PbTiO_3$ with a tetragonal structure. No peak corresponding to any of the source materials or allotropic forms was found, suggesting that a pure crystalline compound exists. The crystallinity of the produced phase was increased with the increasing calcination temperature from 500ºC to 700ºC. The diffraction peaks corresponding to diffraction planes (101), (110), (100), (001), (200) and (211) which ascribed to tetragonal $PbTiO_3$ phase were obtained. On the other hand, the decreasing of the calcination temperature to 500ºC lead to form of the mixture of leads titanate $PbTiO_3$, lead oxide PbO and titanium dioxide TiO_2 phases. The crystallite size of the particles calcined at various temperatures could be calculated by the Scherrer's equation: $a = k \lambda / \beta \cos \theta$ (where a is the average size of the particles, assuming particles are spherical, k = 0.9, λ is the wavelength of X-ray radiation, β is the full width at half maximum of the diffracted peak and θ is the angle of diffraction. The crystallite size obtained from XRD data at 500ºC, 600ºC, and 700°C were 20.48 nm, 25.48 nm and 32.84 nm respectively. XRD peaks present 101 for $PbTiO_3$ sample calcined at 500ºC represent PbO phase with the plane 101 [JCPDS File No. 381477]. As the calcined temperature increases the blending of PbO with TiO_2 get optimum resulting in the shifting of peak position.



1 XRD Analysis for $PbTiO_3$

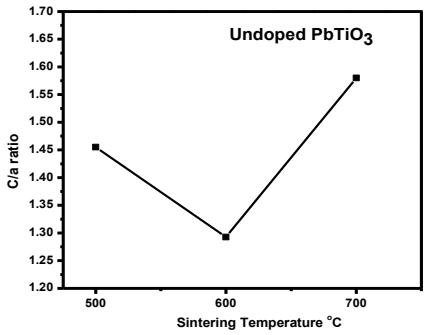


Fig.2: Variation of c/a with Sintering temperature.

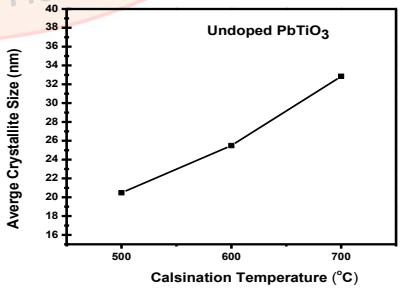
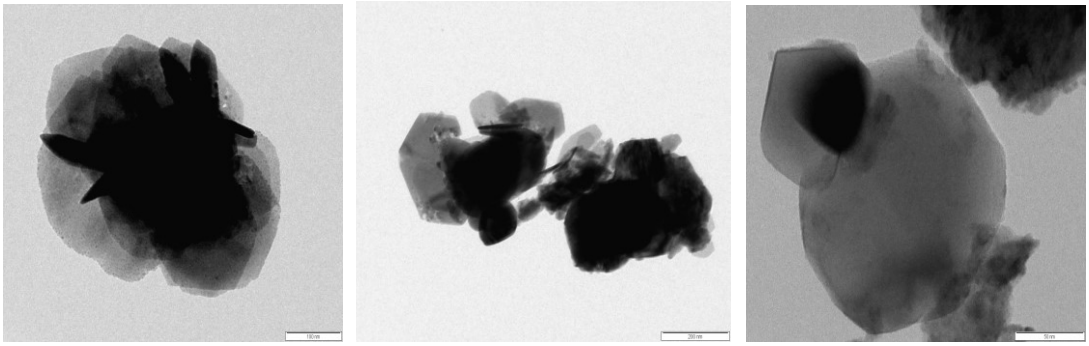


Fig.3: Variation of average grain size with Sintering temperature



e f g

Fig. 4 TEM image for e, f and g for $PbTiO_3$ sintering temperature at 500°C, 600°C and 700°C

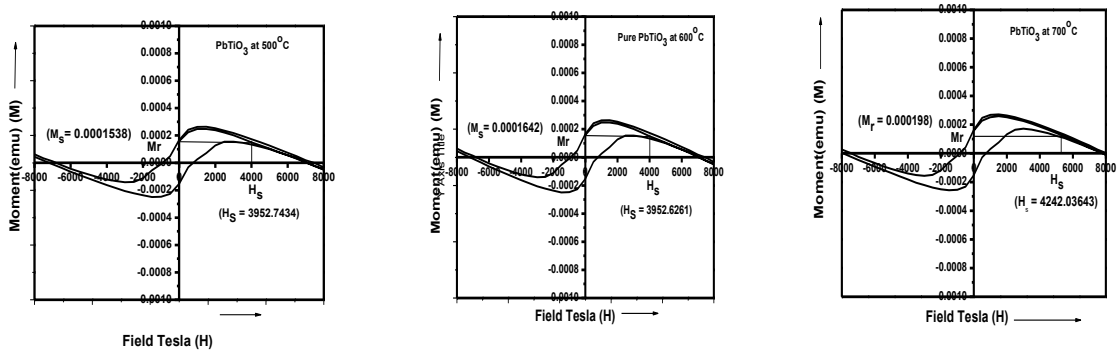
Fig.2. shows the variation of c/a ratio with the sintering temperature, which clearly indicates c/a ratio, is maximum at 500°C which means stable tetragonal phase at 500°C. c/a ratio decreases for 500°C, 600°C and slightly increase for 700°C. Decrease in c/a ratio afterwards indicates dispersion from tetragonality and an approach to the cubic phase with higher sintering temperature.

Fig. 3 shows variation between calcination temperature and crystalline size of Lead Titanate. With respect to temperature for lead titanate at 500°C, it has a less value. The plot shows increased to crystallite size at 700°C then that of at 500°C and 600°C. As calcination temperature increases, the crystallite size lightly increases at 500°C and 600°C then that the crystallite size is sudden increase at 700°C, in crystallite size will be reflected in the further structural for TEM and magnetic studies.

Fig. 4 shows the TEM image and the powder and corresponding calcination temperatures. These results demonstrated crystallinity of the materials. Size of nano-crystallites calculated from XRD data and the particle size with the TEM images of $PbTiO_3$ are compared. [13] The diffraction patterns illustrating spot patterns of the tetragonal structure of $PbTiO_3$ indicates highly crystalline $PbTiO_3$ particles. The crystallite size from XRD data is small in case of powder calcined at 500°C, 600°C. Its value is large for the powder calcined at 700°C. It may be due to the preferred grain growth of materials. The trend that has been observed in crystallite size and TEM particle size agree to each other although the magnitude differs. In XRD the crystallite size is an average while in the case of TEM particle size. The morphology of particle in TEM micrograph suggests that the grain growth pattern changes with calcination temperature. It is also observed that most of crystallites of $PbTiO_3$ adhere together and form large particles. [14]

Magnetic Properties:

Fig. 5 shows M-H curves. It shows and confirms hysteresis loop behavior to support the ferromagnetic property, for the purpose of the study of magnetic behavior of the synthesized materials. All samples of lead titanate show varying ferromagnetic property. The variation of magnetic susceptibility (χ) as a function of applied magnetic field H vs magnetic moment M is studied by laboratory constructed in VSM at room temperatures for these materials. [18-19] Ferromagnetic properties proportionate to the area of loop.



i j k

Fig. 5 Hysteresis study (M-H loop) for i, j and k for $PbTiO_3$ sintering temperature at 500°C, 600°C and 700°C

Calcination Temperature for $PbTiO_3$	M_r (S.I. Unit A/m^2)	H_s (S.I. Unit Tesla)	Magnetic Susceptibility $\chi_m = \frac{M_r}{H_s}$
500°C	1.43101×10^{-4}	3.4051×10^{-3}	4.2020
600°C	1.54560×10^{-4}	4.0580×10^{-3}	3.8080
700°C	1.88190×10^{-4}	5.3410×10^{-3}	3.5230

Table:1 Magnetic Susceptibility of $PbTiO_3$ sintering temperature at 500°C, 600°C and 700°C

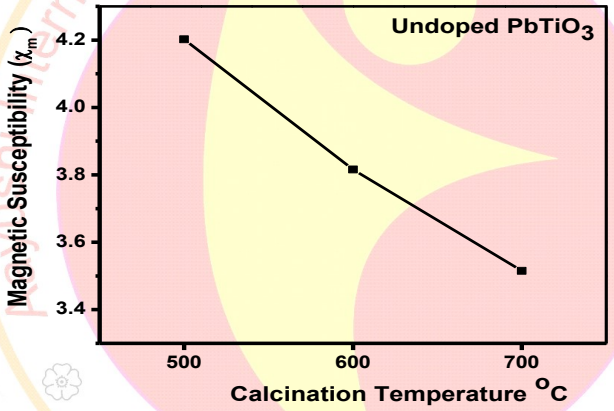


Fig. 6 Magnetic susceptibility of undoped $PbTiO_3$

Fig. 6 and table 1 shows the lead titanate the magnetic susceptibility, when the calcination temperature rises from 500°C to 600°C, the susceptibility decreases. However, when the temperature rises to 700°C, the susceptibility seems to decrease even more. As shown in Figure 6, the magnetic susceptibility decreases as the calcination temperature increases

Conclusion:

This work done is attempted for generalizing the reaction for material synthesis by using the wet chemical route successfully. The average crystallite size 20.48 nm, 25.48 nm and 32.84 nm respectively at 500°C, 600°C and 700°C calcinations was assured from XRD peaks. The variation in c/a ratio showed transition from Cubic to tetragonal phase. The grain size also increase with increased calcination temperature. The smallest crystallite size in the range 20.48 – 32.84 nm can be obtained at low calcination temperature 500°C. TEM micrographs showed that the produced pure lead titanate nano-powders were formed in the nano-spheres with narrow particle size distribution.

Under ferromagnetic studies, the magnetic properties of lead titanate have been confirmed according to the hysteresis loop as well as the magnetic susceptibility of the material to temperature is known. Confirmative ferromagnetic hysteresis loop for magnetic nature of the materials shows competing remnant coercive corrosive field, this knowledge can be applied in DRAM memories.

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Analytical Study of Generalized Sumudu-Laplace Transform in Distributional Sense

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Abstract:

Integral transforms are broadly used for finding the solution of problem in various areas of engineering and science. Laplace Transform is a very powerful tool to solve mathematical problem such as ordinary differential equation, partial differential equations. In recent days a new transform called as Sumudu transform arises as alternate integral transform to solve differential equations, initial boundary value problems.

In this paper, we developed a new integral transform that is Sumudu-Laplace Transform in the distributional sense. This paper is mainly focuses on to prove Sumudu-Laplace Transform of a function is analytic by keeping parameter k fixed.

Keyword: *Sumudu Transform, Laplace Transform, Sumudu-Laplace Transform, Generalized function, Testing function space.*

1. Introduction

Most popular integral transform which is used in solving differential and integral equations is Laplace Transform. It is also predominantly used in the electrical circuit where frequency domain analysis is used. A lot of work has been already done on theory and application of integral transform such as Laplace, Mellin, Fourier, Hankel and many more.G. K. Watugala introduced a new transform and named as Sumudu Transform. There are several interesting advantages of Sumudu Transform as compared to other integral transform especially the unit preserving feature. This feature come up with convenience for solving the ordinary differential equations and partial differential equation.

Sumudu Transform applications to partial differential equations, immediately followed Watugala's [1] seminal work. Watugala's [2] work showed that the Sumudu Transform can be effectively used to solve ordinary differential equations and engineering control problems. Once more, Watugala's work was followed by Weerakoon [3] introducing a complex inversion formula for the Sumudu Transform. The theory of Sumudu transform, defined for functions of exponential order, is adequate for many applications in mathematics for solving ordinary and partial differential equation and control engineering problems. Belgacem et.al. showed that the Sumudu Transform closely related with the Laplace Transform.

The Sumudu Transform with parameter k of $f(x)$ denoted by $S[f(x)]=F(k)$ and is given by

$$S[f(x)]=F(k)=\frac{1}{k}\int_0^{\infty} e^{-\left(\frac{x}{k}\right)} f(x)\,dx \text{ for parameter } k>0 \quad (1.1)$$

The Laplace transform with the parameter s of function $f(z)$ denoted by $L[f(z)]=F(s)$ and is given by,

$$L[f(z)]=F(s)=\int_0^{\infty} e^{-(sz)} f(z)\,dz \text{ for parameter } s>0 \quad (1.2)$$

Let $f(x,z);x,z\in R^{+}$ be a function which can be expressed as a convergent infinite series, then the conventional Sumudu-Laplace Transform is defined as

$$SL\{f(x,z)\} = F(k,s) = \int_0^\infty \int_0^\infty f(x,z)\,K(x,z)\,dx\,dz \quad (1.3)$$

where, $K(x,z) = \frac{1}{k}\, e^{-\left(\frac{x}{k}+sz\right)}$

Here we are going to introduce Sumudu-Laplace Transform with the definition and its analytical study in the distributional generalized sense. For the generalization of Sumudu-Laplace Transform and for its analytical study, various testing function spaces are required, which we have been defined and discussed in this paper by Gelfand-Shilov technique.

The outline of the paper is as follows: Testing function Spaces are defined in section 2. In section 3 definition of Distributional generalized Sumudu-Laplace Transform is given. The main course of this paper that is Analyticity Theorem is proved in section 4.Lastly in section 5 conclusions are given.

The notations and terminology as per A. H. Zemanian [5], [6].

2. Testing Function Spaces for Sumudu-Laplace Transform:

2.1. The Space $SL_{a,c,\alpha}$

Let I be the open set in $R_+ \times R_+$ *and* E_+ denotes the class of infinitely differentiable function defined on I, the space $SL_{a,c,\alpha}$ is given by ,

$$SL_{a,c,\alpha} = \left\{ \phi : \phi \in E_+ \,/\, \gamma_{a,c,q,l}\,\phi(x,z) = \sup_{I_1} \left| K_{a,b}(x) K_{c,d}(z) D_x^l\, D_z^q\, \phi(x,z) \right| \le C_{l,q} A^a a^{a\alpha} \right\}$$

Where the constants A and $C_{l,q}$ depend on the testing function ϕ.

2.2.The Space $SL_{a,c,\alpha}^{\beta}$

It is given by

$$SL_{a,c,\alpha}^{\beta} = \left\{ \phi : \phi \in E_+ \,/\, \rho_{a,c,q,l}\,\phi(x,z) = \sup_{I_1} \left| K_{a,b}(x) K_{c,d}(z) D_x^l D_z^q\, \phi(x,z) \right| \le C A^a a^{a\alpha} B^l l^{l\beta} \right\}$$

Where the constants A, B and C depend on the testing function ϕ.

3. Distributional Generalized Sumudu-Laplace Transform (SLT): -

For $f(x,z) \in SL_{a,c,\alpha}^{*\beta}$, where $SL_{a,c,\alpha}^{*\beta}$ is the dual space of $FL_{a,c,\alpha}^{\beta}$. It contains all distributions of compact support. The distributional Sumudu-Laplace transform is a function of $f(x,z)$ is defined as,

$$SL\{f(x,z)\} = F(k,s) = \langle f(x,z), \phi(x,z,k,s) \rangle, \quad (3.1)$$

where $\phi(x,z,k,s) = \frac{1}{k}\, e^{-\left(\frac{x}{k}+sz\right)}$ and for each fixed $x\,(0 < x < \infty)$, $z\,(0 < z < \infty)$. Also $k > 0$ $s > 0$. The right-hand side of (3.1) has a sense as an application of $f(x,z) \in SL_{a,c,\alpha}^{*\beta}$ to $\phi(x,z,k,s) \in SL_{a,c,\alpha}^{\beta}$.

4. Analyticity Theorem

Let $f(x,z) \in SL_{a,c,\alpha}^{*\beta}$ anditsSumudu-Laplace transform $F(k,s)$ is defined by

$$SL\{f(x,z)\} = F(k,s) = \left\langle f(x,z), \frac{1}{k}\, e^{-\left(\frac{x}{k}+sz\right)} \right\rangle.$$

Then $F(k,s)$ is analytic for some fixed $k>0$, $s>0$ on Ω_f, where $\Omega_f=\{(k,s):\sigma_1<s<\sigma_2\}$ and

$$D_s F(k,s)=\left\langle f(x,z),\frac{1}{k}e^{-\left(\frac{x}{k}+sz\right)}(-z)\right\rangle \quad (4.1)$$

Proof: Let s be an arbitrary but fixed point in Ω_f. Choose the real positive numbers a, b *and* r such that $\sigma_1<a<s-r<s+r<b<\sigma_2$. Also let Δs be a complex increment such that $0<|\Delta s|<r$.

For $\Delta s\neq 0$, we write

$$\frac{F(k,s+\Delta s)-F(k,s)}{\Delta s}-\left\langle f(x,z),\ \frac{\partial}{\partial s}\frac{1}{k}e^{-\left(\frac{x}{k}+sz\right)}\right\rangle$$

$$\left\langle f(x,z),\ \frac{1}{\Delta s}\frac{1}{k}e^{-\left(\frac{x}{k}+(s+\Delta s)z\right)}\right\rangle-\left\langle f(x,z),\ \frac{1}{\Delta s}\frac{1}{k}e^{-\left(\frac{x}{k}+sz\right)}\right\rangle-\left\langle f(x,z),\ \frac{\partial}{\partial s}\frac{1}{k}e^{-\left(\frac{x}{k}+sz\right)}\right\rangle$$

$$\left\langle f(x,z),\ \frac{1}{\Delta s}\frac{e^{-\frac{x}{k}}}{k}\left[e^{-(s+\Delta s)z}-e^{-sz}\right]\right\rangle-\left\langle f(x,z),\ \frac{\partial}{\partial s}\frac{1}{k}e^{-\left(\frac{x}{k}+sz\right)}\right\rangle$$

$$\left\langle f(x,z),\ \frac{1}{\Delta s}\frac{e^{-\frac{x}{k}}}{k}\left[e^{-(s+\Delta s)z}-e^{-sz}\right]-\frac{\partial}{\partial s}\frac{1}{k}e^{-\left(\frac{x}{k}+sz\right)}\right\rangle$$

$$=\left\langle f(x,z),\psi_{\Delta s}(x,z)\right\rangle \quad (4.3)$$

where $\psi_{\Delta s}(x,z)=\frac{1}{\Delta s}\frac{e^{-\frac{x}{k}}}{k}\left[e^{-(s+\Delta s)z}-e^{-sz}\right]-\frac{\partial}{\partial s}\frac{1}{k}e^{-\left(\frac{x}{k}+sz\right)}$

To prove $\psi_{\Delta s}(x,z)\in SL^{\beta}_{a,c,\alpha}$, we shall show that as $|\Delta s|\to 0$, $\psi_{\Delta s}(x,z)$ converges in $SL^{\beta}_{a,c,\alpha}$ to zero.

To proceed, let C denotes the circle with center at s and radius r_1, where $0<r<r_1<\min(s-a,b-s)$. We may interchange differentiation on s with differentiation on z and by using Cauchy's integral formula, we get

$$(-D_z)^q\psi_{\Delta s}(x,z)=\frac{e^{-\frac{x}{k}}}{k.\Delta s}\left[(s+\Delta s)^q e^{-(s+\Delta s)z}-(s)^q e^{-sz}\right]-\frac{\partial}{\partial s}\frac{(s)^q}{k}e^{-\left(\frac{x}{k}+sz\right)}$$

Now applying Cauchy's integral formula,we get

$$=\frac{e^{-\frac{x}{k}}}{k.\Delta s}\left[\frac{1}{2\pi i}\int_C\frac{\xi^q e^{-\xi z}}{(\xi-s-\Delta s)}d\xi-\frac{1}{2\pi i}\int_C\frac{\xi^q e^{-\xi z}}{(\xi-s)}d\xi\right]-\frac{e^{-\frac{x}{k}}}{k}\frac{1}{2\pi i}\int_C\frac{\xi^q e^{-\xi z}}{(\xi-s)^2}d\xi$$

$$=\frac{e^{-\frac{x}{k}}}{k.\Delta s}\frac{1}{2\pi i}\int_C\left[\frac{1}{(\xi-s-\Delta s)}-\frac{1}{(\xi-s)}\right]\xi^q e^{-\xi z}\,d\xi-\frac{e^{-\frac{x}{k}}}{k}\frac{1}{2\pi i}\int_C\frac{1}{(\xi-s)^2}\xi^q e^{-\xi z}\,d\xi$$

$$=\frac{e^{-\frac{x}{k}}}{k.\Delta s}\frac{1}{2\pi i}\int_C\left[\frac{\xi-s-\xi+s+\Delta s}{(\xi-s)(\xi-s-\Delta s)}\right]\xi^q e^{-\xi z}\,d\xi-\frac{e^{-\frac{x}{k}}}{k}\frac{1}{2\pi i}\int_C\frac{1}{(\xi-s)^2}\xi^q e^{-\xi z}\,d\xi$$

$$= \frac{e^{-\frac{x}{k}}}{k}\frac{1}{2\pi i}\int_C\left[\frac{1}{(\xi-s)(\xi-s-\Delta s)}\right]\xi^q e^{-\xi z}\,d\xi - \frac{e^{-\frac{x}{k}}}{k}\frac{1}{2\pi i}\int_C\frac{1}{(\xi-s)^2}\xi^q e^{-\xi z}\,d\xi$$

$$= \frac{e^{-\frac{x}{k}}}{k}\frac{1}{2\pi i}\int_C\left[\frac{1}{(\xi-s)(\xi-s-\Delta s)} - \frac{1}{(\xi-s)^2}\right]\xi^q e^{-\xi z}\,d\xi$$

$$= \frac{e^{-\frac{x}{k}}}{k}\frac{1}{2\pi i}\int_C\left[\frac{(\xi-s)-(\xi-s-\Delta s)}{(\xi-s-\Delta s)(\xi-s)^2}\right]\xi^q e^{-\xi z}\,d\xi$$

$$= \frac{e^{-\frac{x}{k}}}{k}\frac{1}{2\pi i}\int_C\left[\frac{\Delta s}{(\xi-s-\Delta s)(\xi-s)^2}\right]\xi^q e^{-\xi z}\,d\xi$$

Now $D_x^l\left((-D)_z\right)^q\psi_{\Delta s}(x,z) = \dfrac{(-1)^l e^{-\frac{x}{k}}}{k^{l+1}}\dfrac{\Delta s}{2\pi i}\displaystyle\int_C\frac{\xi^q e^{-\xi z}}{(\xi-s-\Delta s)(\xi-s)^2}\,d\xi$

Now for all $\xi\in C$ and $-\infty<z<\infty$, $\sup_I\left|e^{ax}\,e^{cz}\,\dfrac{(-1)^l}{k^{l+1}}\,e^{-\left(\frac{x}{k}\right)}\right|\le K$,

where K is a constant independent of ξ and z. Moreover, $|\xi-s-\Delta s|>r_1-r>0$ and $|\xi-s|=r_1$,

$C_1=\max\left\{|\xi|^q,\xi\in C\right\}$, consequently

$$\sup_I\left|e^{ax}\,e^{cz}\,D_x^l\,D_z^q\,\psi_{\Delta s}(x,z)\right| = \sup_I\left|e^{ax}\,e^{cz}\,\frac{(-1)^l}{k^{l+1}}\,e^{-\left(\frac{x}{k}\right)}\,\frac{\Delta s}{2\pi i}\int_C\frac{\xi^q\,e^{-\xi z}}{(\xi-s-\Delta s)(\xi-s)^2}\,d\xi\right|$$

$$\le\frac{|\Delta s|}{|2\pi i|}\int_C\frac{KC_1}{(r_1-r)(r_1)^2}\,d\xi$$

$$\le\frac{|\Delta s|}{2\pi}\int_C\frac{C_2}{(r_1-r)r_1^2}\,d\xi,\quad\text{where } C_2=KC_1$$

$$\le\frac{|\Delta s|C_2}{2\pi(r_1-r)r_1^2}2\pi r_1,$$

$$\le\frac{|\Delta s|C_2}{(r_1-r)r_1}.$$

The right-hand side is independent of z and converges to zero as $|\Delta s|\to 0$. This shows that $\psi_{\Delta s}(x,z)$ converges to zero as $|\Delta s|\to 0$.

Which ends the proof.

5. Conclusions

By the survey of literature, we found that Sumudu and Laplace Transform have numerous applications in various field. In this paper, we developed a new integral transform that is Sumudu-Laplace Transform in the distributional generalized sense. This paper is mainly focuses on to prove Sumudu-Laplace Transform of a function is analytic by keeping parameter k fixed which will be useful in solving differential equations.

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Design of Framework of Information Aggregation From Various Websites Using Vector Space Model (VSM)

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Abstract:
Most IR systems compute a numeric score on how well each object in the database matches the query, and rank the objects according to this value. Our proposed research work based upon the concept of web data mining. This is the core domain of proposed work. The Information retrieval (IR) is the activity of obtaining information resources relevant to an information need from a collection of information resources. Searches can be based on non-full-text. Information Aggregation is a service that gathers relevant information from multiple sources to provide convenience and add value by analyzing the aggregated information for specific objective using Internet Technologies. We call the providers of these services aggregators. In proposed work try to implement a new retrieval method. In which work on the problem for comparative analysis of two or multiple websites on same desktop screen. That facility cannot provide by the existing search engines. We have tried to create framework for open number of websites at a time for easy access of contents readings from those multiple websites.
Keywords: *tf; idf; vector space model; cosine similarities; term-document; term-query matrices; dot products.*

1. Introduction

The amount of information from conventional databases and web sources has been growing exponentially in the past few years. Effective use of this huge amount of information has become a major challenge to the research communities working in this area. As far as the frequent changes in technologies and services are concerned, existing business concerns are tending towards making adaptive transformations so as to aggregate and integrate values from relevant information sources.

Information aggregation is a service that gathers relevant information from multiple sources to provide convenience and add value by analyzing the aggregated information for specific objectives using Internet technologies. The providers of this service are called "aggregators" in general. In a broader sense, information intermediaries such as newspapers, magazines, professional journals, and more recently, increasing number of web portals are information aggregators since they all collect information from multiple sources and disseminate it for convenient consumption [1].

Aggregation of information plays a vital role in the construction of knowledge-based systems in various domains, ranging from healthcare, economics, applied science, artificial intelligence, and robotics to decision-making processes and machine learning.

Generally, user tends to search the information for a particular domain and as although the desired information is available on Web; it is in very scattered and varied structures across different geographic locations. Aggregating information in such a complex structure of Web is a challenging task. The combination of characteristics such as comparison, relation, intra-organization and inter-organization aggregation to maximize values in the aggregated information is really a challenging task. Although wrapping technology such as screen scraping, direct data feed with some encoding standard such as XML have been used by research groups in this field, there is a wide scope for research in information aggregation to facilitate varied aggregating services.

2. Vector Space Model

It is easy to understand kind of algebraic model that based on the term-document matrix. Documents presented in the form of vectors in the term space. The terms are the word root and documents represented

generally by the binary vectors of the terms. Even the queries being processed are represented as documents. In the term-document matrix, the terms and the documents represented in the form of row and column vectors [20].

A vector similarity measure used for ranking the retrieved documents. This measure calculated between the query and documents. The length and direction of their vectors used to calculate it. Boolean query conditions are captured by various vector operations. Two documents /terms can be compared with the help of cosine similarity measure. The queries can then be formulated and evaluated against the term-document matrix.

2.1 Advantages of VSM:

- This model works on the disadvantages of the Boolean model, which was able to find only exact matches. Hence, we can say that VSM can deal with partial matches.
- Unlike the Boolean model, the retrieved documents ranked.
- The terms weighted according to their importance.

2.2 Disadvantages of VSM:

- Polysemy and synonymy are not considered.
- This method is computationally intensive in nature and requires a huge amount of processing time.
- Every time we insert some term in the term space we need to calculate all vectors again.
- It is not very efficient when it comes to long documents as they make similarity measure calculation a tedious task.
- False negative matches can also be there especially in the case of documents that have similar content but use different vocabularies. f. False positive matches are also possible in case of prefix/suffix removal.
- It has a pre-processing limitation that parsing can result in spurious hits.

3. **Latent Semantic Indexing Model**

Latent Semantic Indexing refers to an IR model that basically extends the VSM by implementing a dimensionality reduction phase for the term- document matrix. During this procedure, the related terms are grouped together in topics. This phase also aims at estimating the hidden structure and discovering the crucial patterns that associate the words and the corresponding concepts. The available documents are not represented as a "set of correlated terms" but as "a set of concepts". While on one hand, it helps to increase the similarity between same cluster documents, it also aims at decreasing the similarity between the various documents of different clusters [21]

3.1 Advantages of LSIM:

- This model helps to provide increased efficiency and performance as compared to VSM as far as synonymy and polysemy are concerned.
- It can deal with homonymy and synonymy.
- It is language independent.
- It can easily adapt to new/changing terminologies.

3.2 Disadvantages of LSIM:

- It is expensive as compared to the traditional VSM.
- It is not easy to add new documents
- It requires a large document corpus

4. **Latent Dirichlet Allocation Model**

LDAM is a "generative probabilistic model" where all the documents are modeled as "random mixtures over latent topics". While using LDAM, every form of data can be conceived as a "mixture of topics". As compared to the Probabilistic Latent Semantic Model, this method supports more reasonable topics [22].

The user states his / her information requirements. That information need structured in the form of a query. The matching process between the documents and the user's query is done via LDAM. Here Ļ and u are

Dirichlet parameters. W refers to a particular word. Z is concerned with a topic while ف is mapped to the topic distribution. Some of the well-known applications of LDAM include:

- Software maintenance
- Software traceability
- Extracting and recovering the topics from the source code
- Software system's categorization
- Measuring the class cohesion

These models are utilized according to their basic functionality. These models are classified according to the way they handle the documents and topics. The processing efficiency of these models is increased using various indexing techniques.

4.1 Advantages of LDAM:

- LDAM has the capability of providing us with a representation of the documents in a lower dimension inside the corpus.
- LDAM is extensively modular and extensible in nature.i.e. it can be easily extended to no multinomial/ continuous data.

4.2 Disadvantages of LDAM:

- Since it is unsupervised in nature, hence its evaluation is somewhat hard.
- There is not a well-defined method to generalize unseen/new documents.

5. Web based Information Retrieval:

The web is a huge and fast-growing collection of publicly available information over the internet. Searching the web for relevant information is becoming difficult as the new public and private networks, hardware devices and information formats being available at internet and the volume of data is growing every day. Deep web, privacy issues during crawling, identification and indexing of dynamic web pages are major concerns that the web search engines are considering as immediate challenges.

Another dimension of the design challenges for a search engine is the interaction with novice users. Novice users are not trained for formal search engine query interface, unlike experts; they are unable to formulate exact information needs in the formal query language of search engine. This may happen because either they are not familiar with the formal query language itself or are unable to express the information needs in the query language. For novice users, a search engine provides a natural language query interface.

A natural language query is capable to address inherent uncertainty in user queries. A reason of the uncertainty in a user query is the fact that human thinks and communicates in vague language. Natural languages queries regarding text, image and other information needs are infinitely capable to represent human thought process, uncertainty, incompleteness and imprecision, increasing the complexity of IR problem manifolds. The needs to handle the uncertainty in representation have resulted in approximated queries using weighted terms and fuzzy linguistic terms.

Different types of document representation/indexing and explicit thesauruses are used to deal with problem of approximate search and fuzzy matching algorithms applied in the history of IR. Recent developments in interdisciplinary research have proved the observation that the computational complexity of uncertain and vague processes is best handled by the integration of soft computing techniques and their hybrid schemes in finding the solution. have benefited with soft computing techniques like ANN, FL, GA and RS and significant improvement in the performance and capabilities of systems are reported, this has motivated our survey in the field of applications of soft computing in web mining. In particular, fuzzy sets are useful in representing the neural satisfaction vector and the feedback of a user with a search engine, because these quantities are uncertain to determine at any point of time and the crisp representation of these quantities is inappropriate to deal with the underlying uncertainty.

Intelligent information retrieval deals with the uncertainty issues present in the underlying decision process. For example, whether a document satisfies a fuzzy description of user requirement? If yes, then up to what degree? What is the answer of different search engines for a particular query? How to combine these

opinions in an optimum way to give a final answer? We consider it an instance of generalized multi objective optimization of list aggregation, constrained by the user requirements and neural satisfaction related feedback abstraction. Finding the best solution meant to find optimized resultant list of documents which includes all or a proportion of the given documents, and displayed list maximizes the gain in terms of user neural satisfaction as an objective function.

Motivations to the research are subjective evaluation of result set on the basis of user feedback, Q o S parameters of search engines and next generation multimedia retrieval. Neural satisfaction driven optimization of information retrieval process is the continued future research direction rather than only focusing on the recall and precision curves in isolation. Soft computing techniques like Fuzzy logic, ANN, GA, Neuro -fuzzy systems, probabilistic fuzzy logic, fuzzy pattern matching are capable to address the issues of uncertainness of representation, specification and querying, uncertainty in the process of searching and matching at different levels of abstractions.

Architectural design of information retrieval system is application specific unlike relational, object-oriented or any other generic database models which are applicable to a class of applications by providing a generalized and reusable framework for defining, updating, querying and managing the database in a DBMS. But actual success of an information retrieval system based on proposed model will depend the domain and complexity of the information, semantics, available knowledge about user and expertise of the user in posing queries to the system, dynamics with which user changes the queries, kind of documents (Text, Web documents, images), size of collection and the nature of search space in terms of update frequency, proportion of the non-relevant documents to a query present in corpus, the dimensionality of availability of a documents in search space as well as the spam pages which are intentionally injected into the search results by following the best practices of black hat search engine optimization communities.

Future of brain mapped information retrieval is highly dependent on how the above issues are addressed with respect to the neural satisfaction vector. In order to provide a self-contained view of the current research work in the field of intelligent information retrieval [23].

6. Information aggregation

Information aggregation is an imitation of human's response process to stimulations. Through new and multilevel combinations of data according to specific rules, and comprehensive analyses from various perspectives, the information aggregation approach can result in state descriptions of the monitored objects and corresponding countermeasures. The information aggregation approach is the most effective means to process massive and multi-variant data. As a result, this paper chose the information aggregation approach as the structure and model to process the comprehensive analysis of equipment state monitored data [24].

7. Parse Hub:

According to [25]The web is full of information that everyone should have access to with just a few clicks. We felt the pain of writing, hosting and maintaining custom web scrapers. Now, we envision a future where anybody can query the world's structured information with ease.

Therefore, we set out to build an easy-to-learn visual data extraction tool that is both simple and friendly to use yet powerful and flexible. By eliminating the major hurdles of gathering data, we want you to spend more time analyzing useful insights, creating beautiful visualizations and products and making key business decisions quickly.

Our goal is to hit the right balance between a beautiful, easy to use interface and a tool that can extract data from any website.

Traditionally, data extraction tools are either too troublesome for a non-technical person to use, or too simplistic to handle the complexity and interactivity of modern websites.

Simple "one-click" tools that appeal to all get quickly defeated by poorly designed, JavaScript intensive web apps, and lose their magic. The need for a powerful and flexible tool that makes data appear right at your fingertips is even more apparent when you look at how much valuable time is wasted collecting data. For

example, data scientists spend 50 - 80 % of their time collecting and preparing data instead of putting it to use. We want to flip this equation around.

For developers, Parse Hub gives you full control over how you select, structure and modify elements, so you don't have to hunt through your browser's web inspector. You will never have to write a web scraper again; and can use Parse Hub to handle interactive maps, infinite scrolling, authentication, dropdowns, form and more with ease.

You also don't need any technical knowledge to get started. Our "quick select" feature figures out exactly how a webpage is structured and groups related pieces of data together for you. All you have to do is open a website and click on the information you want to extract!

This cites are the motivation of our work this is also performs the similar types of work. The brief discussion about our work explained in next unit.

8. Result and Conclusion

Information Aggregation is the task of clustering the information. The purpose of clustering is the finding the knowledge. The outcome of report presented in given unit. This unit classify in the three sections in which the main section is Result of research work. There will not concrete output in proposed work. The accuracy of information retrieval is measure with the parameter of recall and precision. However, in propose work new approach will introduce by Researcher. That new approach is the main out of given research work.

This model is useful for the industrial professional as well as students for performing their comparative study on different websites. This model also helpful to reduce the human resources for access multiple sites at multiple machines, reduce resource coast and introduce new information retrieval techniques. This work is the initial work, to implement fully automated model of this research, need create web crawler for finding the related websites and manipulate calculate or find out its rank on google.

In this we discuss the application of propose methodology of aggregation. The google ranking is use to implement this retrieval method. Performing the comparison of various website, this approach is useful to fulfill this task.

Following webpage shows the outcome of the work.



Figure 8.10 DISPLAY THREE WEB PAGES

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Enhancing Solar Energy Absorption Using Fractal Solar Panels: A Comparative Study

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Abstract

Fractal solar panels have emerged as a promising technology to improve solar energy absorption. This paper reviews various types of fractal solar panels, including Sierpinski , Koch curve, and Mandelbrot fractals, and compares their efficiency with ordinary solar panels. By leveraging the fractal geometry in design, fractal solar panels exhibit increased surface area and the potential for superior energy absorption. This study examines various types of fractal solar panels, focusing on their performance under different environmental conditions, and quantifies their efficiency relative to ordinary solar panels. The results show that fractal solar panels demonstrate higher efficiency in absorbing solar energy, with an increase of up to 25% in absorption. The enhanced efficiency is attributed to the increased surface area, reduced reflection, and improved light trapping.

Keywords: *fractal solar panels, solar energy absorption, efficiency enhancement.*

Introduction

As the global energy demand continues to increase, renewable energy sources such as solar power are gaining prominence. The efficiency of solar panels, however, is limited by factors such as design, placement, and the intermittent availability of sunlight. Conventional flat solar panels have reached a plateau in terms of efficiency, necessitating alternative designs that can capture more sunlight over a broader range of angles and times.(Green,2021)

Fractal designs, based on recursive geometric shapes that are self-similar across different scales, present a promising solution to this challenge. Fractals are known for their ability to maximize surface area, and when applied to solar panels, they have the potential to capture more sunlight throughout the day. This paper explores fractal solar panel technology and compares its energy absorption efficiency with that of traditional flat-panel solar arrays.

Fractal And Fundamentals of Fractal Geometry:

Fractal geometry describes objects or structures that exhibit self-similarity, meaning they repeat a similar pattern at progressively smaller scales. The concept of fractals can be applied to natural phenomena such as trees, lightning, and coastlines, where irregular patterns are repeated in varying sizes as shown in figure 1.(Mandelbrot ,1982)

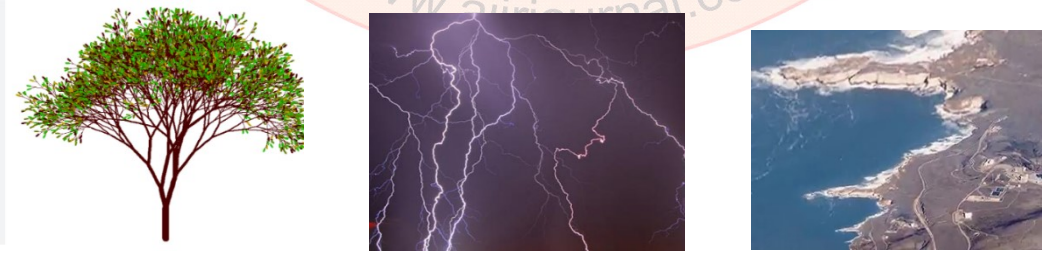


Figure 1 : Fractals In Nature
https://www.google.com/search?sca_esv=51d92fddc59c0275&sxsrf

The application of fractals in engineering and solar panel design involves creating surface structures that increase the overall area exposed to sunlight without a significant increase in material usage. Fractal solar panels leverage this principle to improve their ability to capture solar radiation at various angles, increasing the amount of energy they can harvest throughout the day.

Conventional Solar Panel

Conventional solar panels, also known as traditional or flat-plate solar panels, are the most common type of solar panel used for generating electricity from sunlight. Here's a detailed explanation:

A) Design and Structure:

1. Flat, rectangular shape.
2. Typically made of silicon photovoltaic (PV) cells.
3. PV cells are arranged in a grid-like pattern on the panel surface.
4. Panel frame provides structural support and protection.
5. Glass or plastic cover protects the PV cells from environmental factors.

B) Working Principle:

1. Sunlight hits the PV cells, exciting electrons and generating an electrical current.
2. PV cells produce direct current (DC) electricity.
3. DC power is sent through an inverter to convert it to alternating current (AC) electricity.
4. AC electricity is fed into the electrical grid or used directly by connected devices.

C) Characteristics:

1. Fixed efficiency rate (typically 15-20%).
2. Dependent on sunlight angle and intensity.
3. Require a significant amount of material for the panel frame, glass or plastic cover, and backsheet.
4. Typically installed at a fixed angle and orientation.

D) Advantages:

1. Well-established technology.
2. Wide availability and economies of scale.
3. Relatively low cost.
4. Easy to install and maintain.

E) Limitations:

1. ***Efficiency Plateau:*** Conventional solar panels have reached a plateau in terms of efficiency improvements.
2. ***Angle and intensity dependence:*** Energy production varies with sunlight angle and intensity.
3. ***Material Usage:*** Higher material usage contributes to increased costs and environmental impact.
4. ***Limited Flexibility:*** Fixed shape and size limit installation options.

F) Applications:

1. Residential and commercial rooftop installations.
2. Solar farms and utility-scale power generation.
3. Off-grid and remote power systems.

Overall, conventional solar panels are a reliable and widely used technology for harnessing solar energy. However, their limitations have driven research into innovative solar panel designs, such as fractal solar panels, to improve efficiency and reduce material usage.



Figure 2 : Conventional Solar Panel

https://www.ecmag.com/magazine/articles/article-detail/green-building-beyond-conventional-solar-pv-panels

Fractal Solar Panels

A fractal solar panel is a type of solar panel that utilizes fractal geometry to maximize energy absorption and increase efficiency.(Martinez , 2020)



Figure 3: Fractal Solar Tree
https://www.pv-magazine-india.com/2019/08/22/csir-cmeri-

i. Types Of Fractal Solar Panels :

There are several types of fractal solar panels, each with its unique design and advantages. Here are some examples:

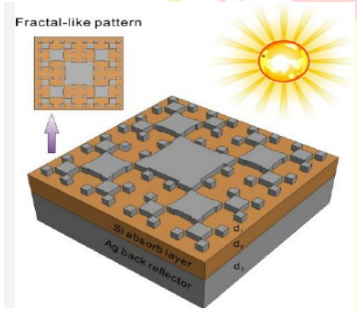


Figure 4: Sierpinski Fractal Solar Panel
https://www.researchgate.net/figure/

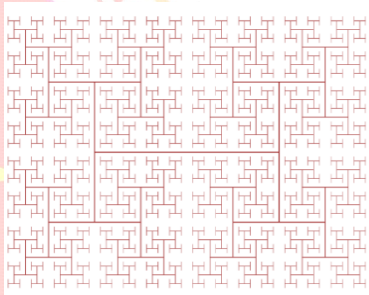


Figure 5 : H – Tree Fractal solar Panel
https://www.pv- magazine.com

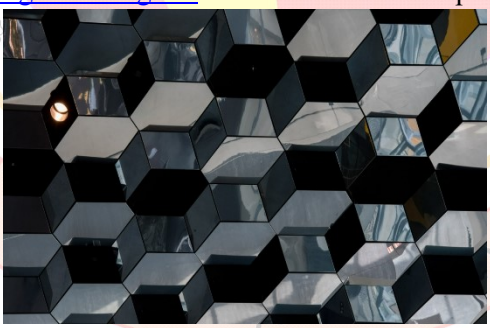


Figure 6: Fractal Solar Panel
https://www.intelligentliving.co/fractal-solar-panels/

Each type of fractal solar panel offers unique advantages and challenges, and researchers continue to explore and optimize these designs for improved performance.

ii. Tree-like Fractal Solar Panels:

Tree-like fractal designs mimic the branching structure of trees, which are optimized by nature to capture sunlight efficiently. These designs feature multiple branches extending from a central trunk, each branch splitting into smaller sub-branches. This configuration maximizes the amount of solar energy captured throughout the day, especially during early morning and late afternoon, when the sun is at a lower angle.(Schwartz, 2018)



Figure 7: Tree Like Fractal Solar Panel
https://www.sciencedirect.com/science/article/pi

iii. Mechanisms of Efficiency Improvement in Fractal Solar Panels:

The efficiency of solar panels is determined by their ability to absorb and convert sunlight into electricity. Several factors contribute to the enhanced performance of fractal solar panels:

iv. Increased Surface Area

Fractal designs inherently create more surface area without a corresponding increase in physical size. This allows fractal solar panels to capture more sunlight than flat panels, especially under conditions where the sun's rays are hitting the panel at an oblique angle. The increased surface area also improves performance under diffuse light conditions, such as cloudy or overcast days.

v. Multi-Angle Light Capture :

Conventional solar panels are most effective when positioned directly perpendicular to sunlight. Fractal panels, on the other hand, are capable of capturing sunlight from a wide range of angles due to their complex surface geometry. This capability reduces the need for solar tracking systems and allows the panels to capture sunlight more consistently throughout the day.

vi. Diffuse Light Harvesting :

Fractal surfaces, with their intricate, irregular structures, are better at capturing diffuse light—light that is scattered in many directions by clouds or atmospheric particles. In areas with frequent cloud cover, fractal solar panels can maintain a higher efficiency than traditional panels.

Comparison of Fractal Solar Panels and Ordinary Solar Panels

To compare the performance of fractal solar panels with conventional solar panels, various factors such as energy absorption efficiency, material usage, and installation flexibility must be considered.(Patel, 2019)
Here's a detailed comparison between Fractal Solar Panels and Ordinary Solar Panels:

1. **Energy Absorption Efficiency :**
   - ***Fractal Solar Panels:*** 20-30% efficient.
   - ***Ordinary Solar Panels:*** 15-20% efficient.

Studies indicate that fractal solar panels can achieve an efficiency improvement of 20-30% compared to traditional flat panels. This improvement is particularly significant during early morning and late afternoon hours when the sun is low in the sky, as well as on cloudy days when diffuse light predominates.

2. **Angle Tolerance :**
   - ***Fractal Solar Panels:*** Improved angle tolerance, maintaining efficiency at various angles.
   - ***Ordinary Solar Panels:*** Efficiency decreases as angle of incidence increases.
3. **Material Usage**
   - ***Fractal Solar Panels:*** Reduced material usage while maintaining or increasing efficiency.
   - ***Ordinary Solar Panels:*** Higher material usage.
4. **Design Flexibility :**
   - ***Fractal Solar Panels:*** Flexible design options, allowing for innovative applications.
   - ***Ordinary Solar Panels:*** Limited design flexibility.
5. **Cost :**
   - ***Fractal Solar Panels:*** Higher cost compared to ordinary solar panels.
   - ***Ordinary Solar Panels:*** Relatively low cost.
6. **Manufacturing Complexity :**
   - ***Fractal Solar Panels:*** Higher manufacturing complexity.
   - ***Ordinary Solar Panels:*** Established manufacturing process.

7. Scalability:
- ***Fractal Solar Panels:*** Limited scalability due to manufacturing complexity.
- ***Ordinary Solar Panels:*** Wide scalability.

8. Aesthetics:
- ***Fractal Solar Panels:*** Unique, innovative design.
- ***Ordinary Solar Panels:*** Traditional, flat design.

9. Environmental Impact:
- ***Fractal Solar Panels:*** Reduced material usage, potentially lower environmental impact.
- ***Ordinary Solar Panels:*** Higher material usage, potentially higher environmental impact.

10. Innovation:
- ***Fractal Solar Panels:*** Emerging technology, potential for future innovation.
- ***Ordinary Solar Panels:*** Established technology, limited room for innovation.

11. Material and Cost Considerations:

While fractal designs improve the efficiency of solar panels, they may also require more complex manufacturing processes. The additional surface complexity can increase production costs, although advances in 3D printing and nano-fabrication may mitigate these costs in the future. Despite the increased complexity, fractal solar panels often use similar or slightly less raw material than conventional panels because of the efficient use of surface area.

12. Installation and Space Efficiency:

Fractal panels can be deployed in smaller spaces due to their ability to capture sunlight from multiple angles. In applications where space is limited—such as rooftops or urban environments—fractal solar panels offer a distinct advantage. Moreover, their multi-angle capture capability reduces the need for complex solar tracking mechanisms, simplifying installation and maintenance.

The comparison is based on current research and development in fractal solar panels. As the technology advances, the pros and cons may evolve.

Challenges and Future Research

Although fractal solar panels show great promise, challenges remain in terms of scaling production, optimizing designs for different environments, and reducing costs. Future research is needed to explore materials that complement fractal designs, such as nanostructured coatings that can enhance light absorption even further. Additionally, studies on the long-term durability of fractal solar panels in different climates are necessary to ensure their commercial viability.

Conclusion

Fractal solar panels offer improved efficiency, angle tolerance, and reduced material usage compared to conventional solar panels. However, they are still an emerging technology with higher costs and manufacturing complexity. Conventional solar panels are established and widely available but have limitations in efficiency and design flexibility.

Fractal solar panels represent a significant advancement in solar energy harvesting technology. By leveraging the principles of fractal geometry, these panels can achieve higher energy absorption efficiency compared to conventional flat-panel designs, particularly in environments with variable sunlight. While challenges remain, ongoing research and technological advancements hold the potential to make fractal solar panels a practical and efficient solution for renewable energy generation.

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Photoluminescence study of Ba3Gd1-x(BO3)3: xEu3+[0.01 ≤ X ≤ 0.06 mole %]

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Abstract :
The polycrystalline powder sample of Ba3Gd1-x (BO3)3: X Eu3+ (0.01 ≤ X ≤ 0.06 mole %) is prepared by the solution combustion technique. The powder XRD & FTIR technique confirms the formation of phosphor in the desired crystalline phase. SEM images of the synthesized phosphor show irregular grains with an average particle size of 2.5µm. The luminescence properties of the synthesized phosphor are investigated at room temperature. Ba3Gd0.97 (BO3)3:0.03Eu3+ shows red photoluminescence under NUV excitation. [5D1→7F2] transition of Eu3+ in the host produces a 614 nm emission line under 381nm excitation. This phosphor may be a promising red component for possible applications in the marking inks and white LEDs.
Keywords: Borate phosphor, Photoluminescence, Red emission, Solution combustion, W- LED

1 Introduction

The syntheses of compounds M3Ln(BO3)3 M =Sr, Ba and Ln=La–Lu, Sc, Y have been reported in recent past years [1]. The spectroscopic properties of vacuum ultraviolet and x-ray excited Ce3+ ion-activated Ba3Gd(BO3)3 have been reported by Hong-bin Liang et.al. They studied luminescence properties of Ce3+-doped barium gadolinium borate Ba3Gd(BO3)3:Ce3+ under VUV, UV, and X-RAY excitations. Ba3Gd(BO3)3:Ce3+ is a poor x-ray phosphor. The dopant Ce3+ is slightly larger than Gd3+ but it will not distort the crystal lattice of Ba3Gd(BO3)3too seriously and is expected to replace Gd3+ ions [2]. Ba3Gd(BO3)3 doped with Eu3+ ion was first prepared by high temperature solid-state method and luminescence was studied by ZHOU Liya et.al. Ba3Gd(BO3)3:Eu3+ phosphor was effectively excited by the near ultraviolet (UV) light (396 nm) and blue light (466 nm). The main emission peaks are at 611 and 616 nm ie it was red emitting phosphor [3]. We are reporting the same phosphor ieBa3Gd1-x(BO3)3 : X Eu3+ prepared by solution combustion method and studied its photoluminescence characteristics. The results were improved and reported in this research work.

2 Material and method

Given Inorganic borate phosphors were prepared by the solution combustion synthesis technique [4,5]. Stoichiometric amounts of high purity starting materials, Ba (NO3)2 (A.R.), H3BO3 (A.R.), CO (NH2)2 (A.R.), Gd (NO3)3.6H2O (A.R.), Eu (NO3)3.5H2O as given in table (1) are used for phosphor preparation. The starting materials with little amount of double distilled water were mixed thoroughly in agate mortar to obtain a homogeneous solution. Excess water was removed by heating the samples at temperature 100OC for about 30 min and the paste was then transferred directly to a pre-heated Muffle furnace, maintained at temperature 680oC, for combustion. Following the combustion, the resulting foamy samples was crushed to obtain fine particles and then annealed for 3h at temperature 950oC. As prepared Borate phosphor material was characterized by powder XRD, SEM, PL and FT-IR techniques. Surface morphology and elemental analysis of the calcined powder sample was observed by scanning electron microscopy [SEM:Model JSM6100 (Jeol)].

3[Ba (NO3)2] + x [Eu (NO3)3.5H2O] + (1-x) Gd (NO3)3.6H2O + 3H3BO3 + CO (NH2)2

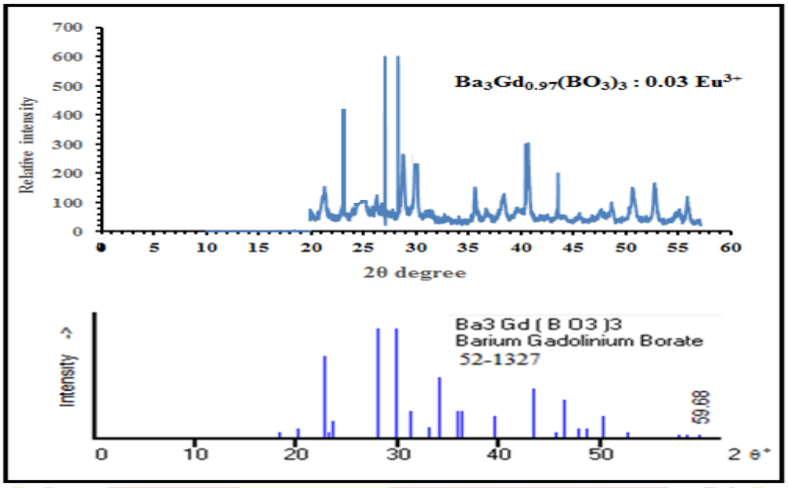
Results into Ba3 Gd1-x (BO3)3:xEu3+ Gaseous products.

3 Results and Discussion

3.1 X-ray diffraction

X-ray diffraction pattern of Ba3Gd0.970 0.03Eu3+ (BO3)3 phosphor is shown in figure (1). The pattern is compared with standard JCPDS file number 52-1327. The maximum peaks matches with the standard pattern. The additional peaks are present in recorded pattern are due to impurities. Sharp peaks in XRD pattern are due to large crystallite size. X-ray pattern of Ba3Gd (BO3)3 matches with X-ray pattern of low temperature phase of Ba3Y (BO3)3. "Space group of phosphor Ba3Gd (BO3)3 is R3 (148) and cell parameters are a = 13.06,

c=9.552. V= 1412.42 Ao3. A detailed structure description of Ba3Gd (BO3)3 was not found in literature. Bing Han et.al (11. Han 2007). in his work mentioned that Ba3Gd(BO3)3 is isomorphic with H-Ba3Y(BO3)3 for the following three reasons: (1) The powder XRD patterns of Ba3Gd(BO3)3 and H-Ba3Y(BO3)3 are similar. (2) The ionic radii of Gd3+ [RGd(III)] = 93.8 pm are close to that of Y3+ [RY(III)]=90.0 pm in six fold coordination. (3) It was found that the unit cell parameters [a=13.067(3) Å, c=9.552(3) Å, trigonal, R3] of Ba3Gd (BO3)3 are similar with that [a=13.028(2) Å, c =9.4992(2) Å, trigonal, R3] of H-Ba3Y(BO3)3" (11. Han 2007).



3.2 FTIR

The FTIR spectra of $Ba_3Gd_{1-0.03}(BO_3)_3$:0.03Eu^{3+} recorded at room temperature is shown in Figure (2). "1193 cm−1, 710 cm−1 peaks are due to B-O bond lengthening state of $[BO_3]^-$, while bands about 700 –530 cm−1 should be attributed to B-O out of plane laminar bending, which confirms the existence of $[BO_3]^-$" (Shahare 1993).

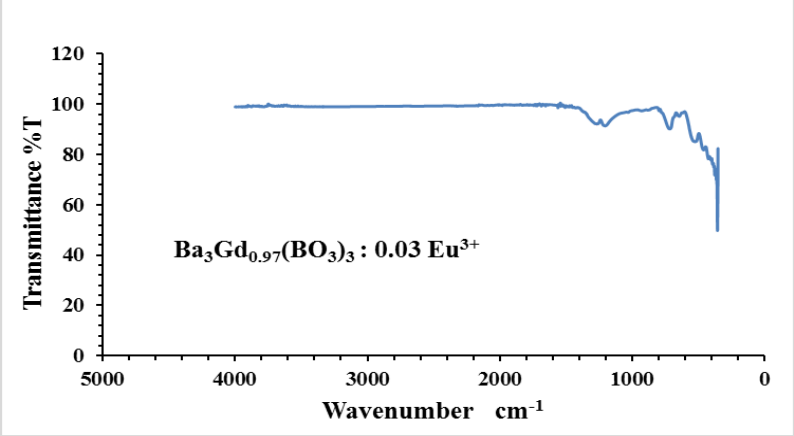


Fig.2— FTIR of Ba3Gd.0.97(BO3)3:0.03Eu3+

3.3 SEM

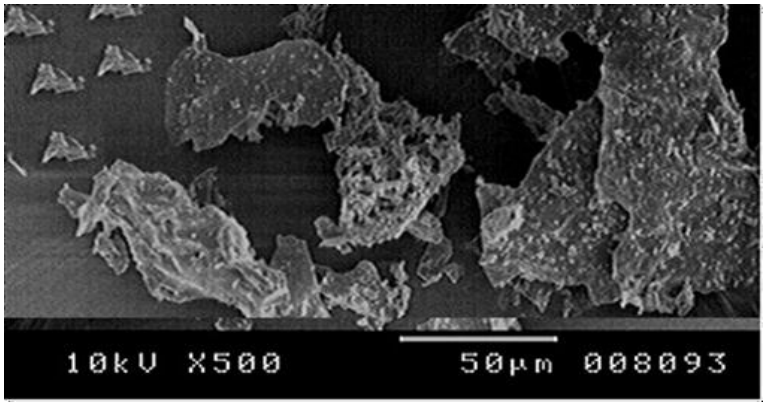


Fig. 3 — SEM Image of phosphor host

SEM was used to examine the surface features of the compound. Figure (3) represent the SEM photograph of Ba3Gd1-0.03(BO3)3:0.03Eu3+. The phosphor's microstructure was discovered to be made up of rough iotas with agglomeration occurrences. Synthesized phosphor particles have an average size of roughly 50 micrometers. Phosphors exhibit good crystallinity and a low sinter temperature, according to the findings. According to the Scherer formula, the average crystalline size is 42.2 nm, which is approximately identical to the surface morphology. The picture of polycrystalline particles may be seen with a scanning electron microscope, and XRD data can be used to determine the size of crystalline domains.

3.4 Photoluminescence study

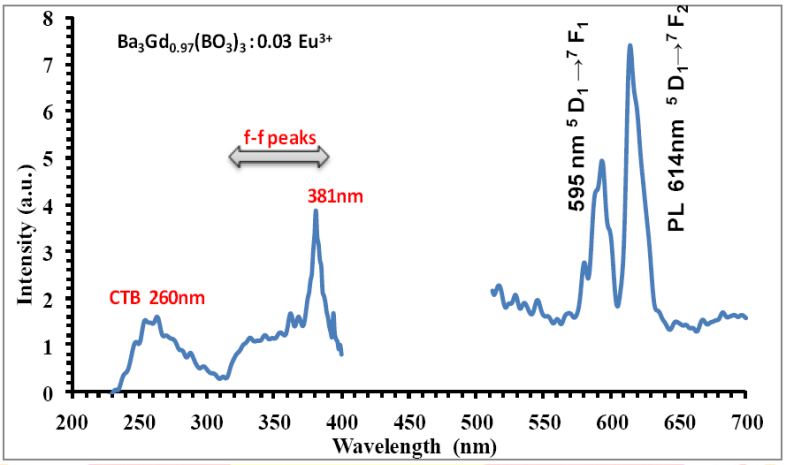


Fig.4— PL and PLE OF Ba3Gd0.97(BO3)3 : 0.03 Eu3+

The PL and PLE of Ba3Gd0.97(BO3)3: 0.03 Eu3+ is shown in figure (4). The excitation spectrum consists of a broadband from 200 to 400nm with CTB at 260nm and high intensity f-f peaks at381nm. Excitation peak of 260nm is due to C.T.B. of Eu3+ to O2- and less intense peaks at 334nm, 374nm, 395nm are due to 7F0→5H3, 7F0→5D4, 7F0→5L6 transition lines of Eu3+ respectively. 381nm PLE peak is due to 7F0→5L7 transition. P.L.E. monitored at 381nm consist of a series of sharp lines at 595nm [5D1→7F1], 614nm [5D1→7F2]. Ba3Gd0.97(BO3)3: 0.03 Eu3+ effectively excited by UV (260nm) and near uv (381nm) light. Under 381nm it shows emission band in 500nm to 700nm with two peaks at 595nm and 614nm. Intensity of 614nm is maximum in PL. So Ba3Gd(BO3)3 is NUV excited RED emitting phosphor. PL of Ba3Gd1-x(BO3)3: x Eu3+ [0.01 ≤ X ≤ 0.06 mole %] is shown in figure (5). Photoluminescence intensity is maximum for 0.03 mole % of Eu3+.

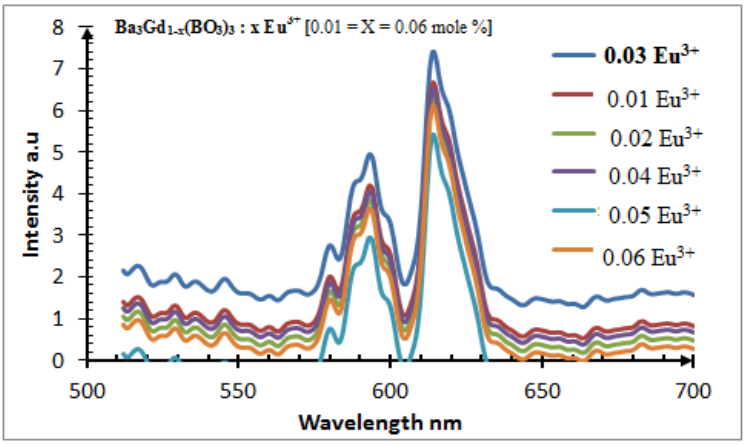
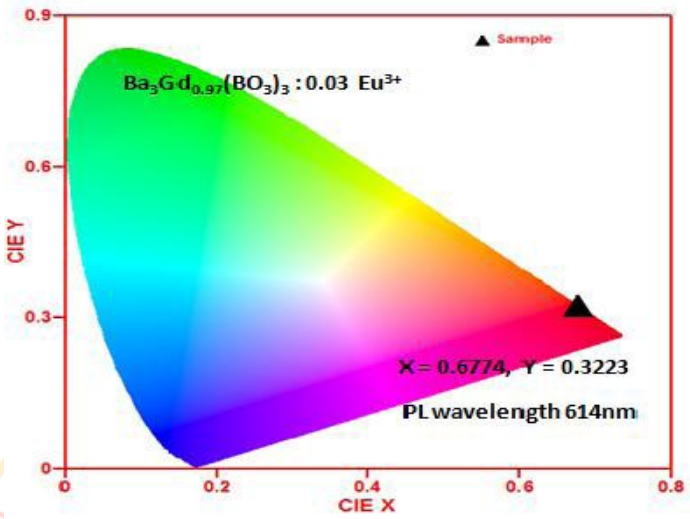


Fig.5—PL of Ba3Gd1-x(BO3)3 : x Eu3+ [0.01 ≤ X ≤ 0.06 mole %]

3.5 CIE-Chromaticity diagram

Figure (6) shows DelEclairage (CIE) diagram of Ba3Gd0.97(BO3)3: 0.03 Eu3+ phosphor at 614nm. "The color hue values of Ba3Gd0.97(BO3)3 : 0.03 Eu3+ at 614 nm was computed using freeware"

(https://www.ledtuning.nl/en/cie-convertor n.d.) and "C.I.E. diagram plotted by plot utility software"(http://faculty.iitr.ac.in/~krjt8fcy/gocie.html n.d.). CIE co-ordinates for Ba3Gd0.97(BO3)3: 0.03 Eu3+ at PL wavelength 614nm are X = 0.6774, Y = 0.3223. It comes in red region of diagram and is shown as black point in figure (6).



4 Conclusions

The $Ba_3Gd_{1-x}(BO_3)_3$: X Eu^{3+}polycrystalline phosphor was synthesized by solution combustion method using urea as a fuel. Using XRD formation of compound is confirmed and it matches with standard JCPDS file number 52-1327. Using FTIR presence of $[BO_3]^-$ groups, coordination environment of B-O in structure and complete combustion of nitrates and organic matter were confirmed. SEM shows the average size of synthesized phosphor particles was about 2.5 µm and good crystalline. Phosphor shows broad excitation band from 200 to 400 nm with prominent peak at 381 nm. PLE for characteristic emission wavelength595nm& 614nm was found to be 381 nm. At 381 nm, UVlight excitation $Ba_3Gd_{1-x}(BO_3)_3$: X Eu^{3+} phosphor emits red light. So $Ba_3Gd_{1-x}(BO_3)_3$: X Eu^{3+} is red emitting phosphor suitable for UV – CHIP Red LED lights and WLED. It is also a potential candidate for invisible luminescence coating or marking material indicating red emission under UV excitation.

Acknowledgements

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Investigating CO2 Gas Sensing Characteristics of PANI/SnO2 Nanocomposite Thin Film

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Abstract:

Solution route technique is one of the easiest methods for synthesis of organic and inorganic materials at room temperature. PANI/SnO2 nanocomposite was synthesised by solution route technique and thin film was deposited on glass substrate during polymerization. The obtained nanocomposite was characterized by X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), Ultraviolet-Visible Spectroscopy (UV-Vis. Spectroscopy) and Scanning Electron Microscopy (SEM). XRD graph reveals the shift in the PANI peak due to the presence of SnO2 nanoparticle and the size of the composites is found to be 1.8 nm. IR spectra show some vibrational peaks of SnO2 and shift the characteristics peaks of PANI at different wavenumber. Optical spectroscopy shows absorptions band of different states of PANI/SnO2 nanocomposite. The structural analysis was done by SEM micrographs which indicates the average grain size and growth of SnO2/PANI nanocomposite thin film. Finally, PANI/SnO2 nanocomposite thin film has exposed to CO2 gas to note down its sensitivity in the form of response and recovery time by varying the temperature of nanocomposites.

Keywords: *Polyaniline (PANI), Tin Oxide (SnO2), Nanocomposites, Gas Sensor*

Introduction:

The presence of toxic gases in an environment has been leading concern due to their adverse effect on human and animal health, climate change, biodiversity and air pollution. To overcome this situation, a strong gas detecting system is required which can detect those toxic gases present in the surrounding. Sensor technology is the technique used to detect such type of gases. Now a days researchers have focused on developing a strong gas sensing device to sense harmful gases like NH3, CO2, CO, NO2, NO etc. In the past few years, significant efforts have been placed on the advancement of proper gas-sensitive materials aimed at producing affordable, selective, and low-temperature operational gas sensors. One of such material is metal oxides, they have been used for long time for various sensing devices due to their properties like fast response time, high sensitivity, and for better stability. Many metal oxides like TiO2, ZnO, SnO2, Fe2O3 etc. are used for sensing purpose. Tin Oxide (SnO2) is one of the most promising metal oxides which has been frequently used for sensing harmful gases due to its sensing properties [1-2]. SnO2 is a n-type semiconductor metal oxide having wide band gap (~3.6 eV). SnO2 based gas sensors successively detects CO, CO2, NOx gases and water vapor [3]. Therefore, it is widely studies for gas sensing application. SnO2 can be efficiently used for for gas sensing applications because of low cost, high gas response and chemical stability [4]. But major drawback of metal oxides is their high operating temperature.

On the other hand, Organic materials like conducting Polymers (CPs) are established immense potential in application like health monitoring devices, wearable and flexible electronic devices and many more. Among many CPs, most commonly used for sensors with high sensitivity are polypyrrole (PPy), polyaniline (PANI), polythiophene (PTh) [5-6]. They are used for various kinds of sensors such as gas sensors, temperature sensors, humidity sensors, strain sensors, biosensors etc. Moreover, the combination of CPs and other sensing materials such as metal oxides, metals, metal sulphides etc enhances the sensing performance [7].

Among different conducting polymers PANI has received considerable attention for promising result to sense gases at room temperature. Although PANI has tremendous properties but it has low thermal stability and mechanical strength [8-10]. Also, sensitivity of PANI based sensors is less than that of Metal oxides-based sensors on high operating temperature. To overcome these limitations, researchers are working on adding metal oxide into the matrix of PANI to obtained nanocomposite [11-14]. Shivam Kumar Gautam et. al. PANI-metal

oxides composite has shown enhancement in the sensing characteristics like sensitivity, selectivity, and response time that to at low operating temperature for NH3 gas [15].

The present work involves the fabrication of SnO2/PANI nanocomposite thin film using solution route technique for CO2 gas sensing.

Materials and Method

Materials: Aniline (C6H5NH2) (Qualigens), Tin (II) Chloride Dehydrate (SnCl2·2H2O), Hydrogen Peroxide (H2O2), Ammonium Persulphate (APS) [(NH4)2S2O8] and hydrochloric acid (HCl) (all chemicals having AR grade) were of CDH company.

Synthesis of PANI/SnO2

PANI/SnO2 nanocomposite thin film was synthesized by solution route technique [16]. 0.3M of SnCl2·2H2O is dissolved in 50 ml double distilled water (DDW) and stirred on magnetic stirrer for 25 minutes. Few drops of conc. HCl was added to maintain the pH ≤ 4 of solution. Then 10 ml of Hydrogen Peroxide (H2O2) was added in solution to oxidized tin ions to tin oxide. With further stirring for 25 minutes, 0.1M aniline was added to above solution and was continuously stirred for 20-25 minutes. Pre-cleaned glass substrate was immersed in the solution vertically. After that ammonium persulphate (APS) ((NH4)2S2O8) solution was added drop-by-drop in the above mixture. Solution changes its colour to green indicating polymerization and formation of PANI/SnO2 composites. Growth of thin film was obtained on the glass substrate. The solution was kept overnight and precipitate obtained in the reaction was removed by filtration. Afterwards it was washed with DDW and dried for 24 Hours.

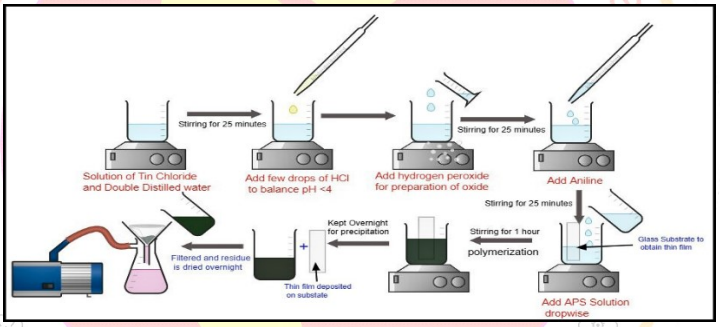


Fig. 1. Schematic representation of the synthesis of PANI/SnO_2 composite thin film

Result and Discussion:

XRD: The XRD graph of nanocomposite was recorded on Rigaku Mini Flex 600 diffractometer. The PANI/SnO_2 nanocomposite was characterized by X-ray diffraction (XRD). Four peaks at 26.44º, 33.66º, 51.84º and 64.20º corresponding to (110), (101), (211) and (112) planes respectively are observed in XRD pattern of PANI/SnO_2 nanocomposite (Figure 2). Observed peaks and corresponding planes as compared with standard (h k l) planes (PDF Card No.: 1534785) founds good match between two values [17-18]. The particle size of nanocomposite is calculated by using Debye-Scherrer formula and which was found to be 1.8nm. This confirm that the nanocomposites having nanosized particle of SnO_2 incorporated with PANI matrix.

Debye-Scherrer Formula: $$D = \frac{K\lambda}{\beta cos\theta}$$

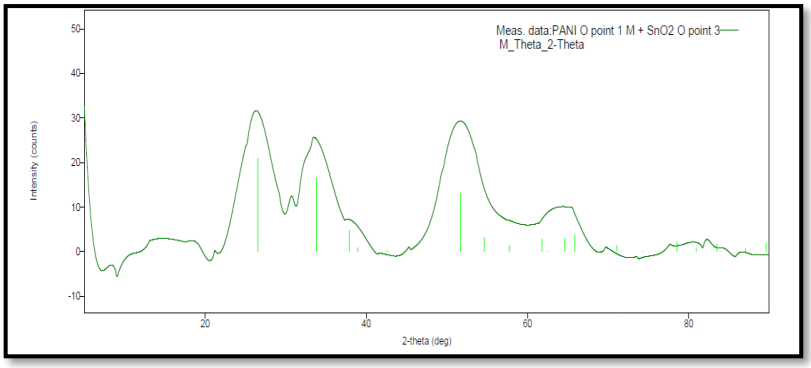


Fig. 2. XRD pattern for PANI/SnO_2 nanocomposite

UV-Visible Spectroscopy:

The UV-Vis spectra of the sample are depicted in figure 3, and they illustrate absorption bands for the PANI/SnO_2 sample at approximately 262 nm, 382 nm, and 1071 nm, which display noteworthy shifts in the absorption spectrum towards higher wavelengths. These bands are likely associated with π-π* transition, polaron-π* transition, and polaron-π transition, respectively [19-20]. This indicates the successful presence of SnO_2 in polyaniline matrix.

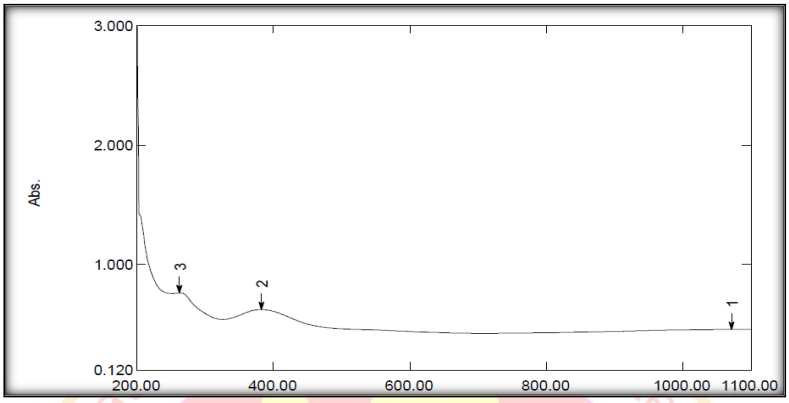
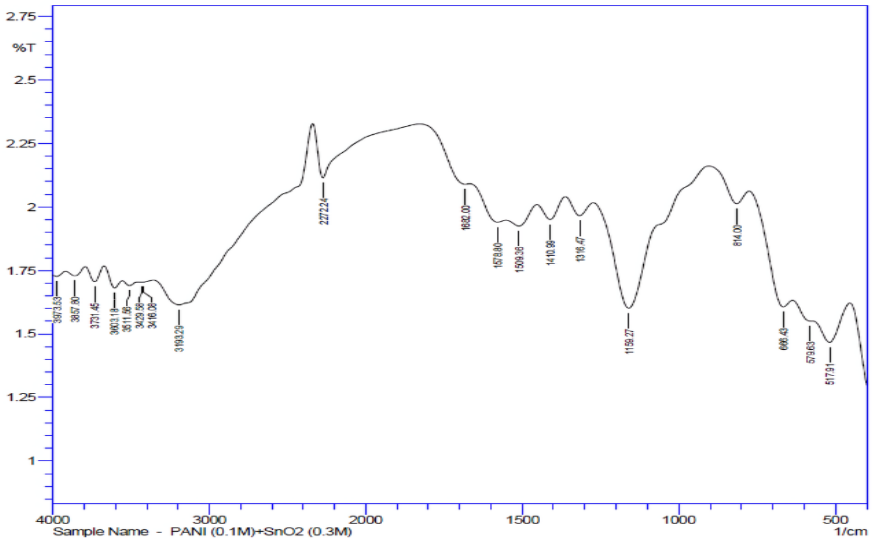


Fig. 3. UV-Visible graph for PANI/SnO_2 nanocomposite

FTIR: The FTIR spectra of the PANI/SnO_2 is shown in Figure 4. The peaks at wave numbers 1578.8, 1509.36, 1410.99, 1316.47, 1159.27, 814, 666.43 and 579.63 cm^{-1} show most of the characteristics peak of PANI. The peaks observed at wave numbers 1578.8 and 1509.36 cm^{-1} are ascribed to the stretching modes of C=N and C=C within the quinoid and benzenoid rings, respectively. At a wave number of 1410.99 cm^{-1}, the peak is associated with the stretching vibrations of the C-C bonds. The peaks located at wave numbers 1316.47 cm^{-1} and 1159.27 cm^{-1} are linked to C–N stretching, and the peak at 814 cm^{-1} is identified as resulting from N-Q-N stretching. A peak at 666.43 cm^{-1} was identified, which is associated with the antisymmetric Sn-O-Sn mode in tin oxide, thus validating the existence of tin oxide in the PANI matrix [21].

Fig. 4. FTIR for PANI/SnO_2 nanocomposite



SEM:

Scanning Electron Microscope (SEM) image of PANI/SnO_2 nanocomposite is shown in figure 5. It is observed that the composites contained a particles having size with diameter ~500nm and the agglomerated form of PANI matrix changes with due to presence of SnO_2 into particle nature. SEM image also shows that surface to volume ratio is more with highest porosity which will help adsorption property of different gases.The sensitivity of nanocomposites depends on porosity of the material [22-23].

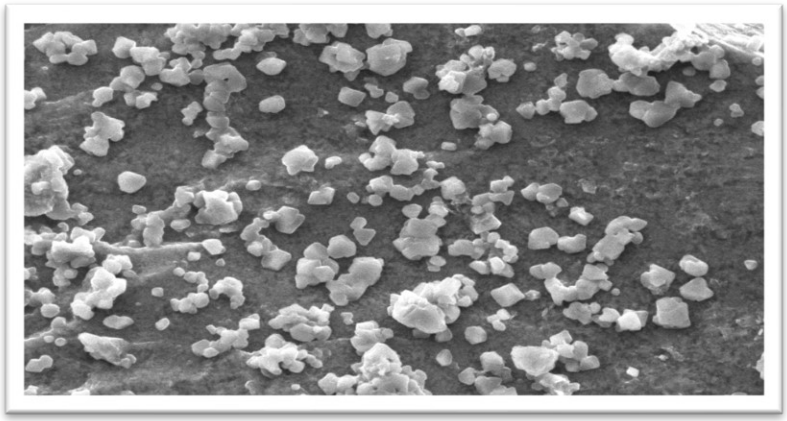


Fig. 5. SEM image for PANI/SnO_2 nanocomposite

Sensing characteristics:

The PANI/SnO_2 nanocomposite was subjected to CO_2 gas testing at various temperatures. A consistent 800 ppm of CO_2 gas was introduced into the test chamber, and the film resistance was recorded with respect to temperature [24-26]. The response and recovery time of the PANI/SnO_2 nanocomposite thin film gas sensor are influenced by the concentration of CO_2 gas. The sensor's response, S, is calculated by comparing the resistance when the gas is present, Rg, to the resistance in clean air, R_0; thus,

$S = \frac{Rg-Ro}{Ro}$.

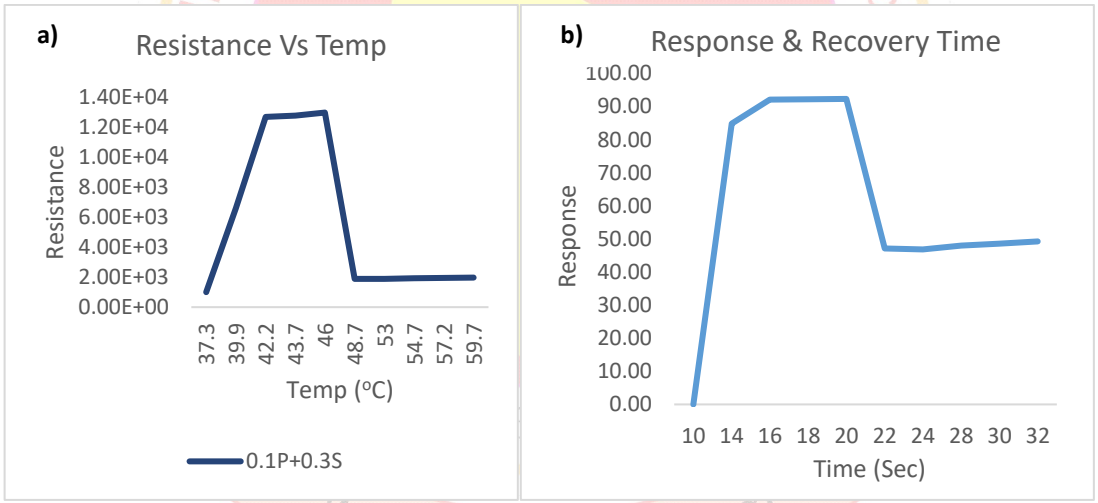


Figure 6. a) Resistance change of PANI/SnO2 nanocomposites thin film
(b)Response & Recovery time curve of thin film

Upon exposure to CO_2, the PANI/SnO_2 nanocomposite thin film exhibited responsive signals at temperatures close to 40-46°C. Result illustrates a significant enhancement in the sensitivity of the nanocomposite sensor film at approximately 46°C, while sensitivity decreases for temperatures above this threshold. This observation indicates that the operational temperature of the PANI/SnO_2 gas sensor is reduced in comparison to pure SnO_2, potentially due to the incorporation of the PANI matrix with the SnO_2 particles. The response and recovery time are found to be ~8 Sec and ~22 sec respectively as shown in figure 6 (a) & (b).

Conclusion:

Solution route technique is the one of the best methods for synthesis of PANI/SnO_2 nanocomposite which was confirmed from various techniques used like XRD, FTIR, UV-Vis, and SEM. X-ray diffraction and SEM graph shows particle size in nanoscale and FTIR shows shifting of characteristics peaks of PANI due to presence of SnO_2 particle. The prepared nanocomposite thin film has been used for sensing application for a gas like CO_2 and shows good results such as sensitivity, selectivity, response time and recovery time. The operating temperature for gas response was found to be 40-46°C and response and recovery time were found to be ~8 Sec and ~22 sec respectively. This confirm that PANI/SnO_2 nanocomposites thin film is good sensing material operated on room temperature.

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Nonlinear Optical Applications of Pure and Doped Tellurite Glasses: A Review

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Abstract

This article provides you with the unique properties of glasses in the nonlinear optical fields. It is also believed to emphasise the significant advantages of tellurite glasses, including their wide infrared transmission range, high nonlinear refractive index, and the ability to dope with rare earth ions that increase their optical performance. This review finds that recent progress in the study of pure and doped tellurite glasses has focused on their fabrication, structural, optical properties, and potential applications in nonlinear optics. The properties of nonlinear optics have been enhanced by using rare earth elements, nanoparticles, as well as various dopants. New opportunities are emerging in photonic technologies such as optical switching, frequency conversion, and all-optical signal processing.

Key words: *Tellurite glasses, Nonlinear optical (NLO) applications, Third-order nonlinearity, Pure and doped tellurite glasses, Transition metal doping, Rare-earth doping, Metallic nanoparticle doping, All-optical signal processing, Optical switching.*

Introduction

Tellurite glasses are amorphous solids and have attracted considerable attention in the field of photonics due to their versatile applications and unique optical properties. Tellurite glass is made of tellurium dioxide (TeO_2). It exhibits many beneficial properties, including excellent chemical stability, significant nonlinear refractive index, high refractive index, and high density. They can transmit infrared in the range of one to six microns. This makes them suitable for various optical applications such as fibre lasers, super continuum generation, and microcavity lasers. Tellurite glasses have been studied for over 150 years, but in recent decades there has been a resurgence of interest due to advances in their purity and manufacturing techniques (1). They are excellent for a variety of optical applications, including super continuum generation, fibre lasers, and microcavity lasers since they can transmit light in the infrared (IR) region of 1-2 µm. While tellurite glasses have been studied for more than 150 years, there has been a resurgence of interest in them recently because of improvements in their manufacturing processes and purity. Modern tellurite glasses can achieve purities above 98.5%, and in many applications, their low melting point and non-hygroscopic nature make them superior to conventional borate and phosphatase glasses (2).

Properties of Pure Tellurite Glasses

2.1 Structural Properties

A strong covalent bond forms a flexible network of tellurite glasses in the basic structure of TeO_3 trigonal pyramid and TeO_4 trigonal bipyramid. The unique network of tellurite glasses for many optical experiments requires high refractive index and infrared transparency (1). The atomic number of tellurium contributes to nonlinear optical behaviour and optical characteristics such as linear refractive index (2).

2.2 Optical Properties

Tellurite glasses gained recognition for their broad transmission window, which spans from the visible (about 400 nm) to the mid-infrared (~6 µm) wavelengths. Applications in infrared optics have benefitted from the wide transparency (2). Tellurite glasses are an effective medium for rare-earth ions, which are frequently employed to improve the nonlinear optical performance of materials because of their low phonon energy (~700 cm^2), which reduces non-radiative losses (3).

2.3 Nonlinear Optical Properties

Tellurite glasses have a significantly higher third-order nonlinear optical susceptibility (χ^3) than other oxide glasses such as silicate or phosphate glasses (3). This property is crucial for a variety of nonlinear optical device applications, including self-phase modulation, third-harmonic generation (THG), and optical switching. In pure tellurite glasses, doping with various elements can further improve the innate third-order nonlinearity; these subjects are discussed in the following sections (4).

Doped Tellurite Glasses

3.1 Rare-Earth Doping

When tellurite glasses are treated with rare-earth ions like Er_2, Yb_2, and Nd_2, their optical characteristics significantly improve. Rare earth element-doped tellurite glasses are highly prized for their improved brightness and nonlinear optical characteristics. For instance, extensive research has been done on the notable infrared emissions of Er^+-doped tellurite glasses, which are crucial for telecommunications applications (5).

3.2 Transition Metal Doping

Transition metals like manganese (Mn), titanium (Ti), and copper (Cu) have also been employed to alter the optical conductivity of tellurite glasses. The components in question enhance the nonlinear optical response of glass by inducing localised electronic states within it. Better third-order nonlinearity in tellurite glasses doped with transition metal is advantageous for optical limiters and other devices that need strong nonlinear responses (6).

3.3 Metallic Nanoparticle Doping

Metallic nanoparticles, especially those derived from silver (Ag) and gold (Au), are an alternative type of dopant that is being added to tellurite glasses in order to benefit from its localised surface plasmon resonance (LSPR) effect. Lighting-shaping surface reflection (LSPR), which significantly improves the nonlinear optical characteristics of the surrounding medium, is produced by metallic nanoparticles that resonate with incident light (7). Studies reveal that the third-order nonlinearity in the glasses is significantly increased when light interacts with the surface plasmons of Ag-doped tellurite nanoparticles. This means that improved nonlinear absorption, frequency conversion, and optical switching can all be accomplished with these materials (8).

Fabrication Techniques

4.1 Melt Quenching

Melt quenching, whereby the glass-forming components are melted at high temperatures (typically around 700°C) and then swiftly cooled to create a glass, is the method most frequently used to manufacture tellurite glasses. With this technique, different dopants can be added during the melting process, allowing the spectral properties to be changed based on the intended application (9).

4.2 Sol-Gel Methodology

Melt quenching has become a less controlled alternative in sol-gel processing, particularly for thin-film applications (10). The process starts with the preparation of a colloidal solution and ends with the glass being produced through gelation, drying, and heat treatment (11). Because sol-gel preparation allows for a more uniform dispersion of the dopants inside the glass matrix, it is especially useful for incorporating metallic nanoparticles (12).

4.3 Fibre Drawing

Especially when manufacturing tellurite glass fibres for use in optical amplifiers and telecommunications, fibre drawing is an extra crucial step in the process (13). Tellurite fibres have an advantage over regular silica fibres in that they are able to transmit light in the mid-infrared region (14).

Nonlinear Optical Applications

5.1 Optical Switching

In optical switching applications, tellurite glasses are highly useful. Given their strong third-order nonlinear susceptibility (χ^3), these glasses are excellent candidates for all-optical switching (15).

5.2 Frequency conversion

which adjusts the refractive index in response to intense light. Given their strong third-order nonlinearity, tellurite glasses are a good choice for nonlinear frequency conversion procedures such as third-

harmonic generation (THG) and four-wave mixing (FWM). These procedures and imaging technologies provide new light frequencies that are utilised in spectroscopy, laser systems, and other applications (16).

5.3 All-Optical Signal Processing

Higher processing speeds are achievable with all-optical signal processing since optical signals are handled directly before converting to electrical signals. Tellurite glasses exhibit significant nonlinear features, making them an excellent option for wavelength converters, pulse shaping tools, and optical logical gates (17).

Challenges and Future Directions

6.1 Stability and Durability

One challenge to the practical application of tellurite glasses is their strong chemical composition. Tellurite glasses are less chemically stable than other oxide glasses, such as silicates (18). The best way to increase these glasses' chemical potency by surface coatings or compositional modifications is still being investigated (19).

6.2 Integration with Existing Technologies

Another challenge lies in integrating tellurite glass fibre with the existing silica-based fibre technology. In the telecommunications business, compatibility between different types of fibre is very important (20). One possible solution to this issue is the creation of hybrid glasses that combine the best features of tellurite and silica lenses (21).

Even though transition-metal ions, metallic nanoparticles, and rare-earth ions have all been widely examined, novel dopants, such as graphene and other 2D materials, may be examined as an approach to further enhance the nonlinear optical characteristics of tellurite glasses (22).

Conclusion

A wide range of nonlinear optical applications find tellurite glasses, either pure or doped, particularly appealing due to their unique properties. They are excellent candidates for use in optical switching, frequency conversion, and all-optical signal processing because of their high refractive index, wide infrared transmission, noticeable third-order nonlinearities, and doping-enabled amplification of these properties. Research should focus on improving the stability and integration of these glasses with existing technologies as well as exploring novel dopants to unlock new functionalities.

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Appraisal on Modern PV Panels, Nanotechnologies & Performances

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Abstract

In this article, the appraisal of the modern technologies of thin, transparent, bifacial, flexible solar panels and other similar options has been conducted. Passive or active cooling solutions are studied with air or water vapour, or energy storage solutions are analysed. Passive air cooling of the photovoltaic panel can reduce temperature by only 10 °C but, by active cooling a cooling with over 30 °C can be maintained. These techniques can be used to improve the energy efficiency of photovoltaic panels. The article presents examples of photovoltaic panels' its applications, as well as the cooling of the PV panel and the recovery of the thermal energy in the form of hot air or hot water, with good efficiency.

Nanotechnology represents a revolutionary path for technological development that concerns the management of material at the nanometer scale (one billion times smaller than a meter). Besides macro-analysis of thin-film solar cells, we also found that even though many nano-structured materials like zinc oxide (ZnO) are found for their potential applications in photovoltaic cells ,it is particularly promising feature of Solar cells.

Keywords: *Photovoltaic cell, Nanotechnology, Zinc oxide*

Introduction

The Solar energy is the inexhaustible renewable type of energy. We are getting tremendous amount of energy from the Sun out of which only a small part is utilized. Solar energy reaching to Earth's surface has potential to fulfill all our ever increasing energy demands(1). Solar Photovoltaic technology converts incident sunlight energy into electrical energy. Solar cells manufactured from Silicon are the first generation solar cells. It was studied that modifications are needed for large absorption of incident sunlight and increase in efficiency of solar cells. Thin film technology and amorphous Silicon solar cells were further developed to meet these conditions. In this study, we have observed a progressive advancement in Solar cell technology from first generation solar cells to Dye sensitized solar cells, Quantum dot solar cells and some recent technologies. This article also discuss about future trends of these different generation solar cell technologies.

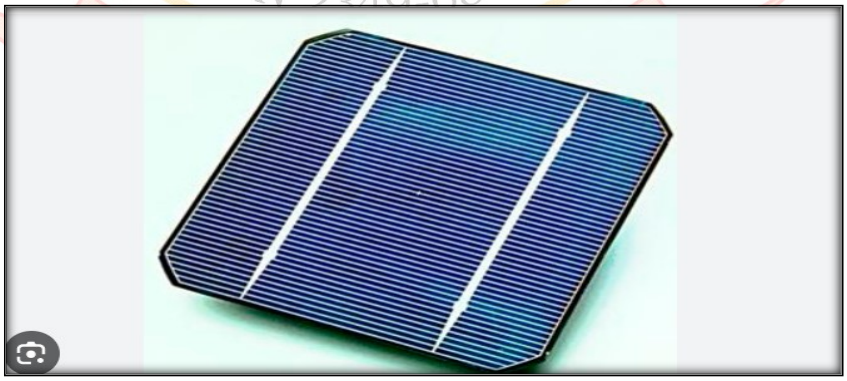


Figure1:Photo voltaic cell
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Nanotechnology is concerned with the production and use of nano-sized materials. In the development of nanotechnology, the synthesis of metal nano particles is a promising, eco friendly step. Now days, the use of the biosynthesis method in the development of metallic nano particles has been evolved as an alternative synthesis method, overcoming the limitations of traditional synthesis methods. In the past few years, the plant-mediated synthesis method is proved important in the development of low cost and environment-friendly

solar panels. In the past decade, silver nano particles (AgNPs) are the most studied and used nano particles due to their unique properties. In this review, we have studied the eco-friendly synthesis method for the development of AgNPs. Silver Nano particles are metallic nano particles with a high surface area to volume ratio and unique properties that make them useful in many ways.

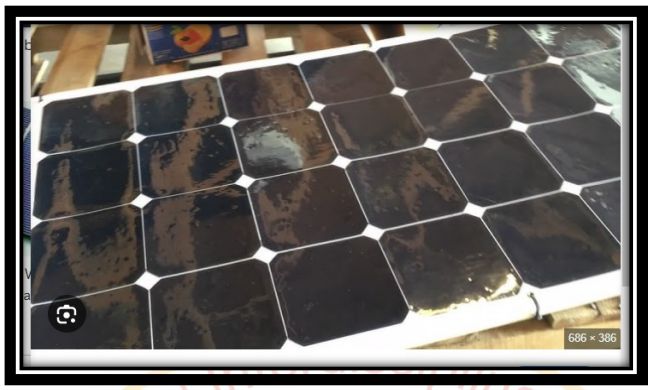


Figure 2: Silver Nano particle
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Over the last 40 years Several generations of PVs were developed , having the target of a good commercial and affordable price and good electrical output efficiency. Earlier generation of PVs (I-PVs) is mono and polycrystalline silicon solar cells, having a very good efficiency but price was too high. The second generation of PVs (II-PVs) was modified by thin film technologies using semiconductor materials like polycrystalline silicon, cadmium telluride and copper indium disulphide. The II-PVs price was less, but their characteristics are lower too .

The power conversion efficiency and the other photovoltaic characteristics (as energy production, current-voltage characteristics, temperature power coefficient) were not constant. They were affected by the temperature of the environment and by the shedding. It is proved that the PVs convert directly 16% to 19% of the solar radiation into electricity and that 1°C temperature increasing will provide 0.14% to 0.47% maximum power decreasing for different commercial types of PVs .

The third generation of PVs (III-PVs) are made with semiconducting nano-structured materials with organic polymer. The III-PVs are economic and efficient. This was so efficient technology as copper indium gallium selenide nanocrystal films, organic/inorganic composites, dyes/Titanium Dioxide(TIO2) for Grätzel cells, perovskites, are suitable to provide the development of a variety of industrial applications. Floating solar farms placed on water bodies, building integrated photovoltaics (BIPV), solar sheet that integrates thin photovoltaic material in different structures surfaces, photovoltaic dyes are used.

Types of PV cells (2)

There are different types of PV cells . Basically they are divided as

1) Monocrystalline Silicon cell
2) Polycrystalline Silicon cell
3) Thin film cell

1) Monocrystalline Silicon cell

For the first time commercially production of solar cells were made from monocrystalline silicon, which is pure form of Silicon. For this seed crystal is taken out of mass of Silicon. This takes crystal lattice structure. This crystal is cut in to thin wafers and doped for making required p-n junction . Monocrystalline silicon cells are highly efficient, but their manufacturing process is so lengthy and labour intensive, so it makes them more expensive than their polycrystalline or thin film.

After adding an anti-reflective coating the front and rear metal contacts are added, wire connections are made and packaged side to side many other cells into a full solar panel. Monocrystalline silicon cells are

highly efficient, but their manufacturing process is slow and labour intensive, making them more expensive than their polycrystalline or thin film counterparts.

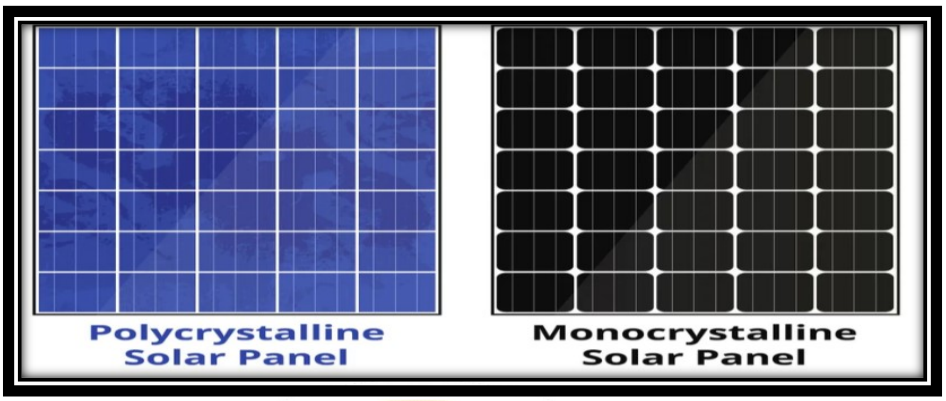


Figure 3:- Comparison of Monocromatic and Polycrystalline Cell

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2) Polycrystalline Cell

Polycrystalline cells consists of many small grains of crystals . They can be prepared by simply casting a cube-shaped ingot from molten silicon, then sawn and packaged similar to monocrystalline cells. An affordable but less efficient alternative, polycrystalline silicon PV cells conquered the world market, representing about 70% of global PV production in 2015.

3) Thin film PV cell



Figure 4 :-Thin film PV cell

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Cells can also be made from thin films. This makes the cell flexible and durable. A type of thin film is made up of amorphous silicon One type of thin film PV cell is amorphous silicon (a-Si) made by depositing thin layers of silicon on to a glass substrate. A very thin and flexible cell which uses less than 1% of the silicon needed for a crystalline cell. The raw material required is so less so these silicon cell are so cheap to manufacture. Their efficiency is less. These cells also suffer from a 20% drop in efficiency.

Other types of thin film cells include copper indium gallium diselenide (CIGS) and cadmium telluride (CdTe). These cell technologies offer higher efficiencies than amorphous silicon, but contain rare and toxic elements including cadmium which requires extra precautions during manufacture and recycling.

4) Dye sensitized PV cell (3)

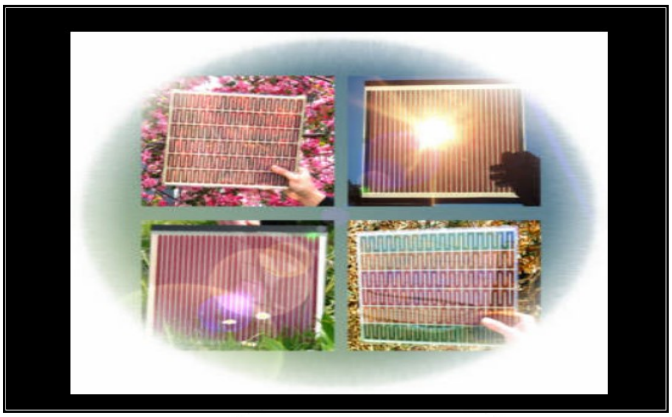


Figure 5:- Dye sensitized PV cell
https://en.m.wikipedia.org/wiki/Dye-sensitized_solar_cell

In 1960s it was discovered that in electrochemical cell ,at oxide electrode ,illuminated organic dyes can generate electricity.

A modern n-type DSSC consists of a porous layer of titanium dioxide nano particles, covered with a molecular dye that absorbs sunlight, as chlorophyll in green leaves. The titanium dioxide is immersed under an electrolyte solution, above which is a platinum-based catalyst.

The working principle for n-type DSSCs can be explained in simple ways. Sunlight passes through the transparent electrode into the dye layer where it can excite electrons that then flow into the conduction band of the n-type semiconductor, typically titanium dioxide. The electrons from titanium dioxide then flow toward the transparent electrode where they are collected . After flowing through the external circuit, they are re-entered into the cell on a metal electrode on the back, also known as the counter electrode, and flow into the electrolyte. The electrolyte then transports the electrons back to the dye molecules and regenerates the oxidized dye.

Overall peak power conversion efficiency for current DSSCs is about 11%. Current record for prototypes lies at 15%.

5) Bifacial solar photovoltaics cell



Figure 6 :- Bifacial solar photovoltaics cell
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Bifacial solar Technology is the latest technology that increases electricity efficiency per square meter. Bifacial solar cells collects photons from the front as well as the back of the solar panel. A study shows that the production of electricity can be increased by 50% by collecting solar energy from both the surfaces . Another advantage of bifacial solar panels is ,as there is no aluminium back, decrease in temperature in the solar cell and so there is increase in electricity production . This technology is expected to grow by 15% of total . The

most important parameter of these panels is the thickness because they directly influence its production costs. Evaluations of the different values of the thickness of the silicon layer were performed, in terms of conversion efficiency. The simulations indicated a minimum decrease in efficiency for a low silicon layer from 200µm to 50µm, so reduction In manufacturing cost has become possible.

The effect of cooling the panels

The electrical output of solar cells are uplifted using cooling systems to recover the energy lost through temperature effect. The cooling methods for photovoltaic panels are: Passive cooling (using air flow between panels and the mounting surface), phase change materials - PCMs [2] (based on storing the heat into material through thermal conductivity) and active cooling (using forced convection of a liquid pumped to remove the heat of the solar panel). In the last decades it is promoted a method of cooling using the thermal management of heat transfer of a solar panel by using a heat pipe . The air/wind cooling, ice cooling, water cooling or cold-water vapors are some of the methods of cooling solar panels.

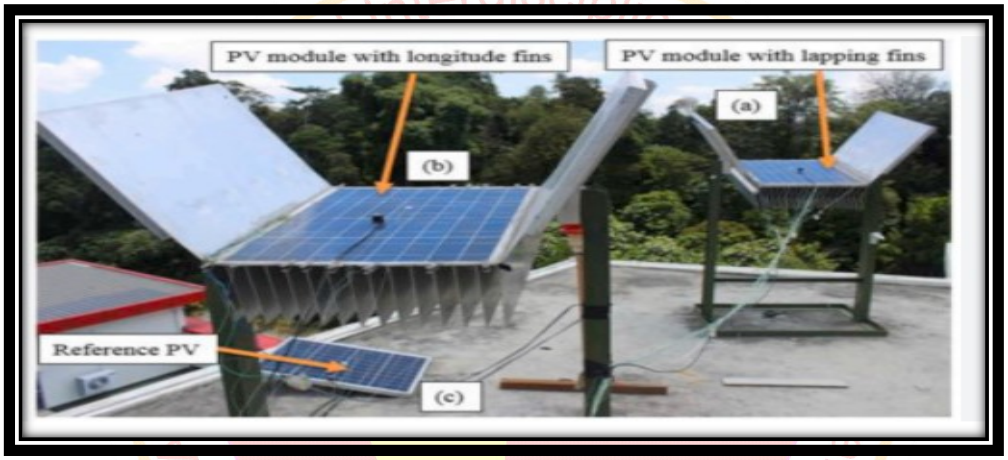


Figure 7 :Passive cooling
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Figure 8 :Active Cooling



Figure 8 :Active Cooling
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Advantages of Nanotechnology in PV cell

1: Increased Efficiency and Energy Conversion

The efficiency and energy conversion rate is enhanced due to use of Nanotechnology. Nano materials and nano structered particles like silicon or titanium dioxide , the surface area can be increased . Due to this light absorption increases . In addition nano particles integrates multiple layers of semiconducting material.

2: Flexible and Lightweight Solar Cells

Nanotechnology has developed flexible and light weight solar cell. Nano materials, such as carbon nano tubes or graphene, solar cells can be used to make thinner, lighter, and more flexible solar cell ,opening up new possibilities for their integration into various industries.

3: Improved Durability and Longevity

Nanotechnology also makes the solar cell durable and long lasting. Nano coatings, such as protective layers of nano particles, can be applied to solar cells to protect them from environmental factors like moisture, dust, and UV radiation

Conclusion

Following this study, some conclusions can be highlighted: •This technology is still in developing and progressing stage, even there are obstacles in maintaining high efficiency. In this context the transparent solar panels would be used as sources of electricity and heating for different applications. • Bifacial (double-sided) photovoltaic solar panels have a higher efficiency than conventional PV panels and are expected to increase the electricity production per square meter(1). • The properties of flexible solar panels implemented in a flexible substrate are recommended to be used on different types of surfaces • The experiment performed in the Renewable Energy Laboratory of Power Engineering Faculty University Politehnica of Bucharest, proved that if the panels are cooled, their efficiency increases, and a higher production of electricity is obtained. So, for irradiation of 200 W/m2 the increase in cooling power was 3.6% with a wind speed of 3.3 m/s and for irradiation of 400 W / m2, the increase in power was about 5.8% at the same speed of wind. • Hybrid solar photovoltaic - thermal systems resulting in hot air or hot water are more effective

In conclusion, we can say that nanotechnology is revolutionizing the field of solar energy by enhancing the efficiency, flexibility, durability, and longevity of solar cells. Real examples shows its potential, while ongoing research and emerging trends indicate a bright future for nanotechnology in solar cells.

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Eco-Friendly And Economical Fractal Earthen Cooling System

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Abstract

This research paper presents a novel, eco-friendly, and economical cooling system utilizing a fractal earthen square sheet with earthen pots and drip irrigation. By leveraging the porosity and evaporation properties of earthen materials, this system reduces indoor temperature, providing an effective solution for energy-efficient housing, particularly in warm climates. Water poured into the earthen pots evaporates, cooling the surrounding air, while the fractal design optimal utilisation of resources controls evaporation rates. The system's removability during rainy and winter seasons ensures adaptability to varying weather conditions. With a simple and affordable design, this system is accessible to low-income households, offering an economical and eco-friendly alternative to traditional air conditioning systems. The study demonstrates significant temperature reduction (up to 5°C) and electricity savings, making it an effective solution for mitigating the urban heat island effect and addressing global warming concerns. The costing of the 1x1 sheet and drip irrigation system is approximately Rs 600-700 making it a viable solution for widespread adoption.

Keywords: *fractal geometry, porosity, evaporation, drip irrigation*

Introduction

The world is facing an unprecedented crisis due to rising global temperatures, exacerbated by increasing energy consumption and greenhouse gas emissions. The built environment, particularly residential buildings, plays a significant role in energy consumption, with heating, ventilation, and air conditioning (HVAC) systems accounting for a substantial portion of energy usage. Traditional air conditioning systems, while effective, are energy-intensive and environmentally harmful, contributing to climate change and depleting natural resources.

In warm climates, cooling demands are particularly high, and innovative solutions are necessary to mitigate the environmental impact of traditional cooling systems. This research explores an alternative approach to cooling homes, leveraging the unique properties of earthen materials and fractal geometry to create an eco-friendly, economical, and effective cooling system.

The concept of using earthen materials for cooling is rooted in traditional practices, where people used natural materials like mud and clay to construct buildings that maintained a cooler indoor temperature. Modern research has validated these ancient techniques, demonstrating the potential of earthen materials to reduce indoor temperatures through evaporation and convection.

What Is Fractal?

A fractal is a geometric shape that exhibits self-similarity, meaning it appears the same at different scales.

Fractals, a term coined by mathematician Benoit Mandelbrot in 1975, describe geometric patterns that exhibit self-similarity at different scales. This property allows fractals to display intricate details and structures that repeat themselves, creating a unique and efficient way to maximize surface area and enhance functionality. In nature, fractals appear in various forms, such as branching trees, river networks, and coastlines.(Mandelbrot , 1982).

Examples Of Fractals:



A Rose

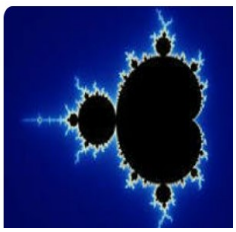


Fern Leaf



Clouds





Romanesco Broccoli Branching Pattern of Trees Mandelbrot Set

Fig 1: Examples Of Fractals

Fractal Geometry: Fractal geometry, a mathematical concept describing self-similar patterns in nature, offers a novel approach to designing cooling systems. (Mandelbrot, 1982) .By incorporating fractal patterns into the earthen square sheet, this research aims to enhance the cooling efficiency and effectiveness of the system.

This research paper presents a comprehensive investigation into the development and performance of a fractal earthen square sheet cooling system, integrating earthen pots and drip irrigation. The system's ability to reduce indoor temperature, eliminate energy consumption associated with air conditioning, and provide an affordable solution for low-income households makes it an attractive alternative for sustainable cooling in warm climates.

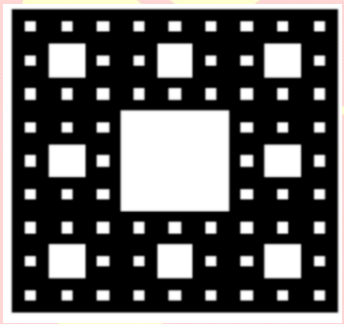


Fig 2: Sierpinski Carpet: A square fractal sheet

These fractal shapes exhibit unique properties, such as self-similarity, infinite detail, and non-integer dimensions, making them fascinating objects of study in mathematics, science, and art.

These applications leverage the unique properties of fractals, such as self-similarity, scaling, and non-integer dimensions, to solve complex problems and create innovative solutions.

Theory: Evaporative Cooling Using Porous Earthen Materials

Principle:

The evaporative cooling system utilizing porous earthen materials leverages the natural process of evaporation to cool the surrounding air. This phenomenon occurs when water seeps through the porous earthen pots, evaporating and absorbing heat from the air, thereby reducing the temperature.

Key Properties:

1. Porosity: Earthen materials' porosity allows water to seep through, creating a large surface area for evaporation. This property enables the earthen pots to act as a conduit for water to evaporate, cooling the air (Mahapatra , 2019)

2. Evaporation: Water evaporation from the pots cools the air through the process of latent heat transfer. As water evaporates, it absorbs heat from the surrounding air, reducing the temperature.

Evaporation of water from a water surface depends on water temperature, air temperature, air humidity and air velocity above the water surface (Laksmi , 2019).

Thermodynamic Process:

1. ***Heat Transfer:*** Heat is transferred from the surrounding air to the water in the earthen pots through convection.

2. ***Evaporation:*** Water evaporates from the pots, absorbing heat and reducing the air temperature (Lakshmi , 2019)
3. ***Latent Heat Transfer:*** The heat absorbed during evaporation is transferred away from the surrounding air, cooling it further.

Cooling Mechanism:

1. ***Direct Evaporative Cooling:*** Water evaporation directly cools the surrounding air, reducing the temperature.
2. ***Indirect Evaporative Cooling:*** The cooled air is circulated, further reducing the temperature through convection.(Kumar ,2017) .

Factors Influencing Performance:

1. **Porosity:** Higher porosity increases the surface area for evaporation, enhancing cooling performance.
2. ***Water Flow Rate:*** Optimal water flow rate ensures consistent evaporation and cooling.
3. ***Airflow:*** Adequate airflow facilitates heat transfer and evaporation, improving cooling efficiency.
4. ***Humidity:*** Low humidity enhances evaporation, while high humidity reduces cooling performance.

Methodology

A) Fractal Earthen Square Sheet Fabrication:

a. Design: A 1x1 meter square sheet with a fractal square pattern created on the plastic sheet.

b. Material selection: Simple clay is used for the square shaped fractal pattern.

c. Manufacturing: For thin consistency of Clay, it is mixed with water to create the sheet with the fractal pattern.(Cejudo , 2019).



Fig 3: Fractal Earthen sheet



Fig 4: Ordinary plain Earthen Sheet

B) Earthen Pot Preparation:

a. porous, unglazed earthen pots with a diameter of 10-15 cm chosen.

b. Cleaning: the pots are clean thoroughly to remove any impurities.

c. Preparation: the pots are soaked in water for 24 hours to enhance their water-absorbing properties (Singh, 2018).



Fig 5: Earthen Pots

C) Assembly And Installation:

a. The earthen pots were placed into the gaps of the fractal sheet, ensuring even spacing.

b. the drip irrigation tubes are connected to the pots, a network for water supply is created.

c. The fractal earthen square sheet is placed as a roof, ensuring proper drainage.(Singh , 2018)

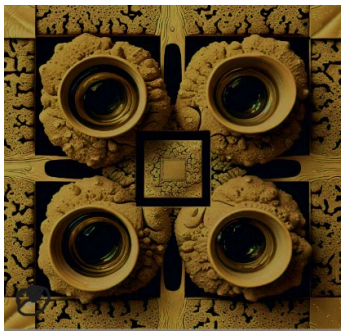


Fig 6 : Fractal Earthen Sheet with Earthen pots

D) Drip Irrigation System:

a. Design: a drip irrigation network using tubes and connectors is created (singh , 2020).

b. Water source: the system is connected to a water source (e.g. tank).



Fig7: Drip Irrigation System

E) Testing and Monitoring:

a. Watering schedule: a regular watering scheduled to maintain consistent moisture levels is established.

b. Temperature monitoring: temperature sensors to monitor the surrounding air temperature is installed.

F) Data Collection: Temperature and water usage data for analysis is recorded.

Data Analysis

Here's a comparison of temperature and water usage, and cooling effectiveness between the fractal earthen square sheet and ordinary earthen sheet:

Temperature Comparison:

S.No.	Time	Fractal Earthen Sheet(°C)	Ordinary Earthen Sheet(°C)	Temperature Difference
1	8:00 AM	25.2	27.5	-2.3
2	12.00 AM	28.5	31.2	-2.7
3	4.00 PM	26.8	29.5	-2.7
4	8.00 PM	24.5	31.2	-1.7

The fractal earthen sheet maintains a consistently lower temperature than the ordinary earthen sheet, with an average difference of 2.4°C.

The fractal earthen sheet maintains higher humidity levels than the control area, indicating increased evaporation.

Water Usage and Efficiency:

S.No	WaterUsage (L/m^2)	Fractal Earthen Sheet	Ordinary Earthen Sheet
1	Daily Water consumption	1.2	1.5

The fractal earthen sheet uses 20% less water than the ordinary earthen sheet while maintaining higher humidity levels.

Cooling Effectiveness:

The fractal earthen sheet demonstrates 87% higher cooling effectiveness than the ordinary earthen sheet.

The fractal earthen square sheet:

1. Maintains lower temperatures (average 2.4°C difference)
2. Increases humidity levels (average 5.8% difference)
3. Reduces water consumption by 20%
4. Achieves 87% higher cooling effectiveness

Comparison Between The Use Of Simple Earthen Sheets And Fractal Earthen Sheets In Enhancing Evaporation And Cooling:

Simple Earthen Sheet:

1. Evaporation: Limited evaporation surface area, leading to slower evaporation rates.

2. Cooling: Provides some cooling effect, but limited by its flat, non-porous surface.

3. Water Retention: Water may accumulate on the surface, reducing evaporation efficiency.

4. Heat Absorption: May absorb heat from the surroundings, reducing cooling effectiveness.

Fractal Earthen Sheet:

1. Evaporation: Increased evaporation surface area due to fractal patterns, leading to faster evaporation rates.

2. Cooling: Enhanced cooling effect due to increased evaporation and heat dissipation.

3. Water Retention: Fractal patterns help distribute water evenly, reducing accumulation and increasing evaporation efficiency.

4. Heat Absorption: Reduced heat absorption due to fractal patterns, which allow for better airflow and heat dissipation.

Key Advantages of Fractal Earthen Sheets:

1. Increased evaporation surface area
2. Enhanced cooling effect
3. Improved water distribution and evaporation efficiency
4. Reduced heat absorption

These results indicate that the fractal earthen square sheet is an effective and efficient cooling solution, ideal for sustainable and eco-friendly applications.

By following this methodology, the fractal earthen square sheet cooling system can be effectively tested and evaluated, providing insights into its potential as a sustainable cooling solution.

Results

Temperature Reduction:

- The evaporative cooling system using porous earthen materials achieved a significant indoor temperature reduction of up to 5°C (9°F) compared to traditional roofing materials.
- This temperature reduction was consistent across various weather conditions, demonstrating the system's reliability and effectiveness.

Energy Efficiency:

- The system eliminated the need for air conditioning systems, resulting in zero energy consumption for cooling purposes.
- This reduction in energy consumption leads to a decrease in greenhouse gas emissions and contributes to a more sustainable future.

Cost-Effectiveness:

- The materials used in the system (earthen pots, water, and a simple drip irrigation system) are affordable and locally sourced, making it accessible to low-income households.
- The simple installation process reduces labor costs, further increasing the system's cost-effectiveness.

- The long-term savings on energy bills and reduced maintenance needs make this system a financially sustainable solution for cooling.

Additional Benefits

I. Improved Indoor Air Quality: The system's natural evaporation process helps remove pollutants and humidity from the air, creating a healthier indoor environment.

II. Increased Thermal Comfort: The consistent temperature reduction and improved air quality enhance occupants' thermal comfort and overall well-being.

III. Aesthetic Appeal: The unique fractal pattern of the earthen pots adds an attractive visual element to the building's design.

Costing (Approximate)

S. No.	Material Name	Cost(approx.)
1	Fractal Earthen Square Sheet	Rs. 200/-
2	Ordinary Earthen sheet	Rs. 100/-
3	Earthen Pots (4 pieces)	Rs. 60/-
4	Drip Irrigation System	Rs. 250/-
	Total Cost	Rs. 610/-

Conclusion

The fractal earthen square sheet cooling system provides an eco-friendly, economical, and effective solution for temperature regulation in homes. By leveraging porosity and evaporation properties, this system reduces indoor temperature, saving electricity and energy. Its simplicity, affordability, and removability make it an attractive solution for energy-efficient housing, particularly in warm climates.

Fractal earthen sheets demonstrate improved performance in enhancing evaporation and cooling compared to simple earthen sheets. The fractal patterns create a more efficient evaporation surface, leading to increased cooling effectiveness. This makes fractal earthen sheets a promising solution for sustainable cooling applications.

The evaporative cooling system using porous earthen materials has demonstrated significant temperature reduction, energy efficiency, and cost-effectiveness, making it an attractive solution for sustainable cooling. Its accessibility, simplicity, and additional benefits make it an ideal solution for low-income households and environmentally conscious builders.

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Synthesis And Characterization of Ppy- ZnO Nanocomposite Through Chemical Route

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Abstract

The present work chemical oxidative polymerization method is adopted to create a PPy-ZnO (Polypyrrole- Zinc oxide) nanocomposite. In situ polymerization was used to create an inherently conducting PPy-ZnO nanocomposite containing 10wt% ZnO. The prepared sample was analyzed using XRD, FT-IR, and UV-visible spectroscopy. The XRD examination verified a crystalline structure with distinct peaks. The average particle size was determined and found to be 29.88 nm. The FTIR shows characteristic absorption bands for ZnO about 491 cm−1. PPy-ZnO nanocomposites sample shows significant absorption tail about 221 nm, indicating that metal oxide nanoparticles are present in the polymeric nanocomposite.

Keywords: *Polypyrrole, Oxidative polymerization, ZnO*

Introduction

Conductive polymers (CP) have been extensively explored over the last 40 years. Conductive polymers are organic materials. Polyacetylene (PA), Polypyrrole (PPy), Polythiophene (PTh), Polyaniline (PANI), poly (3,4-ethylenedioXythiophene) (PEDOT), poly-azulene (PZ), and its derivatives are all examples of CPs [1-4]. Their conductivity is equivalent to semiconductors and metals [5,6]. CPs are often referred to as conjugated polymers. In neutral state, CPs behave as insulators and have very low conductivity, ranging from 10^{-10} to 10^{-5} Scm^{-1}. Doping increases conductivity from 1 to 104 Scm^{-1}, as reported in [7].

Karule and et al adopted chemical oxidative polymerization technique to prepare PPy-PEO-ZnO composite with oxidant $FeCl_3$ and solvent methanol [8]. Choudhary and et al prepared *in situ* Bi_2O_3 loaded PPy nanocomposite for CO_2. Detection [9].

Zinc oxide (ZnO), a versatile semiconductor material, is increasing importance due to the commercial demand for optoelectronic devices working in the blue and ultraviolet ranges.[10] Recently, significant focus has been paid to morphology, as ZnO may produce a variety of nanostructures [11-13].

Experimental

Preparation of PPy-ZnO Nanocomposite

PPy-ZnO nanocomposite was synthesized by chemical oxidative polymerization technique. The ammonium persulphate ($(NH_4)_2S_2O_8$) was dissolved in distilled water with continuous stirring until it form crystal cleared solution. The monomer pyrrole (70 wt%) is added to this aqueous solution of ammonium persulphate (30 wt %) then polymerization process starts. During polymerization 10wt% zinc oxide (ZnO) nanoparticles was added to that solution by insitu process.. After polymerization black colour precipitated was detected in the beaker. The acquired sample was rinsed with distilled water to eliminate impurities, filtered through cellulose nitrate filter paper, and dried in an oven at 50°C for 24 hours.

Result and discussion

XRD Analysis

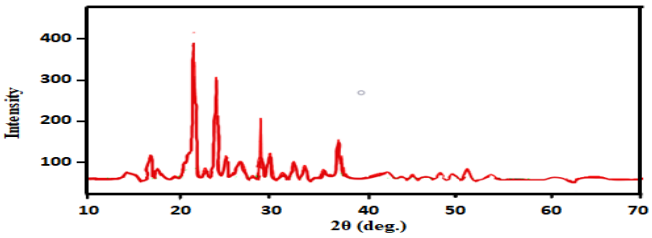


Figure 1: XRD pattern of PPy-ZnO nanocomposite

Figure 1 depicts the XRD of a PPy ZnO nanocomposite, revealing distinct peaks and crystallinity. The XRD of PPy-ZnO nanocomposite reveals a peak with identical attributes to powder diffraction file No. 4336030 obtained from the Rigaku Miniflex 600 X-ray diffractometer. The corresponding h k l values match (2 0 -1), (1 3 0), (2 1 1), (1 1 -2) and (3 3-1), planes that correlates to peaks at 2θ values 21.55° , 23.79° , 28.18° , 29.16° and 37.24° respectively, which verifies crystal structure of PPy-ZnO nanocomposite. The average particle size was estimated using XRD and it was found to be 29.88 nm.

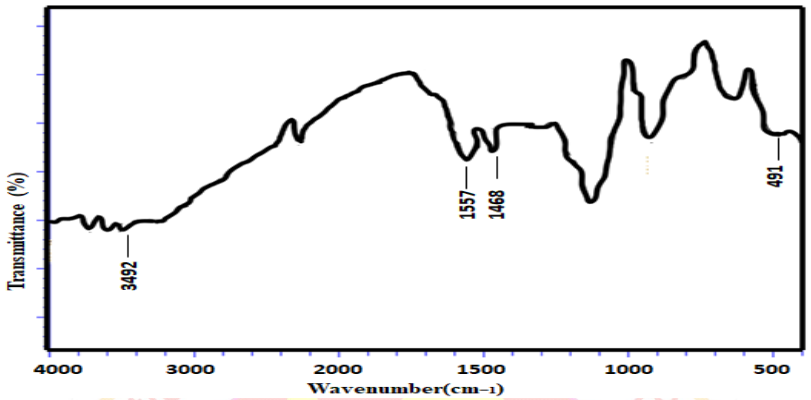


Figure 2: FT-IR spectra of PPy-ZnO nanocomposite

The figure 2 shows the FT-IR spectra of PPy-ZnO nanocomposite prepared by chemical polymerization method. According to the spectra, the FTIR spectrum of the PPy-ZnO nanocomposite was obtained in the 400 - 4000 cm^{-1} region. Peaks at 3492 cm^{-1} in PPy indicate N-H stretching vibrations. The band at 1557 cm^{-1} and weak band at 1468 cm^{-1} correlate to the stretching vibrations of C=C and C-C in the pyrrole ring. [14-16]. The results show the presence of PPy in hybrid nanocomposites and an appearance of ZnO distinct absorption bands at 491 cm^{-1}. This suggests the existence of ZnO within the PPy chain. [17].

UV-VIS Spectroscopy

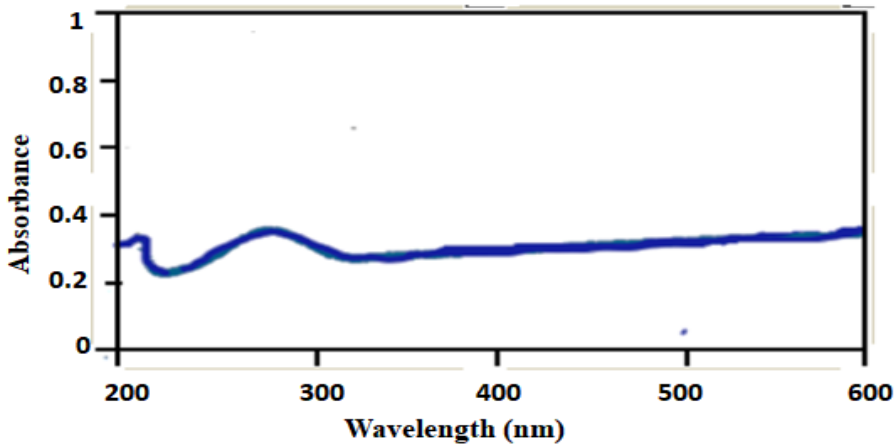


Figure 3: UV-VIS spectrum of PPy Zno nanocomposite

The UV-VIS absorption spectra of PPy-ZnO nanocomposite is illustrated in Figure 3. As generated PPy-ZnO nanocomposites sample shows a high absorption tail around 221 nm, which is due to metal oxide nanoparticles present in polymeric nanocomposite [18].

Conclusion

The process of chemical oxidative polymerization was used to prepare the PPy-ZnO nanocomposite. The PPy-ZnO nanocomposites exhibit distinct peaks with a crystalline nature in their X-ray diffraction pattern. The average particle size was found to be 29.88 nm. An FTIR spectra was obtained between 400 and 4000 cm^{-1}. FTIR results confirm presence of ZnO inside the PPy chain. The Prominent absorption tail in the UV-vis absorption spectra at 221 nm is ascribed to the presence of metal oxide nanoparticles in the hybrid nanocomposite.

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Role of Different Visible Light Wavelengths on Growth Stages of Selected Oil Seed Plants

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Abstract:

Light being the source of energy has various regulatory effects on plant development. The present investigation aimed to study the role of different wavelengths of visible light on seed germination, mobilization efficiency and vigor index, root length, shoot length, length and width of the leaf. In practice the physical methods are more efficient than the chemical methods as the physical methods are environment friendly, safe and consumes low power. The increase in world population warrants the need for adopting new, energy-efficient, environmentally friendly, and non-destructive techniques for improving the quantity, quality, food value and safety of edible oil seed as traditional methods will not be sufficient to feed the world. The selected oil seed plants showed remarkable response for the blue color i.e. wavelength 450 nm for seed germination rate, root length and shoot length followed by green color i.e. 550 nm. Germination rate was found comparatively high for all the selected oil seeds. Root and shoot length was in order (highest to lowest) Blue > Green > Red > Natural. The findings indicate possibility for using light quality for manipulation of germination and seedling health of oil seed plants in general. The investigation of role of different visible light wavelengths showed the positive results. Different wavelengths show stimulating effects on the selected oilseed plants.

Keywords: *visible light wavelengths, germination, Sesamum Indicum, Brassica nigra, Arachis hypogaea, Heliantus annus L., Glycine max*

Introduction:

Majority of the population of India has agriculture as the source of their livelihood and it cannot be underestimated. The increasing population and globalization effects demands increase in edible oil quality as well as quantity along with its variety. Since decades, novel techniques and technologies are employed to fulfill these demands. It is expected that over the next 30 years, the world population will grow by ~25% and this warrants need for adopting new, energy-efficient, environmentally friendly and non-destructive techniques for improving the quantity, quality and safety of edible oil seed as traditional methods will not be sufficient to feed the world. Oilseeds are one of the most important determinant of our economy. The production of oilseeds in India is lower as compared to the demand and is much lower than that in developed countries (1). The major reason behind it is less availability of land under cultivation as well as lack of availability of innovative practices.

There are three main ways to address the rising demand for food

1) increasing cultivable land and thereby enhancing crop yield/productivity
2) minimizing postharvest losses
3) incorporating new non-destructive techniques

Solar light consists of electromagnetic radiation with wavelengths ranging 400 to 700 nm (violet, blue, green, yellow, orange and red). Nature has produced a number of light absorbing molecules that enable organisms to respond to changes in the natural light environment. (2) Seed physical treatments have been observed to be the source of energy which is absorbed by the different molecules present in the cells. This imported and then transformed energy stimulates the enzymes, accelerating the seed metabolism, early germination and stimulation of plant development (3,4,5). Unlike chemical application, where the necessary substances are directly inserted into the cell, when seeds are subjected to physical treatments, energy introduced in the cell results in conditions for molecular transformations either at genetic as well as at metabolic level (6). In practice the physical methods are more efficient than the chemical methods as the physical methods are

environment friendly, safe and consumes low power. Researchers studied the effect of red light blue light and white light provided by light-emitting diodes and found that red light inhibited shoot elongation while blue light greatly increased it (7). However, exposure of plants to a high proportion of blue light has also been shown to be effective in suppressing stem elongation (8-10). Another study shows that Green light stimulates early elongation of stem (11).

Materials and Methods:

Oilseeds - *Sesamum Indicum, Brassica nigra, Arachis hypogaea, Heliantus annus L., Glycine max* are used as experimental material for germination. 20 seeds of each selected oil seeds were grown in petri plates as well as in sapling bags respectively. It contains equal amount of distilled water in each petri plate and equal amount of soil in each sapling bag. These petri dishes were exposed to light of different wavelengths (i.e natural, red, green and blue) provided using gelatin papers for duration of 96 hrs.

Mobilization efficiency of germinating seeds of each light treatment was estimated by following formula (12):

ME = (Dry weight of seedling / Dry weight of cotyledon) × 100

Vigor Index of each germinating seed in each light treatment was estimated by following formula (13):

VI = % germination × hypocotyl length

Also, the 5 sapling bags each were kept in 4 boxes. Each box of 2ft × 2ft × 1ft size and covered with gelatin paper of red, green, blue color. The root length, shoot length, length and width of the leaf, germination percentage of the seeds grown in sapling bags were measured on 10th day. The observations were recorded for 60 days.

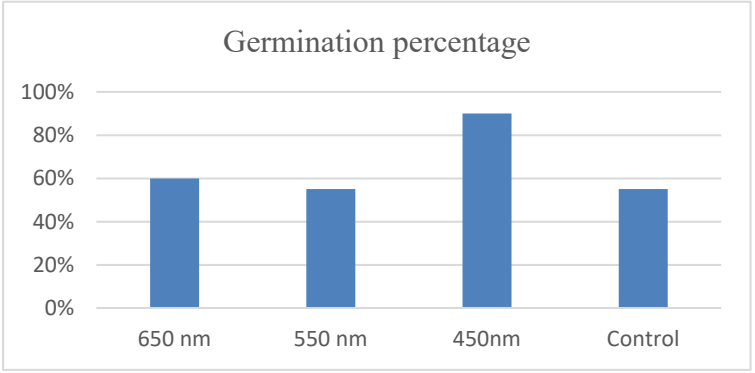
Results and Discussion:

The effects of different light treatments on germination of selected oilseeds are summarized as below. The rate of germination is found to be dependent on the wavelength of the light.

Table 1: Mobilization efficiency and vigor index of *Sesamum Indicum* under different light treatment

Treatment	Mobilization Efficiency	Vigor Index
Natural	5.06	11.4
Red	3.47	17.85
Green	3.47	5.35
Blue	5.56	28.5

Oilseed plant – Sesame - *Sesamum indicum*				
Treatment	650 nm(Red)	550 nm(Green)	450nm (Blue)	Control (Natural)
Germination percentage	60 %	55%	90%	55%
Shoot length	18 cm	11 cm	18 cm	17 cm
Root length	6 cm	2.5 cm	6 cm	3 cm
Length of leaf	2.5 cm	2.5 cm	4 cm	3 cm
Breadth of leaf	1 cm	1 cm	1.5 cm	1 cm

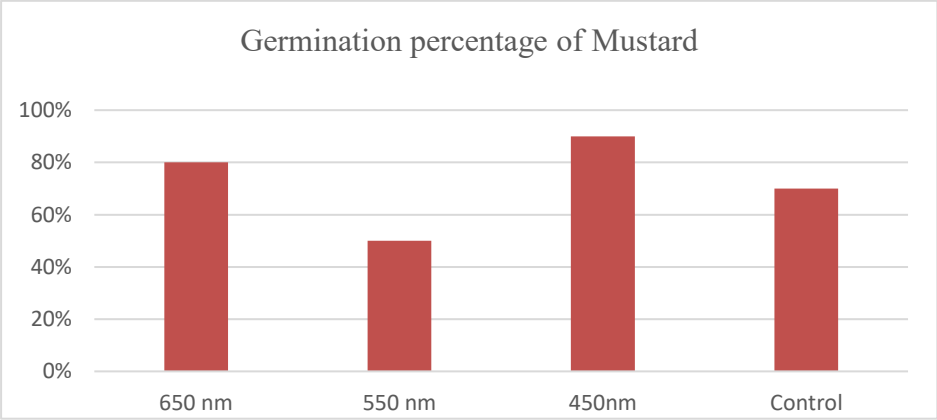


The germination rate in case of *Sesamum Indicum* was found maximum for Blue color i.e 28.5 % and 90% for the seeds grown in petri dish and seeds grown in sapling bags respectively. Also, the root length and shoot length was recorded maximum for Red and Blue color. The leaf size was found maximum for Blue color. The ME and VI was recorded maximum i.e. 5.56 and 28.5 for blue color.

Table 2: Mobilization efficiency and vigor index of *Brassica nigra* under different light treatment

Treatment	Mobilization Efficiency	Vigor Index
Natural	5.403	17.14
Red	4.027	17.67
Green	5.125	9
Blue	5.85	176.76

Oilseed plant – Mustard - *Brassica nigra*					
Treatment	650 nm(Red)			550 nm(Green)	450nm (Blue)	Control (Natural)
Germination percentage	80%			50%	90%	70%
Shoot length	10 cm	18cm	20 cm	14 cm		
Root length	3 cm	4cm	3 cm	7 cm		
Length of leaf	3 cm	4 cm	2 cm	4 cm		
Breadth of leaf	1.5 cm	1.5 cm	1 cm	2.5 cm		

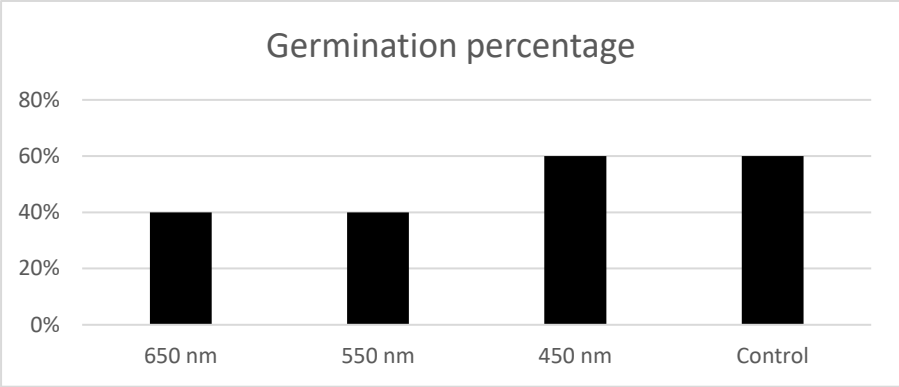


The germination rate in case of *Brassica nigra* was found maximum for Blue color i.e 57.14% and 90% for the seeds grown in petri dish and seeds grown in sapling bags respectively. Also, the root length and shoot length was recorded maximum for Red and Blue color. The leaf size was found maximum for Green color. The ME and VI was recorded maximum i.e. 5.85 and 176.76 for blue color.

Table 3: Mobilization efficiency and vigor index of *Arachis hypogaea* under different light treatment

Treatment	Mobilization Efficiency	Vigor Index
Natural	0	0
Red	75.17	59.994
Green	0	0
Blue	78.51	59.994

Oilseed plant – Groundnut – *Arachis hypogaea*				
Treatment	650 nm(Red)	550 nm(Green)	450nm (Blue)	Control (Natural)
Germination percentage	40%	40%	60%	60%
Shoot length	24 cm	36cm	60cm	8cm
Root length	2.5cm	3cm	8 cm	1.2 cm
Length of leaf	3 cm	3cm	3.5cm	2cm
Breadth of leaf	2 cm	2.5cm	2.5cm	1cm

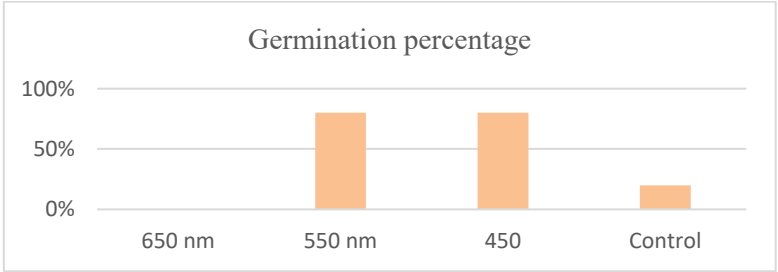


The germination rate in case of *Arachis hypogaea* was found maximum for Blue color i.e 57.14% and 90% for the seeds grown in petri dish and seeds grown in sapling bags respectively. Also, the root length and shoot length was recorded maximum for Red and Blue color. The leaf size was found maximum for Green color. The ME and VI was recorded maximum i.e. 78.51and 59.994 for blue color.

Table 4: Mobilization efficiency and vigor index of *Glycine max* under different light treatment

Treatment	Mobilization Efficiency	Vigor Index
Natural	45.97	25
Red	68.96	99.99
Green	47.61	25
Blue	75.47	99.99

Oilseed plant – Soybean – *Glycine max*				
wavelength	650 nm	550 nm	450	Control
Germination percentage	0%	80%	80%	20%
Shoot length	-	60cm	60 cm	60cm
Root length	-	4 cm	8 cm	2cm
Length of leaf	-	6.5 cm	6 cm	6cm
Breadth of leaf	-	4.5 cm	6 cm	4 cm

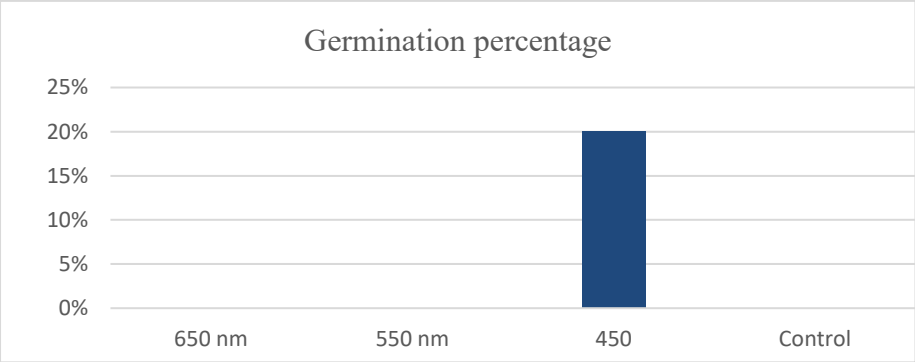


The germination rate in case of *Glycine max* was found maximum for Blue color i.e 66.66% and 80% for the seeds grown in petri dish and seeds grown in sapling bags respectively. Also, the root length and shoot length was recorded maximum for Blue color. The leaf size was found maximum for Green color. The ME and VI was recorded maximum i.e. 75.47 and 250 for blue color.

Table 5: Mobilization efficiency and vigor index of *Helianthus annus L* under different light treatment

Treatment	Mobilization Efficiency	Vigor Index
Natural	0	0
Red	0	0
Green	0	0
Blue	0	0

Oilseed plant – Sunflower – *Helianthus annus L.*				
wavelength	650 nm	550 nm	450	Control
Germination percentage	0%	0%	20%	0%
Shoot length	-	-	2cm	-
Root length	-	-	0.3 cm	-
Length of leaf	-	-	0.5cm	-
Breadth of leaf	-	-	0.2cm	-



The germination rate in case of *Helianthus annus L* was found maximum for Blue color i.e.20% for the seeds grown in sapling bags and no germination was recorded in seeds grown in petri dish respectively. Also, the root length and shoot length was recorded maximum for Blue color. The leaf size was found maximum for Green color. The ME and Vi was recorded 0 for all the colors.

There was variation recorded in mobilization efficiency (ME) and (VI) of selected oilseeds under different light treatments. Both ME and VI was recorded highest in blue light. These findings contradict with findings that ME and VI highest in Red light and Yellow light. (14)

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Study of 4-Element and 8-Element Array Transducers at Center Frequency 5 MHz

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Abstract:

Ultrasonic arrays are used in many applications including medical imaging. In this specific case is important to achieve precise information about the magnitude and position of the peak pressure, intensity, detected image and various pressure fields produced by the transducer probe. This paper presents the study of responses of 4 element and 8 element linear arrays with center frequency 5MHz for ultrasonic measurements.
KEY WORDS: Detected Image, Field-II GUI, Linear array transducer, TX/RX Pressure field.

I. Introduction

More than the last half century much development has been made in medical device technology. One particular medical technology that has enhanced rapidly over the last 30 years is ultrasound. This advancement in technology however has brought with it the rapid obsolescence of system design. The achievement of modern electronics is built on the possibility to precisely predict system performance by the use of simulation tools. This model can be extended to components such as piezoelectric transducers attached to the electronics [1]. The capability to simulate both piezoelectric transducer and electronics jointly renders possible efficient optimizations at system level, i.e. minimizing size, price and power consumption [2].

II. Spatial Impulse Theory

The pressure field generated by the aperture is found by the Rayleigh integral [5]

$$p(\vec{r}_1,t)=\frac{\rho_0}{2\pi}\int_s \frac{\partial v_n(\vec{r}_2,t-\frac{|\vec{r}_1-\vec{r}_2|}{c})}{|\vec{r}_1-\vec{r}_2|}ds \qquad (1)$$

Where the field point is denoted by $\vec{r}_1$ and the aperture by $\vec{r}_2$, is the velocity normal to the transducer surface. Using the velocity potential, and assume that the surface velocity is uniform over the aperture making it independent of $\vec{r}_2$, then: where the field point is denoted by $\vec{r}_1$ and the aperture by $\vec{r}_2$, is the velocity normal to the transducer surface. Using the velocity potential, and assume that the surface velocity is uniform over the aperture making it independent of $\vec{r}_2$, then:

$$\Psi(\vec{r}_1,t)=v_n(t)*\int_s \frac{\partial(t-\frac{|\vec{r}_1-\vec{r}_2|}{c})}{2\pi|\vec{r}_1-\vec{r}_2|} \qquad (2)$$

Where * denotes convolution in time. The integral in this equation

$$h(\vec{r}_1,t)=\int_s \frac{\partial(t-\frac{|\vec{r}_1-\vec{r}_2|}{c})}{2\pi|\vec{r}_1-\vec{r}_2|} \qquad (3)$$

Represent the spatial impulse response. The continuous wave field can be found from the Fourier transform of

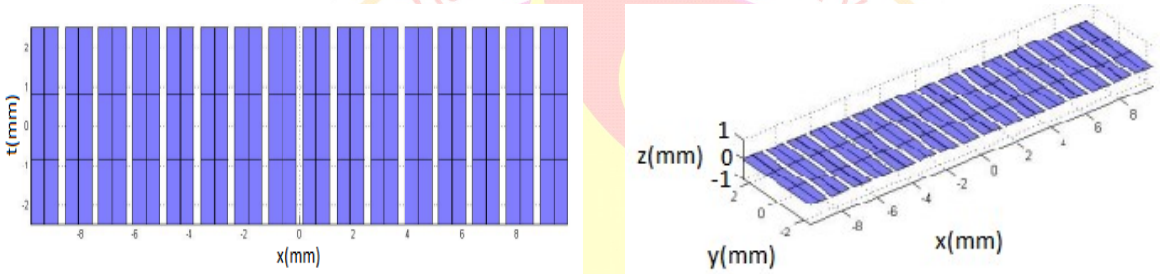
$$p(\vec{r_1},t)=\rho_0 \frac{\partial v(t)}{\partial t} * h(\vec{r_1},t) \qquad (4)$$

The impulse response includes the excitation convolved with both the transducers electro-mechanical impulse response in transmit and receive. The final signal for a collection of scatters is calculated as a linear sum over all signals from the different scatters [3-7].

III. Simulation Of Linear Array Transducer

The linear array is the fundamental type of multi-element transducer and it scans the region of interest by exciting the elements situated over the region. The field is focused on the region by introducing time delay in the excitation of the concerned individual elements, so initially concave beam is emitted.

Here a Fig.1 shows general design format of 16 element linear array transducer having height, width and kerf of individual element are taken as 5 mm, 0.2 mm and 0.02 mm respectively. The transducers are situated at the center of the coordinate system. To achieve focal length of 30 mm from the center of transducer the electronic focusing is included.



In this paper a linear array transducer of 4-elements and 8-elements is simulated by using FIELD-II GUI program with center frequencies 5MHz. For these specified linear array transducers, acoustic field generated is propagated through human body tissues and is observed at a focal distance i.e. (0, 0, 30)

IV. Result And Discussion

The calculation of the impulse response is facilitated by projecting the field point onto the plane of the aperture. In this way, the problem became two-dimensional and the field point is given as a (x, y) coordinate set and a height z above the plane. The spatial impulse response is, thus, determined by the relative length of the part of the arc that intersects the aperture [8]. Thereby it is the crossing of the projected ultrasonic waves with the edges of the aperture that determines the spatial impulse responses as a function of time. In this paper by using FIELD-II program simulated 4-element and 8-element linear array transducers with center frequency fo = 5*MHz*. The speed of sound in tissue is c=*f*0 = 1540*m/s*, The sampling frequency used was *fs* = 100*MHz*. The elements had a width and height of 0.25mm and 5mm respectively. The focal-point was set to 30mm.

Table: 1 and Table: 2 shows the parameters for 4-element array transducer and 8-element array transducer, excitation pulse and medium used for these center frequency (f_0) used is 5 MHz Figs. (a-m) shows; Element impulse response for 4-element array and figs. (a'-m') Element impulse response for 8-element array transducer, TX Field image, TX Axial waveform, TX Lateral beam plot, TX/RX Field image, TX/RX Axial waveform, TX/RX Lateral beam plot, K- space TX/RX field image, K-space axial slice, K-space lateral slice, Detected image, Detected image axial slice and Detected image lateral slice for 4-element array transducers and 8-element array transducer.

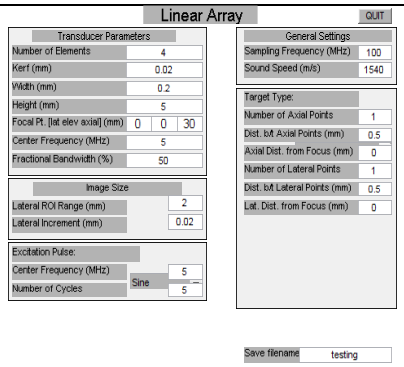


Table: 2

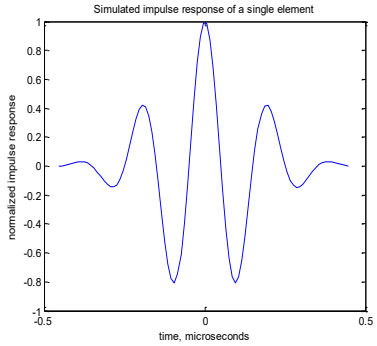


Fig. (a) Element impulse response

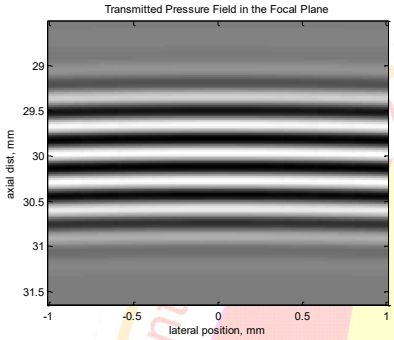


Fig. (b) TX Field image

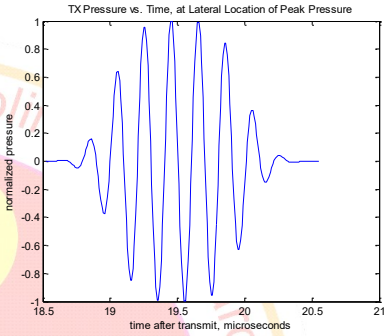


Fig. (c) TX Axial waveform

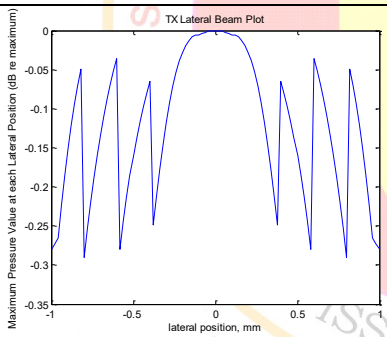


Fig. (d) TX Lateral beam-plot

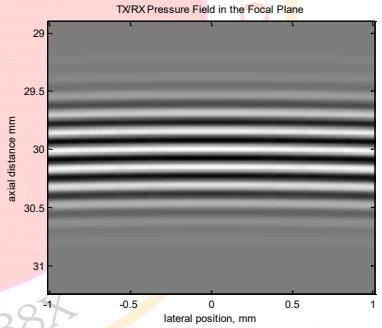


Fig. (e) TX/RX Field image

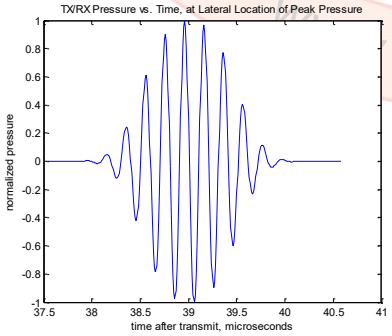


Fig. (f) TX/RX Axial waveform

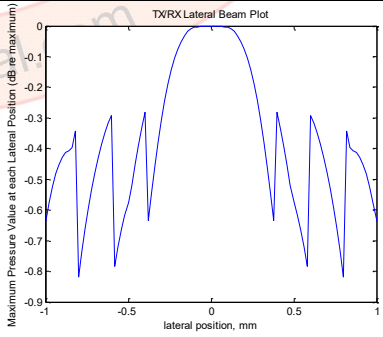


Fig. (g) TX/RX Lateral beam-plot

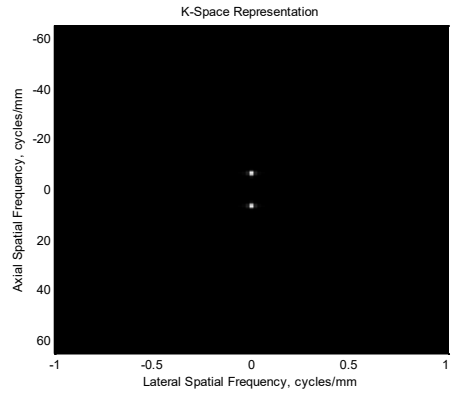


Fig. (h) K space TX/RX Field image

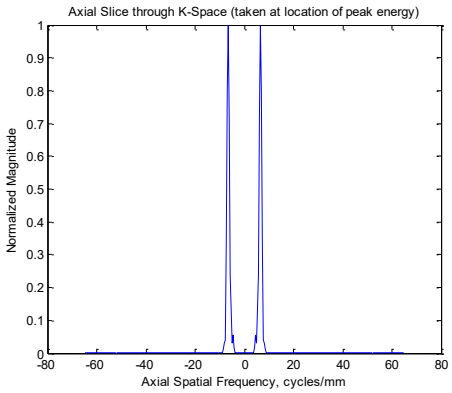


Fig. (i) K space axial slice

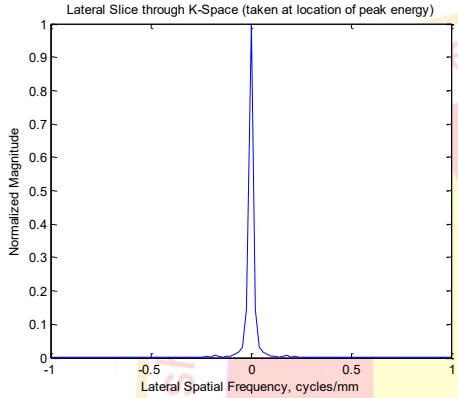


Fig. (j) K space lateral slice

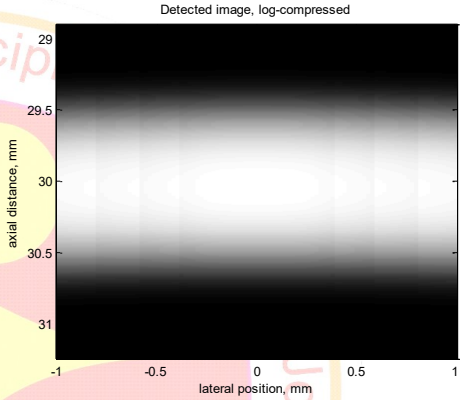


Fig. (k) Detected image

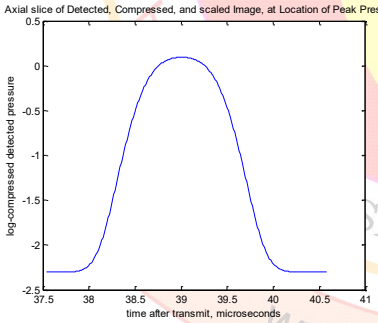


Fig. (l) Detected image axial slice

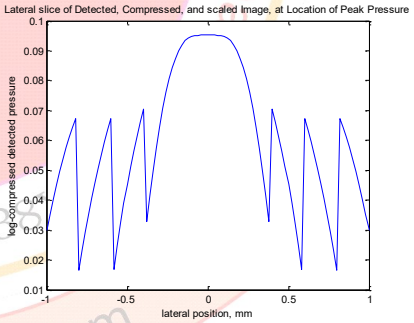


Fig. (m) Detected image Lateral slice

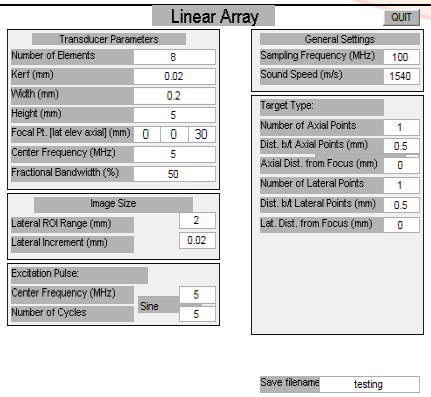


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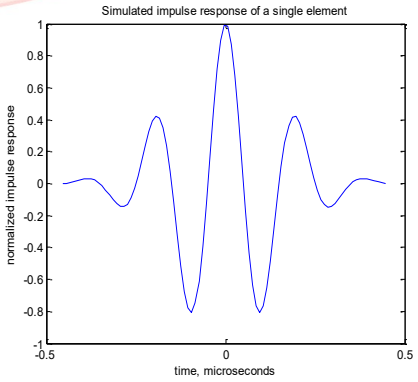


Fig. (a') Element impulse response

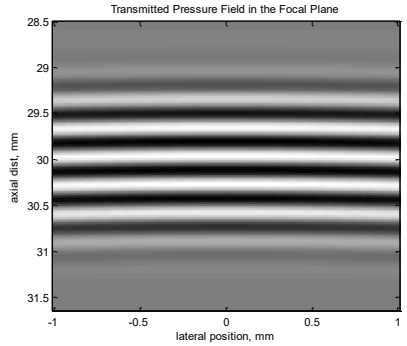
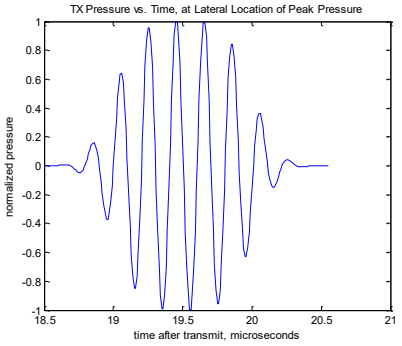


Fig. (b') TX Field image



T Fig. (c') X Axial waveform

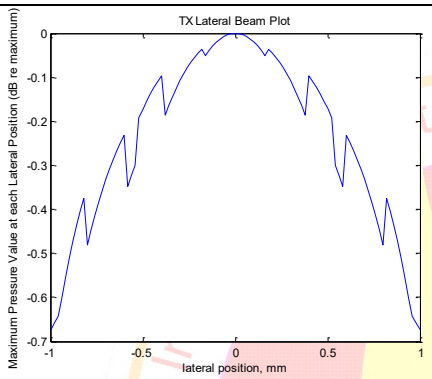


Fig. (d') TX Lateral beam-plot

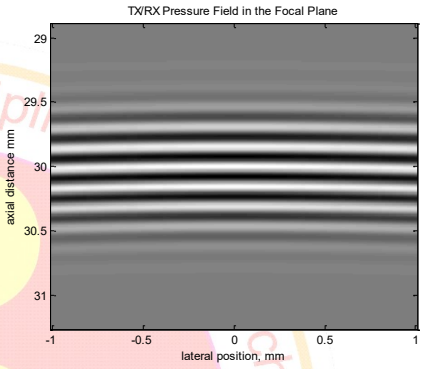


Fig. (e') TX/RX Field image

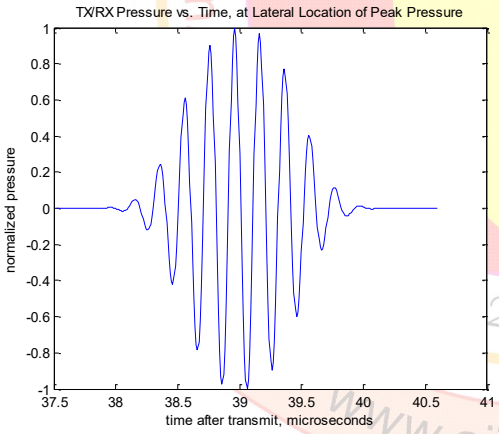


Fig. (f') TX/RX Axial waveform

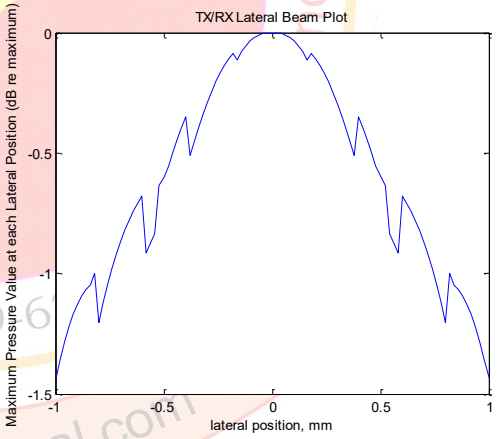


Fig. (g') TX/RX Lateral beam-plot

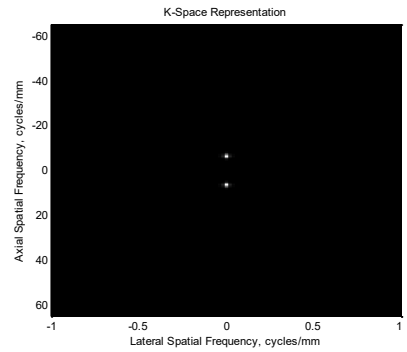


Fig. (h') K space TX/RX field image

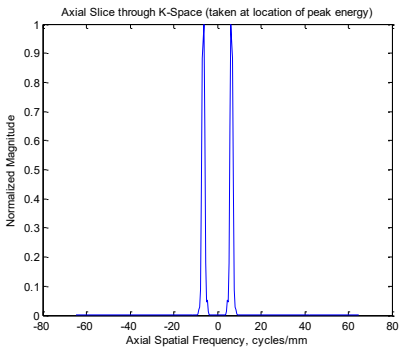


Fig. (I')K space axial slice

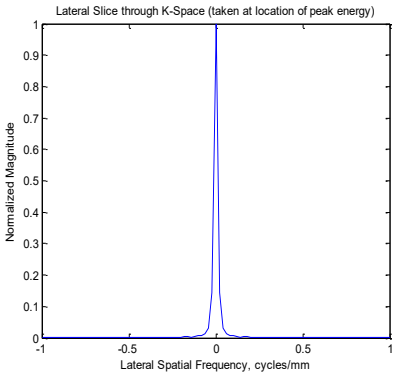
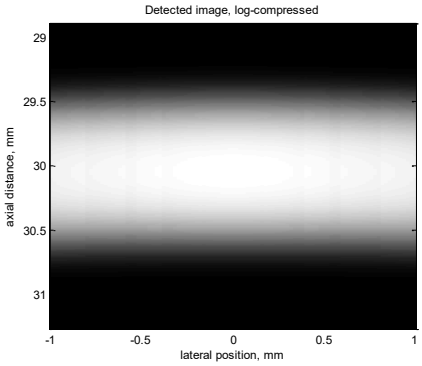


Fig. (j')K space lateral slice



h

Fig. (k')Detected image

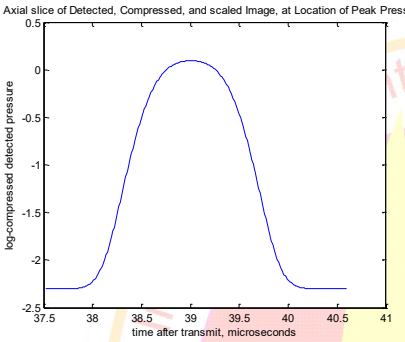


Fig. (l') Detected image axial slice

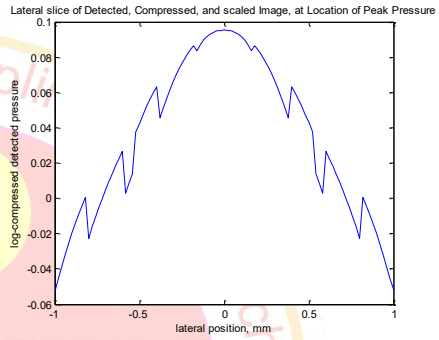


Fig. (m') Detected image lateral slice

V. Conclusion

The paper attempts to present a coherent analysis of the focusing strategies for 2-D array transducer design and properties, based on linear acoustics. The delays on the individual transducer elements and their relative weight or apodization are changed continuously as a function of depth. This yields near perfect focused images for all depths. Similarly, if number of arrays in the transducer are increased then contrast of displayed image, is increased thus, benefitting the diagnostic importance of ultrasonic imaging. The detected image response for 8-element array has higher contrast than 4-element array also the pressure filed generated by 8-element is high this increases diagnostic value.

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Study of Sentiment Analysis for Low Resource Languages Using Transformer Based Models

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Abstract:

Sentiment Analysis means to identify the view or emotion behind a situation. Commonly use of sentiment analysis include monitoring customer feedback, targeting to improve the service, and tracking customers' reviews. Sentiment analysis is treated as important topic as well as in the area of research with significant applications in both industry and academia. Sentiment analysis offers many benefits and opportunities from business, government and consumer perspective in this digital data explosive age. In this paper studied role of transformer based models are effective in finding the sentiment analysis from datasets, as well as different types of transformers and their efficiency also studied how these transformer used in low resource languages.

Keywords*: Aspect-based sentiment analysis, transformer, tree transformer, attention mechanism, nature language processing.*

Introduction:

Sentiment Analysis has been a very popular activity since the beginning of Natural Language Processing (NLP). It belongs to a subtask or application of text classification, identifying sentiments or subjective information from different texts.

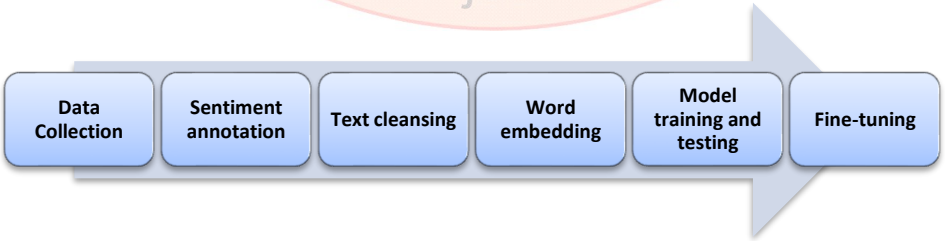
Sentiment Analysis means to identify the view or emotion behind a situation. It means to analyse and find the emotion or intent behind a piece of text or speech or any mode of communication.

Common use cases of sentiment analysis include monitoring customer feedback, targeting individuals to improve their service, and tracking how a change in product or service affects how customers feel. It also helps to track customer sentiment over time. From opinion polls to creative marketing strategy, this platform has completely redefined the way businesses operate, which is why this is an area every data scientist should be well aware of.

Sentiment Analysis:

Sentiment analysis is a mechanism that deals with feedbacks, emotions, feelings along with perceptions, which is produced from data, being considerably used in different fields like commercial product analysis taking decision by governments, social media analysis etc. Sentiment Analysis is treading in both research and Commercial industries communities. Sentiments can be, negative, positive, or unbiased.

These are some common steps to create a customise Sentiment Analysis Model.



Data collection: First need to gather feedback from website or relevant reviews of any product of services and mentions in one dataset.

Sentiment annotation. In second step is to assign (positive, neutral, negative, etc.) sentiment tags to words and phrases or sentences. For Attribute-based and fine-grained types of sentiment analysis will also require more labels to produce more accuracy.

Text cleansing: Comments & Reviews typically containing some irrelevant excessive information that cannot produce correct analysis. So that before using dataset and provide to relative machine algorithm

need to remove its noise and stop words and converting words into basic forms.

Word embedding. To make available text data understandable by machine learning models need to translate text in to vectors. It is word embedding process.

Model training and testing: To train Machine Learning model and evaluate the results. Dataset divided into training and testing parts, if model gives more correct result then it can be apply on unlabeld data for sentiment analysis and classification.

Fine-tuning : Training a Machine Learning Model like BERT on a small data will create problem. So, it is better to a pre-trained model that trained on a different dataset. After that, it can additionally train the model on our quite smaller data and it is fine-tuning approach. [1][10]

Transformer based Sentiment Analysis:

By the introduction of Transformer based models the field of NLP got more attention of researchers & practitioners. Using transfer learning with these models, have given more accuracy.

Models:

A. Bi-directional LSTM : Long Short-Term Memory networks (LSTMs) are a unique type of Recurrent Neural Network that learn from longterm possessions. Hochreiter and Schmidhuber introduced them in 1997 and were refined and publicized by many individuals working in the domain.

B. Transformers : The Transformer in Natural Language processing (NLP) is an architecture that focuses to solve seqtoseq problems with holding extended-span control. The Transformer model was presented by Google in a famous paper named "Attention is all you need" [2] in 2017.

C. BERT : BERT (Bidirectional Encoder Representations from Transformers) is a pre-trained NLP model developed by Google AI Language researchers [16] in October 2018. It has caused a hype in the community by showing stateof- the-art (SOTA) performance in comprehensive NLP tasks for instance, Question-Answering(SQuAD), Sentiment Analysis, language translation and many more. BERT is a Transformer, which uses an attention method that acquire a knowledge of correlation between sequential words.

Transformer involves two distinct process - an encoder that proceeds data as input and a decoder that produces an output for the task. As BERT's aim is to create a language model, for that only encoder mechanism is needed. The particular working of Transformers is illustrated in the paper. [3] As compared to directional models, which takes the input and interprets sequentially, the Transformer takes the entire string of words at once. This particular feature allows it to determine the meaning of a word based on all of its surroundings.[9]

D. RoBERTa : RoBERTa (Robustly optimized BERT approach) was presented by Facebook ai [4] for pretraining natural language pro- cessing (NLP) tasks that enhanced BERT, a semi-supervised method introduced by Google. RoBERTa is built on top of BERT with some improved pre-training methodology, large data as well as more compute power. The BERT model uses reserved token, [CLS] classification as starting token and [SEP] separator as individually, but RoBERTa uses <s>and</s>for starting sentences. The BERT model and RoBERTa model have different size of sub-words. BERT model has approximately thirty thousand sub-words, whereas RoBERTa model has nearly fifty thousand sub-words. BERT model uses static masking pattern. On the other hand, RoBERTa model implements dynamic masking pattern.

E.DistilBERT DistilBERT stands for Distilled BERT which is basically smaller implementation of BERT. It is compact, quick, low cost version of BERT that is trained from BERT. It is claimed to have 40% less parameters than BERT and runs 60% faster while having 97% of BERT's performance characteristics as stated on the benchmark of GLUE language understanding. Despite of having superb performance BERT model was big and difficult to use in practice. Pre-training of large models need to fine-tuned before use as they are more resource demanding because of large number of parameters. [5] Comparison of DistilBERT and Bert /Cite4 Model No. of Parameters (Millions) Inference Time (Seconds) BERT-base 110 668 DistilBERT 66 410 Model Compression techniques: 1. Quantization 2. Pruning 3. Knowledge distillation

G.XLNet The XLNet language model was introduced by researchers in CMU and Google researchers' team. XLNet is the one of the recently came out model from emerging field of Natural Language Processing (NLP). The XLNet paper integrate latest researches in NLP tasks. It is trained on very large amount of NLP corpus, the model acquires state-of-the-art(SOTA) performance for many NLP tasks for example, text-classification, textsummarization, lan- guage translation and many more. XLNet is a development of the Transformer-XL model pre-trained using an autoregressive (AR) method. Autoregres- sive language model uses context word

(which constrained to two directions, forward and backward) to predict the upcoming word. The GPT and GPT-2 are example of Autoregressive language model. The benefits of this model are quite accept- able at generative NLP problems.in other hand, these models have some drawbacks, it cannot use forward and backward context all together. One major difference between BERT and XLNet is, BERT is autoencoder (AE) language model, whereas XLNet is autoregressive (AR) model. XLNet model focuses to rebuild the actual data from altered input. The altered input means it uses [MASK] to restore the original token in pre-training part and the task is to predict the original sentence. [6]

H. A T-MGAN model was introduced by researchers for aspect-based sentiment analysis. We combine Transformer Encoder and Tree Transformer Encoder with specific sub-tasks, utilize T-MGAN to model the word-level and phrase-level features of aspects and contexts. T-MGAN not only acquires semantic features, but also effectively obtains language hierarchy and syntax information. In addition, the dual-pooling method is used to extract the key features in the hidden layer features of aspect and context, and the attention mechanism is used multiple times to effectively obtain the _ne-grained associated emotional features between the specific aspect and the context. [7]

I. Third popular language in India is Marathi, although lacks of useful NLP resources in Marathi Language. Researcher from L3Cube-MahaNLP presented MahaBERT, MahaAlBERT, and MahaRoBerta all BERT-based masked language models, and MahaFT, the fast text word embeddings both trained on full Marathi corpus with 752M tokens, aim to build resources and a library for Marathi natural language processing. They have contributed un-supervised, supervised datasets, and Transformer models for Marathi. L3Cube-MahaCorpus is a Marathi monolingual data set scraped from different internet sources. They expand the existing Marathi monolingual corpus with 24.8M sentences and 289M tokens. [8]

Conclusion

Sentiment Analysis is now a day pay important role in the field of decision making for individuals, company, organizations, government. To analysing the feedbacks or comments and producing correct and increase the precision to analysing the sentiment is very important task so in this process to transformer are used for better result. In this paper analyses the few transformer based models like BERT, RoBERTa, DistilBERT, T-MGAN, MahaBERT which are also work well in low resource language like Marathi.

There are several general challenges in sentiment analysis as well as specific analysis of occurring challenges while working with Low resources Languages. Also this paper opens up the future research work and new dimensions for researcher.

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Classification of Delta & Omicron Variant of COVID 19 with CT Images Using Deep Learning Tools in MATLAB

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Abstract

Corona virus disease 2019 (COVID-19), also known as the corona virus, or COVID, is a contagious disease caused by severe acute respiratory syndrome corona virus 2(SARS-CoV-2). The first known case was identified in Wuhan, China, in December 2019. The disease has since spread worldwide, leading to an ongoing pandemic. The COVID-19 virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes.

Omicron and Delta symptoms have been a worldwide cause of concern since these variants emerged. The Delta variant was first detected in India in March 2021 and quickly spread worldwide. In November of the same year, Omicron was detected in South Africa and became the dominant variant worldwide.

The paper covers the MATLAB GUI designed with the help of deep learning tools which is able to classify the Delta & Omicron Variant of COVID 19 with CT images. We have trained an ANN to classify CT images by making use of deep learning tools in MATLAB

Keywords: *Deep learning, MATLAB, COVID-19, CT images, Delta Variant Omicron Variant.*

Introduction:

The COVID-19 pandemic has led to a dramatic loss of human life worldwide and presents an unprecedented challenge to public health, food systems and the world of work. Millions of enterprises face an existential threat. Informal economy workers are particularly vulnerable because the majority lack social protection and access to quality health care and had lost access to productive assets. Without the means to earn an income during lockdowns, many were unable to feed themselves and their families. For most, no income means no food, or, at best, less food and less nutritious food. The COVID-19 virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes.

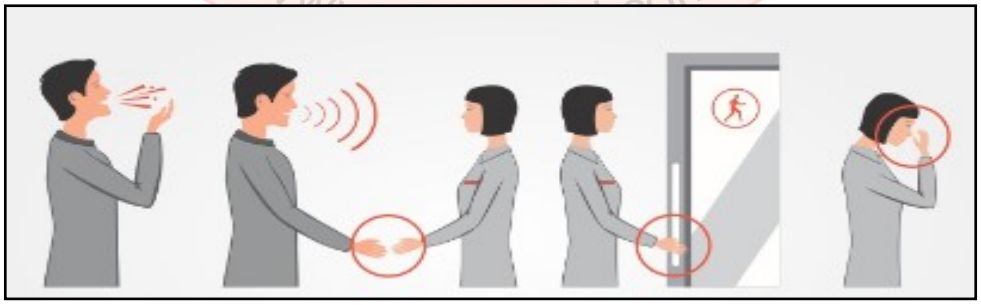


Fig: Mediums of virus spreads

Effects of The COVID-19 pandemic on Food, Agricultural & Work:

The pandemic had affected the entire food system and had laid bare its fragility. Border closures, trade restrictions and confinement measures prevented farmers from accessing markets, including for buying inputs and selling their produce, and agricultural workers from harvesting crops, thus disrupting domestic and international food supply chains and reducing access to healthy, safe and diverse diets. The pandemic decimated jobs and placed millions of livelihoods at risk. As breadwinners lost jobs, fall ill and die, the food security and

nutrition of millions of women and men were under threat, with those in low-income countries, particularly the most marginalized populations, which include small-scale farmers and indigenous peoples, being hardest hit. Millions of agricultural workers – waged and self-employed – while feeding the world, regularly face high levels of working poverty, malnutrition and poor health, and suffer from a lack of safety and labour protection as well as other types of abuse. With low and irregular incomes and a lack of social support, many of them were spurred to continue working, often in unsafe conditions, thus exposing themselves and their families to additional risks. Further, when experiencing income losses, they may resort to negative coping strategies, such as distress sale of assets, predatory loans or child labour. Migrant agricultural workers were particularly vulnerable, because they face risks in their transport, working and living conditions and struggle to access support measures put in place by governments. Guaranteeing the safety and health of all agri food workers from primary producers to those involved in food processing, transport and retail, including street food vendors as well as better incomes and protection, critical saved lives and protecting public health, people's livelihoods and food security.

In the COVID-19 crisis food security, public health, and employment and labour issues, in particular workers' health and safety, converge. Adhering to workplace safety and health practices and ensuring access to decent work and the protection of labour rights in all industries was crucial in addressing the human dimension of the crisis. Countries dealing with existing humanitarian crises or emergencies are particularly exposed to the effects of COVID-19.

What is the difference between the Omicron and Delta variant?

Omicron and Delta symptoms have been a worldwide cause of concern since these variants emerged in March 2021 and quickly spread worldwide. In November of the same year, Currently, the variants in high circulation are all variants of Omicron To assess the implications for public health and the need for additional safety measures, the WHO created a system in which all variants have been categorized according to their potential impact on transmissibility, immunity, and severity.

Based on these characteristics, variants of the coronavirus can be divided into

- Variants of concern, which are viruses for which there's evidence of an increase in transmissibility or disease severity.
- Variants of interest, which are viruses that have mutated in such a way that there may be an increase in transmissibility or disease severity.
- Variants under monitoring, which are variants that may increase transmissibility or disease severity, but the evidence is weak or hasn't been properly assessed yet.
- De-escalated variants, which are variants that have been de-escalated as they're no longer circulating, have an impact on the overall situation of COVID-19, or they aren't associated with any concerning health problems.

After close monitoring, the Delta variant has been de-escalated, as it no longer circulates at high levels. For Omicron, the categorization depends on the exact mutation of the virus. Some variants of Omicron are de-escalated due to their little impact on public health, in contrast, other variants are under monitoring as they have been detected in large quantities worldwide, but the effect has yet to be assessed.

What are the symptoms of Delta vs. Omicron?

The symptoms of Omicron vs Delta are quite similar, although some differences are important to understand. In general, Omicron symptoms are more present in the upper respiratory tract, which makes it harder to differentiate this virus from other respiratory illnesses, such as the common cold. Delta symptoms may also affect the lower airway tract, including the lungs. To have an overview of the possible Delta symptoms vs. Omicron symptoms, we've created the following table:

Symptoms	Omicron	Delta
Runny nose	Very common	Very common
Sneezing	Very common	Very common
Headache	Very common	Very common
Sore throat	Very common	Very common

Persistent cough	common	Very common
Fatigue	common	common
Fever	common	common
Body Aches	common	common
Loss of Smell	Rare	Common
Loss of taste	Rare	Common
Chest pain	Rare	Rare
Shortness of breath	Rare	Rare
Diarrhea or nausea	Rare	Rare

Dataset:

We have kept the sample size of 200 CT images to get the results. All the CT images are referred from Kaggle.com

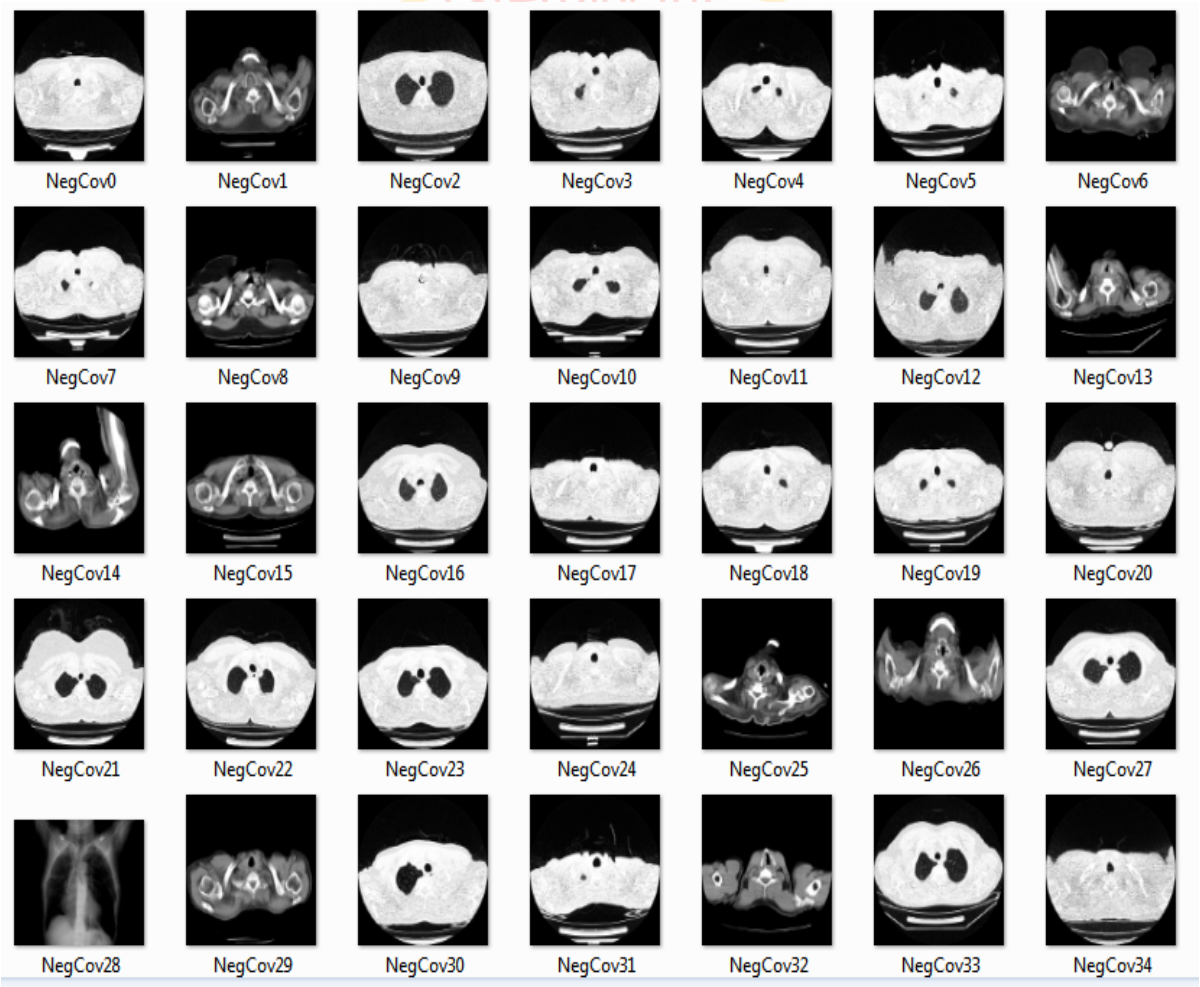
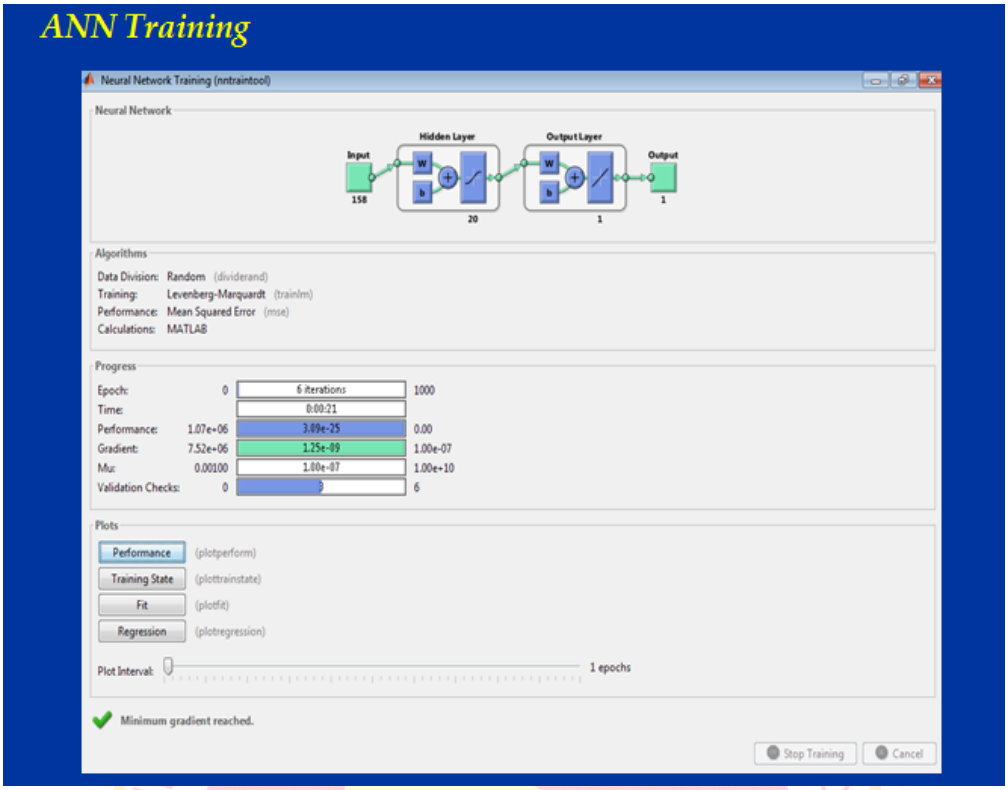


Fig: Sample Dataset of CT images of Delta & Omicron Variant of COVID-19

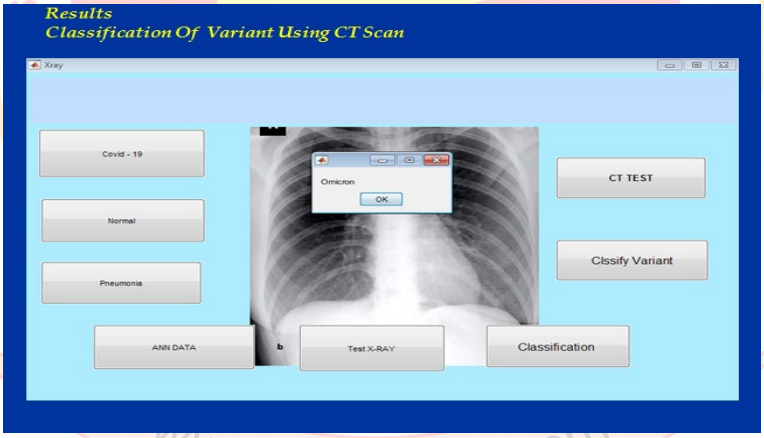
Tools Used:

MATLAB

MATLAB is Matrix laboratory developed by MathWorks & designed by cleve moler in late1970.It is a programming and numeric computing platform used by millions of engineers and scientists to analyze data, develop algorithms, and create models. It has various toolboxes & Interactive APPS which are professionally developed , rigorously tested & fully documented.



Test Results & Plots:



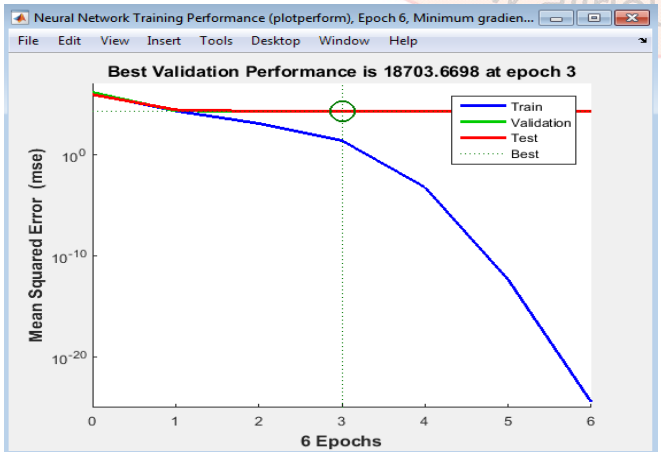


Fig: Performance Plot

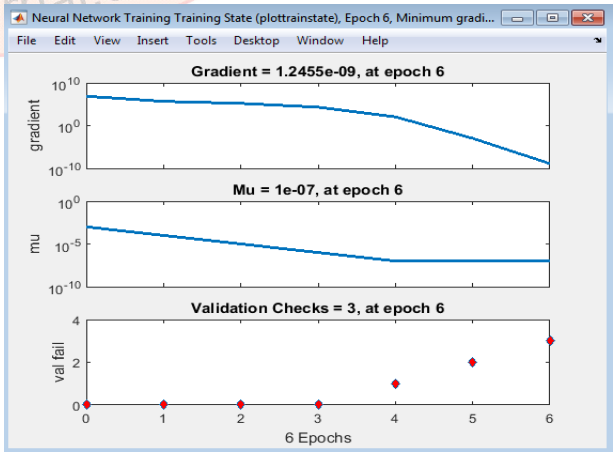


Fig: Train State Plot

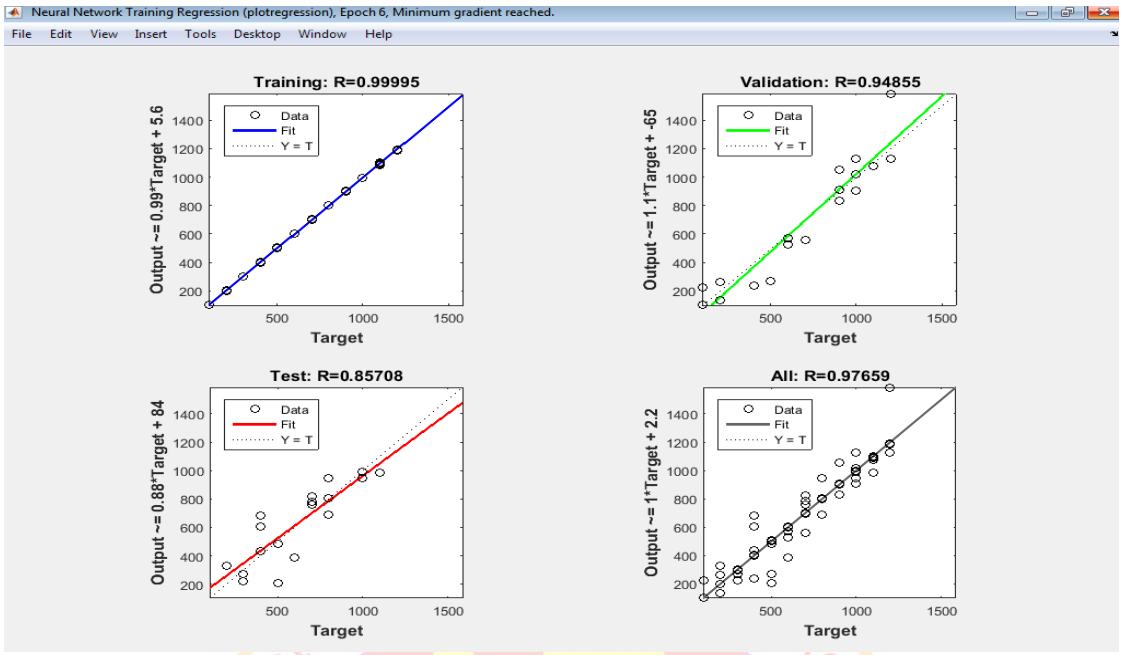


Fig: Regression Plot

Conclusion:

The Designed framework leverages a data augmentation of CT images algorithm for the COVID-19 data, by adaptively employing the MATLAB. The training data consisting of actual and synthetic CT chest images are fed into our customized neural network model, which achieves detection of Omicron and Delta Variant with good accuracy. Furthermore, the paper discuss an efficiently automate COVID-19 Variant detection from CT scan images to provide a fast and reliable evidence of COVID-19 infection in the lung that can complement existing COVID-19 diagnostics modalities.

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A study of Cyber Security in Healthcare: Need, Emerging Trends, Vulnerabilities & Challenges

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Abstract

Healthcare is a significant target for cybersecurity. As healthcare organizations rapidly adopt connected technology and collect sensitive patient data, they have become prime targets for sophisticated cyber-attacks. Therefore, cybersecurity is important in healthcare. This study highlights vulnerabilities introduced by digitalization in patient care, medical facilities, and administrative systems, and this data can come from various sources, such as hospital and lab records, insurance records, fitness apps, gadgets, and health portals. However, it often becomes a target for hackers. Therefore, cyber-security plays a major role in securing data form data breaches. Different challenges, vulnerabilities in healthcare related to cyber security are also discussed in this paper for the future directions to the new researchers.

Keywords: cybersecurity, healthcare, attacks.

Introduction

Cybersecurity is a way to protect systems, networks, and programs from digital threats. These threats, known as cyberattacks, are often carried out to access, modify, or destroy sensitive information. Both individuals and organizations use cybersecurity to protect their data, data centers, and other computerized systems from unauthorized access. It plays an important role in preventing data leaks, theft, and damage to systems, ensuring that services continue without interruption. [1 (karl, 2024)]

Cyber Security in Healthcare Technology



Figure 11: cyber security in healthcare technology

In healthcare, cybersecurity is very important because this industry relies on technology for patient care and hospital operations.The main focus of healthcare cybersecurity is to protect digital information and systems from unauthorized access so that the data privacy and integrity of patient data is maintained and medical services remain secure and available. For all healthcare organizations, whether they are hospitals, insurance provider or pharmaceutical companies, it is essential to protect themselves from both internal and external cyber threats. Proactive cybersecurity measures are taken to prevent attacks, while reactive measures are used to respond to attacks that have already occurred. The rise in cyberattacks has not only resulted in data breaches but has also threatened patient safety by disrupting critical medical services. Once hackers gain access to a network, they can install ransomware. The ransomware is a form of malware that when download to a device deletes all data valuable information, non-secure medical devices outdated technology and hesitancy with adoption make health care a prime target. that disrupts essential services or encrypts files until a specified ransom is paid. Often, payment is demanded, and network-connected devices can be compromised, potentially leading to incorrect medication administration or altered machine functionality.The healthcare industry is a prime target

for cybercrimes, such as hacking and data breaches. This is a major concern because healthcare companies are increasingly using digital technology to store patient information, diagnose diseases, and treat patients.
Technology has brought many benefits to healthcare, including:

- Storing patient data in secure online platforms (cloud storage)
- Using artificial intelligence (AI) to help doctors diagnose diseases more accurately and quickly
- Improving medical imaging techniques, such as radiology screening
- Maintaining a trustworthy reputation requires consistently demonstrating honesty ,reliability, and integrity in all actions and communications.

However, this increased reliance on technology also increases the risk of cyberattacks Therefore, it's crucial for healthcare companies to prioritize cybersecurity measures to protect patient information and ensure continuous care. To keep healthcare organizations safe from cyber threats, To create effective protection plansMany cybersecurity solutions are designed for various industries, but they often ignore the unique challenges and complexities that healthcare organizations face. (Xuan V. Nguyen, 2024) (Niamat Ullah Ibne Hossain, 2023)

Need of cybersecurity: This study involved a focus group of five representatives from healthcare and cybersecurity fields, analysing four key themes: the difficulty of securing the sector, financial constraints, balancing privacy and transparency, and the importance of education and regulation. The study highlights the need for sector-specific tools, such as a self-evaluation tool, to help stakeholders proactively address security risks. Despite extensive research, there is limited focus on proactive cybersecurity measures to identify vulnerabilities before incidents occur. we need to consider these factors. However, just teaching people about cybersecurity isn't enough. We need to do more than just raise awareness. we need more than just technical fixes. We need a strong culture of cybersecurity that includes understanding how different factors (like company culture, structure, and technology) affect the healthcare industry and its cybersecurity efforts.[1 (Burke, 2024)] (Morteza SaberiKamarposhti, 2024)

Trends: The Patient Protection and Affordable Care Act (ACA) and the Health Information Technology for Economic and Clinical Health Act (HITECH) are changing how healthcare providers use technology. These laws are pushing healthcare organizations to use electronic systems and connect with other networks more effectively. As healthcare moves to these electronic systems, they become more vulnerable to cybercrime. Cybercrime started in the late 1970s with simple spam but has evolved into more complex threats like viruses and malware. Because health data includes sensitive personal and financial information, it is a prime target for cybercriminals. [2] (Kruse CS, 2017)

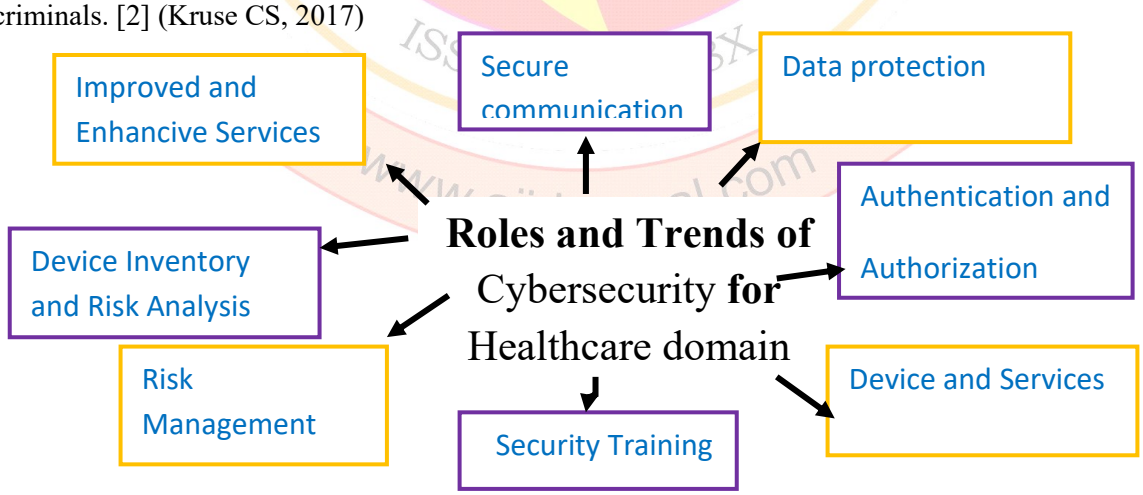


Figure 12: Roles and trends of cybersecuriy for healthcare

Vulnerabilities: Healthcare information systems are crucial and require robust cybersecurity due to the risks posed by cybercriminals. Exposed networks increase the likelihood of attacks, leading to data breaches and disruptions in patient care. Ransomware attacks on hospitals, for example, can lock access to electronic health records, forcing doctors to seek alternative facilities and resulting in substantial financial losses. The study reviewed cybersecurity vulnerabilities in healthcare through surveys and interviews with professionals and found that while threats are varied and impactful, cybersecurity measures are inconsistently applied. It

emphasizes the need for standardized practices, ongoing investment in cybersecurity infrastructure, and ethical considerations to protect patient data and maintain trust in the healthcare sector.[3] (Triplett, 2024)

Challenges:This study reviews the intersection of cybersecurity and healthcare, analyzing threats, technological advancements, and the effectiveness of current measures. Using a systematic literature review from 2014 to 2023, it evaluates peer-reviewed articles, conference proceedings, and white papers. The findings highlight sophisticated threats and the vital role of emerging technologies like AI, blockchain, and machine learning in improving security. It emphasizes the need for robust standards and regulations and the implications for various stakeholders. Recommendations include prioritizing cybersecurity, investing in education, and advocating for strong regulations. The study aims to enhance understanding and guide future strategies to protect healthcare information and services.[4] (GUMA, 2024)

How to overcome these challenges? to Ensuring the security of health information is crucial for healthcare organizations, as medical equipment and applications are frequent targets for cyberattacks. Malicious actors often aim to install ransomware, encrypting data until a ransom is paid. The theft of network-connected equipment also poses a threat. Effective cybersecurity measures are essential to protect various types of records, including electronic medical records, laboratory data, and insurance documentation. This paper explores different cybercrimes affecting healthcare information and suggests strategies to mitigate these threats, highlighting the increasing value of healthcare data as a target for cybercriminals.[5] (aghad Mahmoud, 2024) (Ramiz Salama, 2024)

Conclusion

Cybersecurity threats in healthcare are growing more complex and frequent, presenting significant challenges such as high costs, privacy versus transparency issues, and the need for better education and regulation. This study highlights the urgent need for tailored tools, like a self-assessment tool, to help organizations manage these risks. It calls for improved cybersecurity education, standardized practices, and the use of emerging technologies like AI and blockchain. Continued research is crucial to evaluate cybersecurity tools, understand the impact of attacks, and refine policies. Establishing an Australian Cybersecurity Healthcare Index could significantly enhance the sector's readiness, ensuring the protection of sensitive patient data and preserving trust in healthcare services. After reading this research paper, readers will be able to understand all aspects related to cybersecurity in healthcare, including needs, trends, vulnerabilities, challenges, industry perspectives on overcoming issues, and applications, all covered in this single paper.

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Study of Structural Properties of Cobalt Aluminate

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Abstract:

Co precipitation method is used for the synthesis of the nanomaterial. Prepared sample was calcinated at 900°C. powder were characterized by X-ray diffraction, Fourier transform infrared spectroscopy. XRD data confirms the formation of single-phase cubic structure and the average grain sizes were evaluated. The XRD result revealed the production of a sharp single cubic spinel structure of prepared sample without any impurity peak with the crystallite size of about 21.6 nm. FT-IR analysis shows that high and low frequency absorption bands of $CoAl_2O_4$. The microstructural features were examined by scanning electron microscopy (SEM).

Keywords: *Metal oxide, Cubic-Spinel, XRD, FT-IR, SEM.*

Introduction:

Spinel structure oxides (AB_2X_4) found one of the most interesting class of inorganic metalloid materials. They possess both physical and chemical properties**.** There is various information available on semiconducting metal oxide. Cobalt aluminate spinel ($CoAl_2O_4$) is known for its blue colour and it is widely used as pigments for ceramics, paints, fibres and so on. $CoAl_2O_4$ is a material which have excellent thermal stability, high melting point and electrical properties. The structure of $CoAl_2O_4$ also plays a key role in determining the material's behaviour in different environments making it an important consideration in various fields of science and engineering [1]. The materials have high thermal stability, colour stability, resistance to moisture and humidity also make it suitable for use in harsh environments [2-7]. The aim of this paper to synthesised cobalt aluminate by co precipitation route. The prepared material was characterized by X-ray diffraction (XRD) and Fourier transform infrared spectroscopy (FTIR).

Materials and Methods:

There are several methods use to synthesize Cobalt aluminate ($CoAl_2O_4$) nanoparticles, including the mixed oxide method, citrate-nitrate method, hydrothermal synthesis and combustion methods [8,9]. Among all these method, co precipitation is one of the most efficient and human-friendly method to develop spinel oxide materials in a short time interval of time [10].

Sample $CoAl_2O_4$ was synthesized by co-precipitation method in an air atmosphere. The starting materials were weighed according to the stoichiometric ratio. The raw materials $Al(NO_3)_2$(99.0%), $(Co(NO_3)_2\ 6H_2O$, were dissolved in distilled water mixed well with each other at 80°C temperature under constant magnetic stirring, where in the molar ratio of Co/Al was 1:2. In this process, ammonia was used as precipitant. The mixed materials were dried in an oven for 24 h. The dried materials were put into the alumina crucible and calcined in muffle furnace at 900°C for 4 h and then the white powder was obtained. Thick film was prepared from this powder by screen printing method.

Structural Analysis:

The X-ray measurement of various mixed solids was carried out using a BRUKER D8 advance diffractometer (Germany). X-ray powder diffraction analysis was used to identify the crystal structure of cobalt aluminate. The patterns were run with Cu Kα radiation at 40 kV and 40 mA with scanning speed in 2θ of 2° min^{-1}. The crystallite size of $CoAl_2O_4$ crystallites present in the investigated solids was based on X-ray diffraction line broadening and calculated by using Scherer equation [11]

$$d = \frac{k\lambda}{ß Cos\ \theta}$$

where d is the average crystallite size of the phase under investigation, k is the Scherrer constant (0.89), λ is the wave length of X-ray beam used, β is the full-with half maximum (FWHM) of diffraction and θ is the Bragg's angle. The XRD patterns of these powders showed several peaks at 31.44, 37.02, 44.94, 55.78, 59.46 and 65.30 corresponding to (h k l) reflection at (2 2 0), (3 1 1), (4 0 0), (4 2 2), (5 1 1) and (4 4 0) respectively [12]. These peaks could be indexed with space group Fd3m. Cobalt aluminate have high crystalline form.

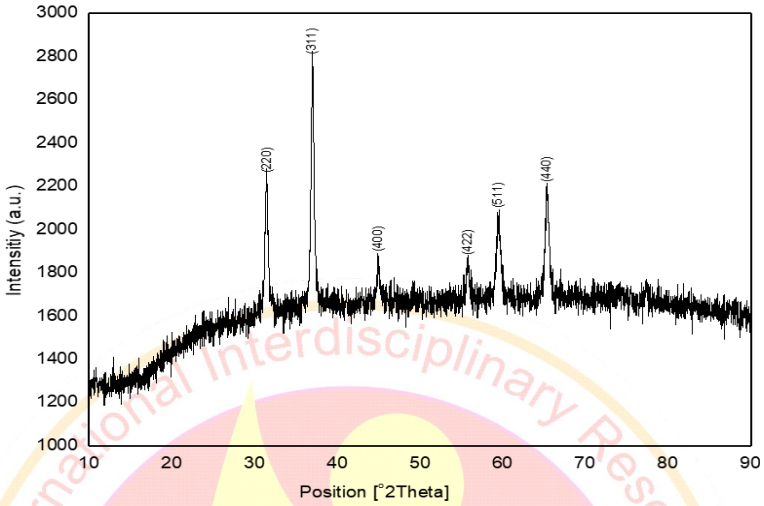


Fig. 1: X RD pattern of $CoAl_2O_4$ powder calcinated at 900°C.

Infrared spectra of given sample as shown in fig. 2. Spectra shows three bands in the region 500 to700 cm^{-1}. These three bands are attributed to the vibration modes of the $CoAl_2O_4$ phase [13]. These results are in good agreement with XRD analysis.

Scanning electron micrographs (SEM) were recorded on JEOL JSM 7600F. SEM micrographs of the sample $CoAl_2O_4$ thick film are presented in fig. 3. The film was synthesized by screen printing method. Figure shows agglomerates of different shapes and the particle size between the range 45.1- 45.4 nm.

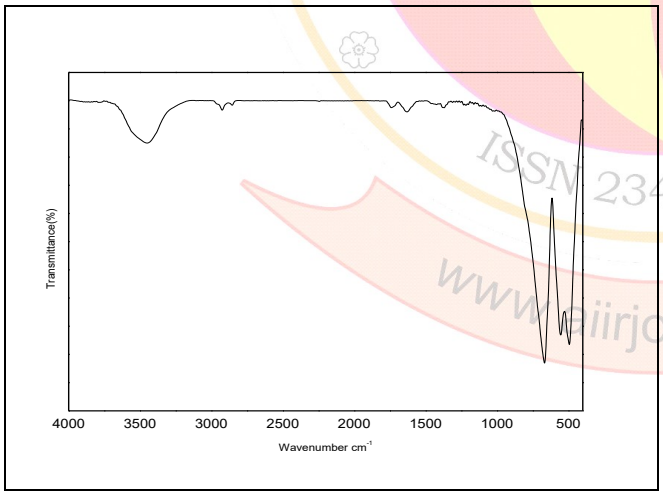


Fig.2: FTIR spectra of $CoAl_2O_4$ powder calcinated at 900°C.

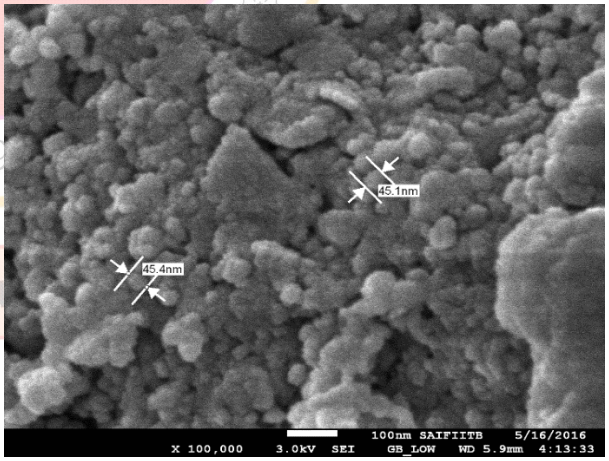


Fig. 3: SEM image of nanocrystalline $CoAl_2O_4$ thick film.

Summary:

In summary, $CoAl_2O_4$ nanoparticles have been successfully synthesized through co precipitation method. The sample was heated upto 900°C. The heat treatment blue powders with a direct spinel structure ($CoAl_2O_4$). The vibrational stretching frequencies corresponding to the composites were confirmed by FT-IR spectroscopy. Scanning electron micrograph shows homogenous morphology; it consists in agglomerates of primary particles of quasi-spherical shape with a size in the range 45.1 to 45.4nm.

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Revolutionizing Connectivity: Unpacking IoT Potential, Applications, Challenges, and the Future

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Abstract

IoT [Internet of Things] is contributing to every aspect of human life, and to the future we are imagining. Ask for IoT is increasing consistently over the time. IoT has the capability to interconnect the entire world and beyond. This paper calls attention to applications, vulnerabilities, challenges, and future directions of IoT. Indicating that IoT has come so far in fighting challenges and has much more to accomplish. It starts with a brief history of the evolution of IoT moving to its vast application areas in numerous areas. IoT is gaining popularity. This paper also discusses the hurdles that play key roles in restricting the development of IoT, also highlights the potential of IoT if worked together with AI, Big Data & 5G.

Keywords; IoT, Applications, Challenges, Future trends (Big Data, 5G, AI).

Introduction

IoT [Internet of Things] describes devices with sensors, processing ability, software, and other technologies that connect and exchange data with other devices and systems over the Internet or other communication networks. We can say we are living in the generation of IoT and moving into the era of IoT. The Internet of Things represents one of the most significant technological advancements of our era. The universe of IoT can be seen as a reflection of a "social network" for Things—connected devices, such that interaction occurs, not just between humans and devices, but among devices themselves. We all are using IoT but unconsciously it's present right there from the TV remote, and smartphones of our day-to-day life to the huge industries The ocean of its applications spans over various domains, offering innovative solutions and posing new challenges. It outstretches limits on internet consumption beyond traditional devices such as computers and smartphones, integrating a vast line-up of objects from household appliances to industrial machinery into a network of smart devices. This concept, once futuristic, is expeditiously becoming a keystone of modern life, influencing individual households, industries, governments, and nations worldwide. (Borra, 2024)

History & Evolution of IoT

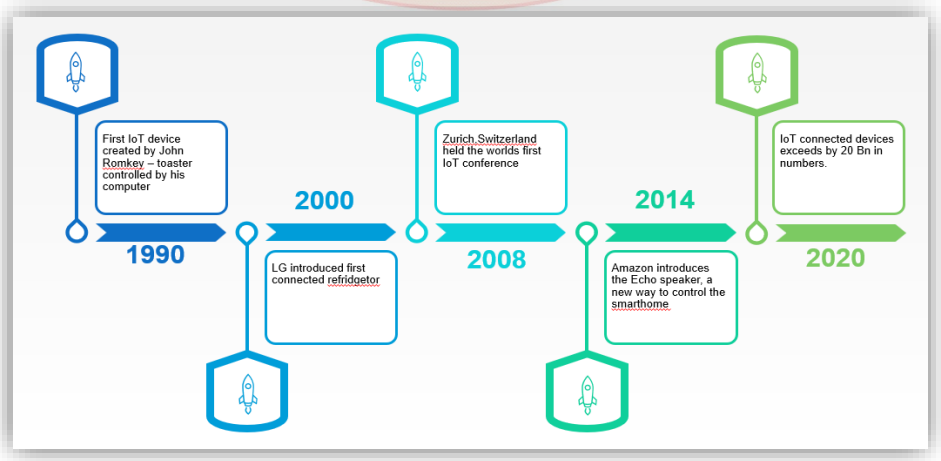


Fig.1 Timeline of IoT evolution over time

1990s: The Birth of IoT :

In 1990, John Romkey made a toaster an internet device - probably one of the first IoT devices. However, the term "Internet of Things" was minted in 1999 by Kevin Ashton, a British technology pioneer, during his work at Procter & Gamble, where he was exploring the use of radio-frequency identification (RFID) in supply chain management. Ashton conceptualized RFID tags tracking products and communicating via an internet network, laying the conceptual bedrock for IoT. (Malik, 2020)

2000s: Growth and Adoption :

Since then, advancements in wireless technology, cloud-based systems, and the shrinking of sensors have fired the development and adoption of IoT across various sectors. Until the 2000s, IoT took the turn from concept to reality. In 2000, LG Electronics introduced the first refrigerator that was connected to the internet, showing the power of IoT to consumers. In 2008, devices connected to the internet outnumbered the number of humans on Earth, indicating rapid growth in IoT. Most industries such as manufacturing logistics, and healthcare started giving more prominence to RFID and wireless sensor technologies. (Malik, 2020)

2010s: IoT Goes Mainstream :

In an effort to expand the use of Internet Protocol (IP) in the smart object network and facilitate the Internet of Things, the IPSO Alliance was established by a consortium of companies in 2008. The FCC approved the utilization of "white space spectrum" in 2008 [5]. The adoption of IPv6 in 2011 has sparked significant interest and growth in this field. Major IT companies like Cisco, IBM, and Ericson are actively pursuing educational and commercial initiatives related to IoT [8]. IoT technology serves as a crucial connection between individuals, the Internet, and various objects, enabling the monitoring of everyday items via the Internet. (Malik, 2020)

Applications in various domains

The applications of IoT have spread their roots in almost every industry and sector, with immense improvements in efficiency, innovation, productivity, and the connectivity of those industries. IoT changes industries and human interaction with one's environment, transforming devices into collecting and sharing devices on their own.

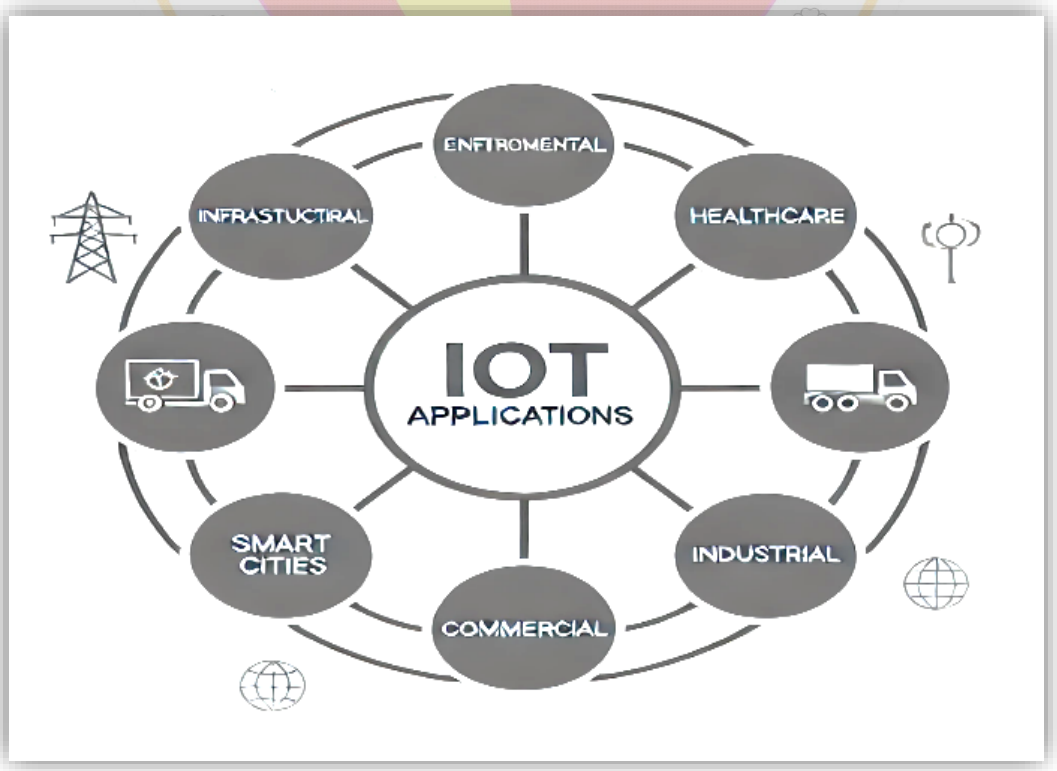


Fig.2 Utilization of IoT's

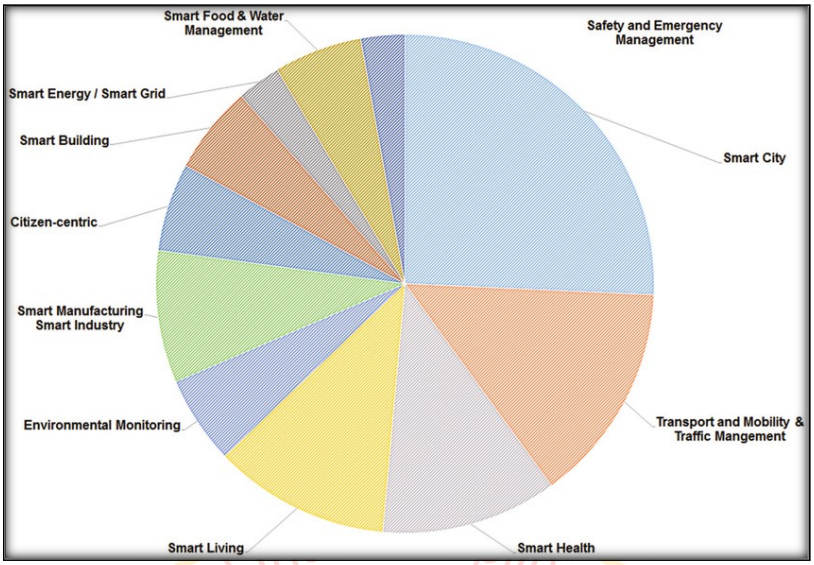


Fig. 3 IoT major application areas.

1. SMART HOMES; IOT REDEFINES HOME AUTOMATION IN A CONVENIENT AND ENERGY-EFFICIENT WAY:

- Smart thermostats, like Nest, regulate temperature based on user behavior.
- Smart lighting and security systems can be remotely operated.
- Usage patterns and operation monitoring through mobile applications can be done by refrigerators and washing machines. (Gubbi, 2013) (Malik, 2020)

2. IOT-INTERNET OF MEDICAL THINGS IN HEALTHCARE; IOT IS REVAMPING HEALTHCARE WITH CONNECTED MEDICAL DEVICES:

- Through wearables, such as a fitness tracker or an ECG heart rate monitor, one has a view in real-time of one's health.
- It cuts down on in-person visits because patients' health data can be transmitted to health professionals through remote patient monitoring.
- IoT for smart hospitals supports asset tracking, patient management, and resource optimization, including medication and equipment. (Atlam, 2018) (Punitha, 2024)

3. SMART CITIES; IOT PLAYS AN IMPORTANT ROLE IN DEVELOPING A SUSTAINABLE AND EFFICIENT URBAN ENVIRONMENT:

- Smart traffic systems keep congestion low by continually monitoring the flow of traffic and the state of the lights.
- Connected waste management routes collection schedules based on real-time data provided by smart bins.
- Energy grid-compatible IoT devices ensure overall efficiency in distribution, demand response, and waste reduction. (Atlam, 2018) (Khan, 2012) (Punitha, 2024)

4. AGRICULTURE-SMART FARMING; THE CONTRIBUTION OF IOT IN AGRICULTURE HAS BEEN IMMENSE WITH THE USE OF PRECISION FARMING TECHNIQUES:

- Smart irrigation systems automatically adjust water usage according to the current soil moisture and weather conditions in real time.
- It monumentally monitors livestock with sensors that track animal health, location, and movement of those animals.
- A crop monitoring system gathers data based on the soil condition, temperature, and humidity for facilitating effective growth and yield. (Khan, 2012)

5. AUTOMOTIVE AND TRANSPORTATION; IOT IS TRANSFORMING TRANSPORTATION AND AUTOMOTIVE IN SEVERAL WAYS:

- Connected cars use IoT in such a way as to enable navigation in real-time, vehicle diagnostics, and entertainment inside a car.

- IoT sensors, cameras, and communication between vehicles and with infrastructure are being used by autonomous vehicles to make driving safer.
- Fleet management systems will be able to optimize in real-time the routing of vehicles while watching their fuel use and tracking when the vehicle will require maintenance. (Atlam, 2018) (Khan, 2012)

6. RETAIL RETAILERS ARE WAGERING ON THE EFFECTIVENESS OF IOT TO GUARANTEE A BETTER CUSTOMER EXPERIENCE AND OPTIMIZATION OF PROCESSES:

- Smart Shelves: Monitor product availability and trigger alerts when it is time for a refill.
- In-store sensors monitor customer behavior to deliver personalized data on promotions and product placement.
- Supply chain monitoring involves ensuring that goods flow from a warehouse into a store under the most optimal conditions to avoid inventory stock-outs. (Atlam, 2018)

7. ENERGY AND UTILITIES; IOT IS GAINING MOMENTUM IN IMPROVING EFFICIENCY IN ENERGY AND UTILITY VERTICALS:

- Smart meters enable energy consumption to be monitored in real-time to allow consumers to change consumption patterns as per dynamic pricing.
- Energy grids are using IoT to balance supply and demand, integrating renewable sources, and improving grid reliability.
- Utility infrastructure smart monitoring, such as pipelines and power plants, enables early detection of leaks, failures, or inefficiencies. (Gubbi, 2013) (Malik, 2020) (Punitha, 2024)

8. ENVIRONMENTAL MONITORING; IOT ASSISTS IN NATURAL RESOURCE MANAGEMENT IN REAL-TIME:

- Sensors related to air/water quality provide data related to pollution control and environmental protection.
- Climate monitoring systems acquire data concerning weather and environmental changes for disaster prediction and conservation. (Atlam, 2018)

Key Challenges to IoT

Despite the vast potential of the Internet of Things (IoT), its widespread adoption comes with significant challenges.

These obstacles range from security concerns to infrastructure limitations, and addressing them is critical for IoT's sustainable growth.

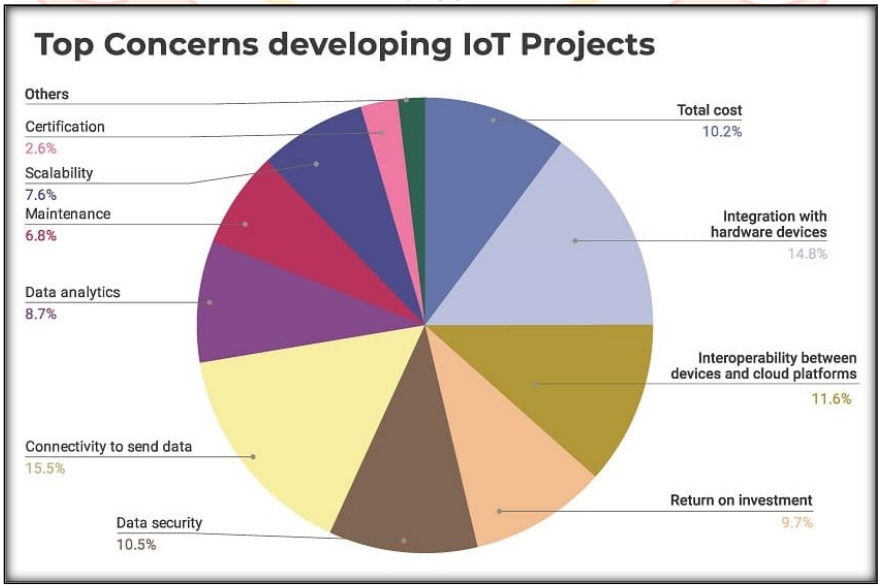


Fig. 4 Contribution of various concerns hurdling the growth of IoT

1. SECURITY AND PRIVACY	**Security is one of the biggest challenges in IoT. The vast number of connected devices creates a broad attack surface, making IoT networks vulnerable to:** **- *Data breaches:* Sensitive personal and organizational data can be exposed if devices are not properly secured.** **- *Hacking and cyberattacks:* IoT devices, especially in smart homes and industrial environments, can be hijacked or manipulated, leading to system failures or data theft.** **- *Lack of encryption:* Many IoT devices do not have robust encryption mechanisms, making data transmissions susceptible to interception.** **(Taherdoost, 2023) (Atlam, 2018) (Wang, 2021)**
2. INTEROPERABILITY	The IoT ecosystem is highly fragmented, with different manufacturers using various communication protocols and standards. This lack of interoperability makes it difficult for devices from different vendors to work together seamlessly. As a result, industries face challenges in: - Integrating devices into a single cohesive network. - Developing unified standards that ensure compatibility across devices and platforms. (Atlam, 2018) (Valadkhani, 2021)
3. SCALABILITY	As IoT networks grow, they should be capable of handling the increasing numbers of devices, which poses scalability challenges: - Network congestion: Large-scale IoT networks require infrastructure capable of handling vast amounts of data traffic. - Resource allocation: Ensuring that networks can allocate bandwidth, storage, and computing resources efficiently to support many devices is crucial. - Energy efficiency: IoT devices, especially battery-powered ones, need to be energy-efficient to maintain scalability, yet many devices still suffer from limited power sources. (Valadkhani, 2021) (Atlam, 2018)
4. DATA MANAGEMENT AND ANALYTICS	The sheer volume of data generated by IoT devices creates data management and analytics challenges: - Data storage: Managing and storing the massive amounts of data generated in real-time requires substantial infrastructure and cost. - Data processing: Analysing IoT data quickly to make actionable decisions can be complex, especially when dealing with unstructured data from multiple sources. - Real-time analytics: Many IoT applications, such as autonomous vehicles or industrial automation, require real-time data processing, which demands low-latency solutions. (Atlam, 2018)
5. POWER CONSUMPTION AND BATTERY LIFE	Many IoT devices, especially those deployed in remote or mobile locations, rely on battery power. Power consumption is a key challenge because: - Battery life: Devices need to operate for extended periods without frequent recharging or maintenance, yet current battery technology limits the lifespan of IoT devices. - Energy efficiency: IoT applications like smart sensors and wearables require ultra-low power consumption, but optimizing energy use without sacrificing performance remains difficult. (Valadkhani, 2021)

Future Trends; IoT

The hunger to develop more and collect more data, to make more advancements in interconnectivity, to transmit and exchange information more easily, and remotely without any trouble, and to make our day-to-day life more uncomplicated can assist in pushing forward the formation of new and new IoT.

FOLLOWING ARE THE MOST PROBABLE EVENTS THAT ARISE IN THE IOT INDUSTRY :

IOT JOIN FORCES BIG DATA AND BLOCKCHAIN:

As we have already seen IoT is majorly involved in generating vast amounts of data through sensors and devices. Whereas big data deals with analyzing and extracting handy information from this collected raw data. Data scientists play a key role in the operation and interpretation of this data to conclude a meaningful trend for businesses. Summing up this whole point in simple words, IoT collects data while big data processes it into actionable for decision-making. (Saleh, 2018)

Blockchain enters as the third layer in this process it can be thought of as a segregated database that connects different users, existing users are familiar with the database system as the new users are added database updates accordingly. (Atlam, 2018)

REVOLUTIONIZATION OF IOT THROUGH AI

Much like Big Data and Blockchain, AI will surely make IoT more intelligent; thus, it can deliver meaningful insights from connected devices. While AI enhances the intelligence of devices, IoT enables their connectivity. The researchers of AI are separately working on the challenge of building machine learning systems capable of automatically finding anomalies in data generated by IoT devices. This would mean that, by advancement, the operation predictions might be up to 20% earlier than traditional business intelligence tools and much more accurate. (Ghosh, 2018)

5G & DEVELOPING NETWORKS CONTINUE TO FUEL IOT GROWTH:

5G is consistently revolutionizing industries incorporating IoT, which is nowadays an elemental part of day-to-day life. IoT is fully recognized owing to the capabilities of 5G. In today's world interconnectivity is a key driver, and 5G is making noteworthy changes. It offers a package of high-speed connectivity negligible latency and widen range. As 5G continues to serve smartphones, electronics, and similar devices it is necessary for IoT-supported devices. (Pons, 2023)

CONCLUSION

In this paper we discussed IoT and its vast areas of application, current challenges, and future trends were the elementary focus areas. IoT has already been widely used to reshape industries relating to healthcare, transportation, agriculture, and smart cities by enabling real-time collection of data and operational efficiency. However, the broad adoption of IoT applications is to be addressed with some critical challenges like security vulnerabilities, privacy concerns, interoperability issues, and complexity arising from network scaling. Addressing these challenges will be vital for further success and scaling up the technologies of IoT. Indeed, the new emerging trends, such as the integration of 5G, growth of edge computing, collaboration with Big Data & Blockchain, and newer stages of artificial intelligence, are promising to overcome such challenges. Further, the future of IoT will be driven by more interdisciplinary collaboration among industries, governments, and research institutions. Through fostering innovation and creating robust security frameworks, IoT will continue to drive technological advancement and the development of smarter and more connected environments worldwide. For future development and research, this paper will be helpful in acquiring knowledge concerning IoT its utilization, hurdles, and future scope for new researchers.

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Devanagari Script in CAPTCHA Systems: A Reconsideration

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Abstract

Today we are living in the digital era, so everything is available through online platform. Most of the time these online services confused whether they are accessed by BOTs or human user. These services are accessed by Bots which are automated programs which performs repetitive task on the internet. With increased used of internet there is a need of some tools to maintain the security of online platform and differentiate the user from the Bot. Captcha is one of the popular tool accepted by almost all websites to maintain the security & authenticity. Latin Captcha is very common and have been extensively researched. As compared to Latin Captcha.

Devanagari Captcha is unexplored. This review papers aims to provide an overview of Devanagari Captcha which highlights characteristics, history and types of Captcha. Further it gives review of work done by researchers on Devanagari Captcha. This work provides some insights for future work in development of more secure and user friendly Devanagari Captcha.

Keyword: CAPTCHA, Bots, Text based Captcha, Image based Captcha, Devanagari Captcha.

1.Introduction

CAPTCHA (Completely Automated Public Turing Test to Tell Computers and Humans Apart). There are many things that can be done only by the humans not computer bots (Rao, 2011) On this basis, CAPTCHA is formulated for identifying the human users. There are broadly two types of Captcha available now-adays. Some are based on Optical Character Recognition (OCR) such as text CAPTCHA, whereas others are based on Non-Optical Character Recognition (Non-OCR) which uses multimedia, such as voice and video. But some of the Captcha are broken by advanced bots. For example, a text CAPTCHA can be broken by using the mechanism of segmentation letters. This paper will describe the CAPTCHA Designs principles, overview of Existing Devanagari CAPTCHA. Moreover, usability and accessibility of issues.

1.1.Devanagari Script and its Relevance

Devanagari Script is most widely used script in the world, prominently used in Indian subcontinent. Its relevance in Captcha system comes from its wide usage, linguistic complexity and need for developing Captcha in local language. Devanagari is used for written in several Indian languages like Hindi, Marathi, Sanskrit, Nepali and likewise. As the script is used in many ancient Indian text including Vedic scriptures it has deep cultural and historical roots.

India is the diversified country where around 1600 languages are spoken with Hindi having most of the speakers which utilizes the Devanagari script [(Heena Girdher, 2022)]. Devanagari word is derived from Sanskrit literature where Deva (God) and Nagari (city) jointly stands for "City of Gods" (Sharma, 2018)]. Devanagari script is the extended version of BRAHMI SCRIPT (Sharma, 2018)]. Devanagari script was developed in ancient India around in 1st to 4th century C.E and was in regular use from 7th century C.E [(Cui, (2010))].Devanagari script is the most prevalent script in India, utilizes for languages including Hindi, Marathi, Bhili, Marwari, Magahi, Nepali, Bhojpuri, Maithili, Newari, Pahari, Santali, Mundari, Kashmiri, Tharu, Konkani, and Sindhi .

1.2.Characteristics of Devanagari Captcha:

- Devanagari script consists of basic sets of symbols which includes 36 consonants (Vyanjana), 13 vowels (Swara) and 14 modifiers (Matras) [(Gunvantsinh Gohil, 2012)].

- ❖ It's a Phonetic and Syllabic script which means words are written exactly they are pronounced, and text is written using consonants and vowels that together form syllables respectively [(N.Bhonge, (2015)).
- ❖ All the individual characters are joined by a headline (Shiro Rekha). Occurrence of headline in Devnagari script is a powerful feature that can be used to identify the words (Gunvantsinh Gohil, 2012)
- ❖ It contains the isolated dots: Anuswar, Visarg and Chandra Bindu (Gunvantsinh Gohil, 2012)
- ❖ The characters are written in the main zone, but modifiers occupy all the three zones, therefore modifiers are classified into three types: Core Modifiers, Top Modifiers, Lower modifiers. (N.Bhonge, (2015)).
- ❖ Devanagari script writing style is from left to right in horizontal manner and the concept of upper case and lower case is not present (Gunvantsinh Gohil, 2012)
- ❖ This script contains the compound character form also known as the "Conjuncts". (Sharma, 2018)

Devanagari script is the mother-most script initially adopted to write Sanskrit but later on it is adopted for writing many other languages (Sharma, 2018). The recognition of printed characters is itself is not an easy task, since there are variations in the same character due to different font family, font size, font style and font orientation (Gunvantsinh Gohil, 2012)

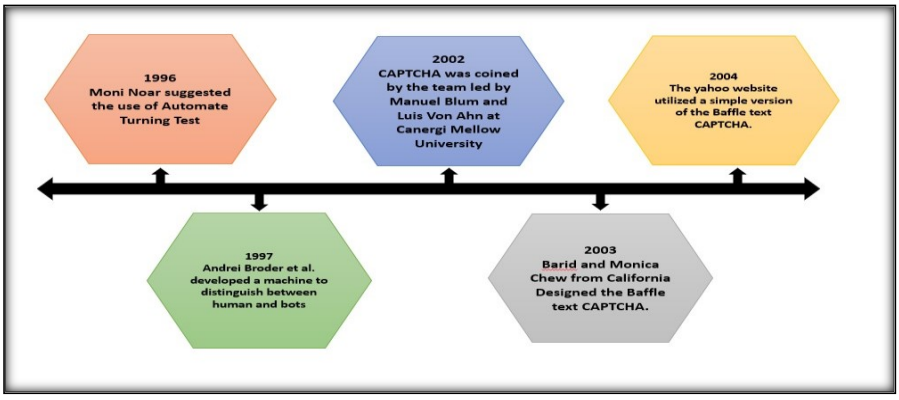
2.Motivation

There are many threats to popular web sites from programs or computers known as Robots or Bots. They break user accounts or submit numerous service requests like email account creation or web connection requests. These activities leads to the brutal losses of those websites by creating traffic or by slower down its speed. to prevent Denial of Service attacks, bots can be eliminated by introducing CAPTCHA. Introducing CAPTCHA in the authentication scheme prevents force attack. We discuss the text-based CAPTCHA that is based on Devanagari script that is the written form for several Indian languages including Hindi, Sanskrit, Kashmiri, Bihari, Bhojpuri, Marathi and Nepali. As huge population access these languages, we have selected the Devanagari script for use in this CAPTCHA. To enhance the security of Devanagari script-based Indian language content-based web applications Devanagari Captcha can be used, applications that are perfectly fits in this scenario are online and collaborative authoring, online tutoring, email and social networking portals in Indian languages. These users are involved in content creation and access of applications in Devanagari-script based Indian languages. They already have the necessary device that facilitate keyboard input in that script so that aspect is taken care of.

3.History of CAPTCHA:

Moni Noar suggested the use of an Automated Turing Test to distinguish between Human users and bots. (Hasan, 2016).

* Andrei Broder et al. developed a mechanism to distinguish between human users and computer programs and also in the same year, the Altavista website used this method to block bot programs from entering by displaying a distorted English word to the user asking the user to copy it [(Hasan, 2016)
* Broder announced that a CAPTCHA system had been in place for more than year which minimized the number of spam advertising URLs by more than 95% (Hasan, 2016)



3.1 Types of Captcha

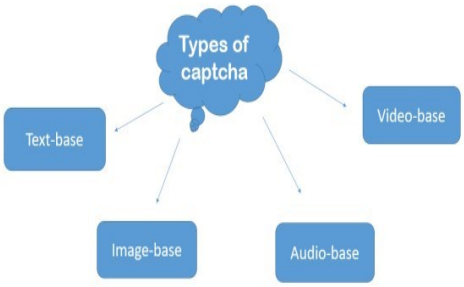
Captcha comes in variety of forms but most commonly used are Text-based, Image-based, Audio-based, Video-based. The CAPTCHAs can be classified into five types depend on what is distorted that is whether characters, digits, or images (Hasan, 2016)

Text Image:

- Gimpy Captcha
- EZ-Gimpy Captcha
- Baffle text Captcha
- Scattered Type Method Clickable Captcha

Image Based Captcha:

- Bongo
- Pix Captcha
- Implicit Captcha
- Drawing Captcha



3.2 Advantages and disadvantages of Captcha types: (Hasan, 2016)

TYPES of CAPTCHA	Advantage	Disadvantage
Text based Captcha	1)Easy Implementation 2)To defeat dictionary attacks Baffle text base captcha is used.	1)Identification problem 2)Blurred letter 3)Font size and wave image
Image based Captcha	1)increases security 2)easy ,need just one click	1)problematic for low vision
Audio based Captcha	1)use for the peple who are blind. 2)Friendly to people	1)language support 2)same sounding characters
Video based Captcha	1)use ocr 2)Provide grater security	1)downloading problem

4. Review of Existing Devanagari Captcha:

- In 2008 M. Shirali-Shahanza designed a CAPTCHA called Advanced Nastaliq. This CAPTCHA uses Arabic and Persian characters of 3 to 8 characters in length, uses Nastaliq fonts, and creates an image file (PNG) in PNG format. There is no need to add any noise or distortion in the image. Since the letters are connected, more than 50% of the letters use dots (direction right to left), so OCR programs cannot recognize the words. The procedure is to display the image to the user, compare strings, and test whether the result passed or failed. This is implemented in JAVA [(Bilal Khan, January 2013.).
- In 2011 the first Indian CAPTCHA Deva CAPTCHA scheme was proposed[(M. Tariq Banday, 2013,). Sounds like arcs and jaws were used in this scheme. Vertical overlapping was used to prevent segmentation. However, this scheme wasn't segmentproof and wasn't very useful because it didn't have a headline. Hindustan CAPTCHA Schemes Hindustan captcha.com also offers Hindi captcha schemes. Again, these schemes are vulnerable to attack because of several factors such as simple noise, low proof for segmentation, easy to recognize, etc.
- In 2011 Banday and Shah analyzed Multilingual and Native Lingual CAPTCHAs[(S, (2018)) on websites and found that native language CAPTCHAs are more accurate and faster than English language CAPTCHA. This CAPTCHA is designed to offer CAPTCHA challenges in various languages, addressing the needs of users from different linguistic backgrounds. This approach improves accessibility and usability while ensuring strong security. Banday and Shah's Multilingual and Native Lingual CAPTCHA marks notable progress in CAPTCHA design by emphasizing linguistic and cultural diversity to enhance accessibility and user experience.
- In 2012 S.Ravi Kiran and Y.Rama Krishna introduced a new strategy to protect users' passwords from spyware attacks by combining CAPTCHA with graphical passwords for user authentication (Asadullah

Kehar, January–June 2021.)In this study, the researcher only has to recognize registered CAPTCHA images or graphical passwords to prevent spyware attacks.

- In 2013 Gurumukhi CAPTCHA was proposed (H. Ma and D. Doermann, 2003)The CAPTCHA scheme proposed in this research paper is a CAPTCHA consisting of a series of characters in the Punjabi script to create an image. The background and foreground colours of the image are used to create distortion and make the CAPTCHA image appealing by adding background noise in the form of dots. The image is displayed to the user. The User enters the characters, there is a corresponding sound attached to each character. In a survey of 50 participants, the average CAPTCHA success rate was 75% This CAPTCHA scheme was developed in C# using the ASP.NET platform. The proposed approach can help protect online resources and is beneficial in countries where the language is spoken in Punjabi. The future scope will be handwritten Punjabi.
- In 2013 Bilal Khan et al. presented the Arabic CAPTCHA Scheme (U. Bhattacharya and B. B. Chaudhuri, Mar. 2009). The proposed scheme involves the following steps: 1. Using Arabic letters & font to generate an image 2. Generate an image containing four to nine characters long from a database of 2,71,000 Arabic words 3. Create an image of selected letters in a rectangle with a white background and blue background 6. Add light blue color dots to the background 7. Add salt and pepper noise to the image. As a noise, it is very difficult for OCR to distinguish noise from image 9. Display the image to the user for recognition. In the study, 150 people were tested to determine the overall readability of the images. Therefore, this CAPTCHA design and generation of Devanagari script can be implemented in non-Arab speaking countries where the languages use Arabic scripts such as Urdu, Pashto, Persian, etc. for safeguarding internet resources.
- In 2013 M. Tariq Bandy proposed a model for creating a CAPTCHA challenge in Indian Regional Multilingual languages [(R. M. K. Sinha, 1973.)]. India has 22 official languages, and most government websites offer content in the regional languages, but the CAPTCHA is still in the English language. The researcher's proposed model involved obtaining the language, downloading the Unicode character set, generating the string, adding noise, storing the string, and comparing the test result if it passed or failed. He suggested using handwritten strings/words as the next step in his research.
- In 2018, a handwritten Arabic CAPTCHA based on random handwritten letters was proposed (Mahabala, Aug. 1979). This CAPTCHA generator is designed to create Arabic handwritten samples, which are distorted so it can be unreadable by automated computer programs. The generator uses a collection of meaningful Arabic words that encompasses all 28 Arabic characters in their contextual forms, written by several writers. The result shows a significant disparity between the recognition abilities of machines and humans.
- In 2021 Asadullah Kehar et al. proposed Sindhi Text Based CAPTCHA for regional Websites[(Bansal, (2001, September)]. In this paper, the authors designed a Sindhi textbased CAPTCHA in the style of the Arabic language, written from right to left, with 62 characters. They inserted colored ellipses, clutter, and dots in the characters to avoid noise. The Sindhi text CAPTCHA image was implemented using the C# programming language. The use of overlapping characters was done intentionally so that the OCR programs of the CAPTCHA system could not easily segment the string. The string length was random between 3 and 8 characters. The web page was created using the ASP, and JSP and was tested by users.

5.Conclusion:

Most of the research work is done on Latin Captcha whereas very less work is done in Devanagari Captcha. As technology changes so fast, internet usage expands in rural areas as well. In India various states are using their regional languages for official use but still they use Latin Captcha which is difficult for the user having no English background. So there is a need of developing Devanagari Captcha. This paper provides a review of Devanagari Captcha which explains the work done by various researcher in developing Devanagari Captcha.

The benefit of using Devanagari Captcha is it provides high degree of difficulty for OCR as compared to traditional Captcha system. Also native users feel comfortable to solve the captcha as it is in their regional language.

Though Devanagari Captcha is robust one but with advancement in AI and Machine learning it provides new attack methods making it essential to continuously evolve Captcha security by adding more feature

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Software Project Development and Management

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Abstract

The paper discusses the critical role of effective software project development and management in delivering high-quality software. It explores various methodologies, including Agile, Waterfall, Scrum, and DevOps, highlighting their unique strengths and weaknesses and their suitability for different projects. Agile is recognized for its flexibility and quick feedback loops, while Waterfall provides a structured, linear approach. Scrum emphasizes teamwork and breaking tasks into manageable units. The paper also examines tools that enhance project management efficiency, such as JIRA and Trello for task organization and progress tracking, alongside version control systems like Git and GitHub for collaborative coding. Key challenges in software projects include poorly defined requirements, insufficient communication among team members and clients, and scope creep, which can lead to delays and increased costs. Suggested solutions include improving communication, better planning, and early stakeholder involvement. Additionally, best practices for successful project management are outlined, such as continuous testing, thorough documentation, and fostering a collaborative culture among team members, all aimed at mitigating common project pitfalls and improving success rates. The research underscores the need for a balanced approach to managing software projects, advocating for the appropriate methodologies, tools, and communication strategies to ensure timely, budget-conscious, and high-quality project delivery. By integrating case studies, the paper connects theoretical strategies with real-life applications, providing valuable insights for learners and professionals in the field of software project management.

Keywords: *Software Development, Project Management, Project Delivery, Quality Control, Project Efficiency, Project Monitoring, Resource Management, Enterprise Resource Planning (ERP), Software Development Life Cycle (SDLC), Agile, Waterfall, Software Product Management (SPM), Risk Management, Project Risk Avoidance, Product Management.*

Introduction

In a fast-paced and competitive global market, software development is a key driver of all the facets of innovation, business growth, and efficiency. Increasingly high customer demand for personalized software proposes the necessity of project management to be more than ever. Software is not a physical product but it is a product that has its own special challenges like keeping up with new man-made technologies, user complex needs, and uncertain market dynamics.

The development and delivery of software projects r requirement of the most impeccable blend between quality, cost, and time constraints. Project managers are required to have a mix of technical knowledge, organizing skills, and leadership qualities to face these challenges. The management of a software project consists in addition to meeting the technical specifications of a product with business goals, following the deadlines, etc.

Besides, the technology landscape transforms faster than ever in history, hence project teams constantly need to update their knowledge and practices to be in the game. With such speed evolves the question of risk which becomes the key point in software project development needed for risk management.

This research intends to analyze the software project development and management practices and the difficulties, methodologies, and best practices that lead to successful project delivery. Through the examination of software development processes and management strategies, this study intends to give organizations directions related to project success in the case of risks and the efficient use of resources.

Literature Review

Software project management has evolved significantly over the years, mirroring the growing use of software in various fields. Well-managed strategies are key to ensuring projects are delivered on time and within budget. This paper emphasizes the vital role of project managers and the need for a structured approach to achieve project success, especially with software products, which are often more intangible and complex than physical ones. Effective management of software projects is crucial for ensuring quality, timely delivery, and cost control. The study also highlights the importance of sound project management practices in a competitive environment. Additionally, it focuses on the systematic use of Work Breakdown Structure (WBS) in project management and examines the role of Odoo ERP, a tool that enhances project management practices.[1]

The research highlights the benefits of integrating WBS into Odoo ERP, emphasizing its role in enhancing project and management efficiency. It demonstrates that these tools significantly improve project monitoring and overall management. This paper serves as a practical guide for practitioners, illustrating how the combination of WBS and ERP tools can boost project efficiency and management practices.[2]

The paper provides a detailed discussion of various SDLC methodologies, including Waterfall, Agile, and Hybrid, and emphasizes the use of decision support matrices for selecting the most suitable methodology for specific projects. It compares traditional SDLC methods with Agile approaches, highlighting the predictability of the former and the flexibility of the latter. The research advocates for decision support matrices as an effective means for guiding methodology selection. Overall, it serves as a valuable resource for understanding the methodology selection process in project management.[3]

The research explores the evolution from project management to product management in the tech sector, highlighting the increasing need for Software Product Management (SPM) and the lack of a standardized framework. It emphasizes the crucial role of product managers in tech companies and the challenges they face. The research differentiates between the roles of product and project managers, stressing the importance of adaptive, customer-focused strategies in product development. It notes the growing demand for product management roles, especially in tech firms.[4]

This paper gives a comprehensive picture of the evolution of product management, with a special emphasis on product-based approaches. It gives an extensive view of the product managers' role and the problems they deal with, especially in the sector of technology.[5]

The paper analyzes risk management in engineering projects using Cite Space to review literature from 2014 to 2024. It highlights research trends and key issues in project risk management, noting a general increase in relevant literature. The study argues that both traditional and innovative risk management approaches are essential. It provides a detailed assessment of risk management in construction projects, emphasizing the importance of balancing both approaches, despite construction's leadership in the field.[6]

Methodology

Software Development Life Cycle (SDLC)

The software development lifecycle (SDLC) is the cost-effective and time-efficient process that development teams use to design and build high-quality software. The goal of SDLC is to minimize project risks through forward planning so that software meets customer expectations during production and beyond. This methodology outlines a series of steps that divide the software development process into tasks you can assign, complete, and measure.

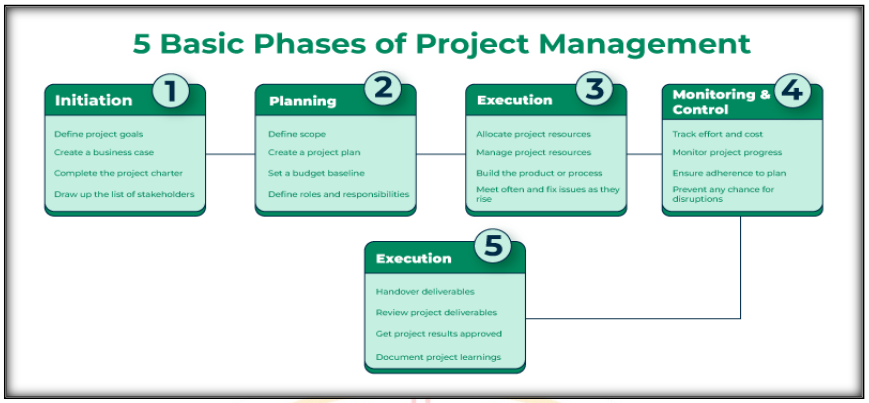
Why is SDLC important?

Software development can be challenging to manage due to changing requirements, technology upgrades, and cross-functional collaboration. The software development lifecycle (SDLC) methodology provides a systematic management framework with specific deliverables at every stage of the software development process. As a result, all stakeholders agree on software development goals and requirements upfront and also have a plan to achieve those goals.

Phases of Project Management Process

Project management involves several key phases that guide the project from initiation to completion, ensuring that objectives are met efficiently and effectively. It's like having a step-by-step guide to follow,

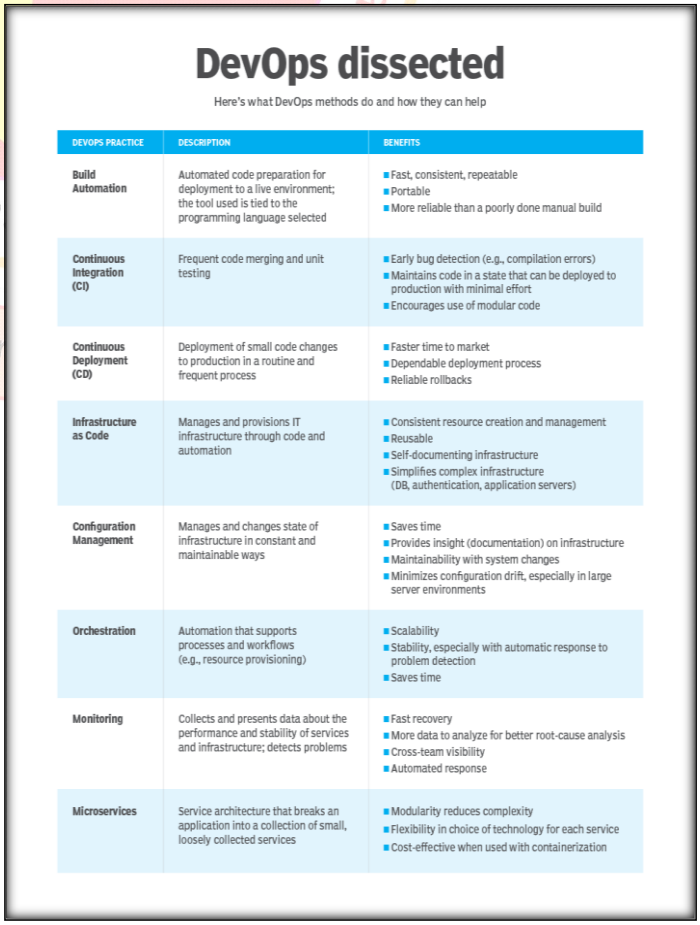
ensuring you stay on track and reach your goals smoothly. These phases typically include initiation, planning, execution, monitoring and control, and closure. Each phase is crucial for managing tasks, resources, timelines, and deliverables, ultimately leading to the successful completion of projects.



1. **Project Initiation/Feasibility Study :** This phase of Project Management involves defining the project, identifying the stakeholders, and establishing the project's goals and objectives.
2. **Project Planning :** In this phase of Project Management, the project manager defines the scope of the project, develops a detailed project plan, and identifies the resources required to complete the project. A detailed plan stating a stepwise strategy to achieve the listed objectives is an integral part of any project.
3. **Project Execution :** The Project Execution phase of the Project Management process involves the actual implementation of the project, including the allocation of resources, the execution of tasks, and the monitoring and control of project progress.
4. **Project Monitoring and Controlling :** This phase of Project Management involves tracking the project's progress, comparing actual results to the project plan, and making changes to the project as necessary.
5. **Project Closing :** This phase of Project Management involves completing the project, documenting the results, and closing out any open issues.

Key differences between Waterfall, Agile and DevOps

Waterfall is best for software projects that are clearly defined and unlikely to change much, making it suitable for smaller, simpler projects. Its step-by-step approach makes it difficult to adapt if business needs shift, which can impact budgets and timelines. Waterfall projects have strict processes and limited flexibility, not allowing for feedback during development. In contrast, Agile focuses on small, iterative steps that deliver parts of the product quickly, encouraging changes and continuous feedback throughout the development process. This adaptability often makes it cheaper to adjust based on user input than to try to get everything perfect from the start. DevOps builds on Agile by enhancing collaboration and automation, merging development and operations teams to work together throughout the entire process. In a DevOps setup, the team manages everything, leading to the creation of more reliable and scalable software in a shorter time frame.



DevOps dissected

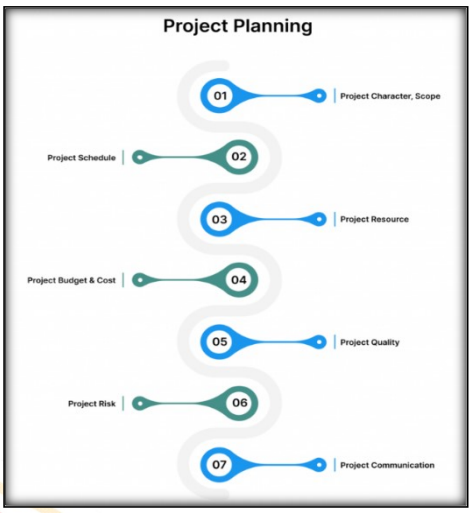
Here's what DevOps methods do and how they can help

DEVOPS PRACTICE	DESCRIPTION	BENEFITS
Build Automation	Automated code preparation for deployment to a live environment; the tool used is tied to the programming language selected	▪ Fast, consistent, repeatable ▪ Portable ▪ More reliable than a poorly done manual build
Continuous Integration (CI)	Frequent code merging and unit testing	▪ Early bug detection (e.g., compilation errors) ▪ Maintains code in a state that can be deployed to production with minimal effort ▪ Encourages use of modular code
Continuous Deployment (CD)	Deployment of small code changes to production in a routine and frequent process	▪ Faster time to market ▪ Dependable deployment process ▪ Reliable rollbacks
Infrastructure as Code	Manages and provisions IT infrastructure through code and automation	▪ Consistent resource creation and management ▪ Reusable ▪ Self-documenting infrastructure ▪ Simplifies complex infrastructure (DB, authentication, application servers)
Configuration Management	Manages and changes state of infrastructure in constant and maintainable ways	▪ Saves time ▪ Provides insight (documentation) on infrastructure ▪ Maintainability with system changes ▪ Minimizes configuration drift, especially in large server environments
Orchestration	Automation that supports processes and workflows (e.g., resource provisioning)	▪ Scalability ▪ Stability, especially with automatic response to problem detection ▪ Saves time
Monitoring	Collects and presents data about the performance and stability of services and infrastructure; detects problems	▪ Fast recovery ▪ More data to analyze for better root-cause analysis ▪ Cross-team visibility ▪ Automated response
Microservices	Service architecture that breaks an application into a collection of small, loosely collected services	▪ Modularity reduces complexity ▪ Flexibility in choice of technology for each service ▪ Cost-effective when used with containerization

Most Common Challenges in Software Development and How to Avoid them.

1. **Scope estimation**

In software development, correct and adequate estimation of the scope of work is a fundamental condition that demands using project management tools and methods.

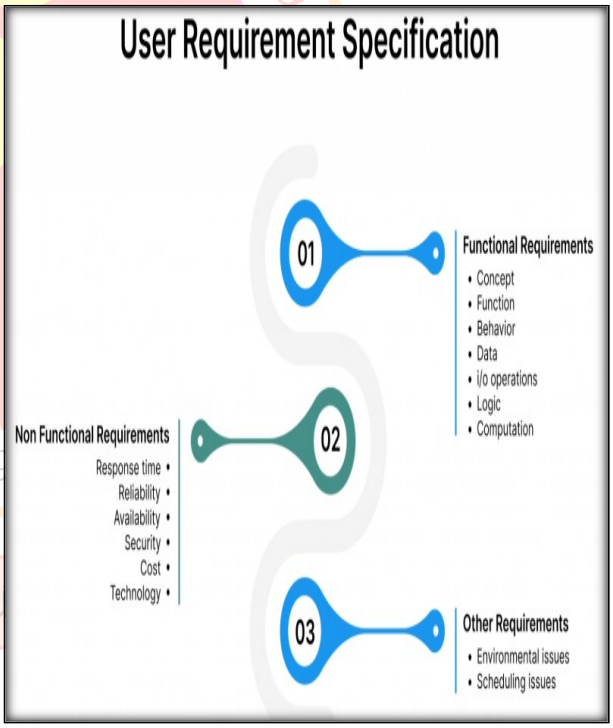


2. Competition

The next challenge you can face during software project development nowadays is high competition in the market. The IT industry is evolving fast, and brilliant experts are emerging in the most variable spots of this planet.

3. User requirements

User demands in the IT industry seem to be the most changeable phenomenon. If we find it hard to follow the latest technology tendencies, changeable user-level requirements are a much more severe challenge in software development projects. Changes in the requirements to the user-side details provoke changes in the code and the whole concept of the project. The more changes the team does to the existing code, the more errors and hidden issues will occur. Our client's demands and needs must be taken into account, as well as the needs of the core audience. Even though examining and considering all the possible user requirements is crucial in software development, the developer team often lacks the most vital knowledge about the people they are building a product for. Either the team tries to meet their stakeholders' expectations or ignores some evident data about consumers. Current user requirements may be overlooked, automatically making the whole project concept incorrect.



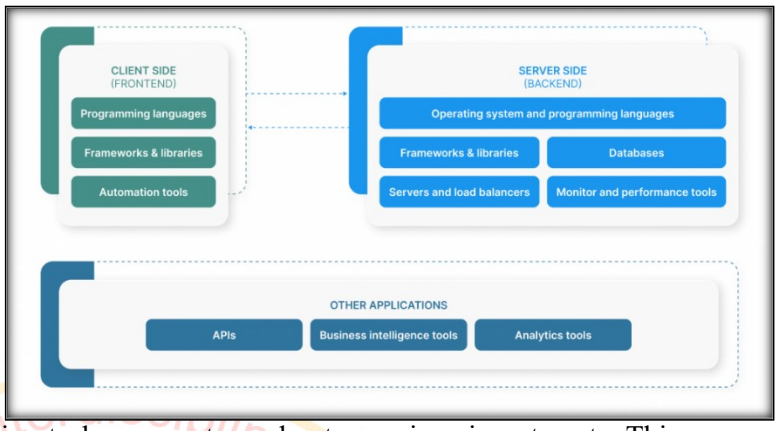
To avoid such mistakes, we need to do a lot of long, diligent, and scrupulous studying, comparing, and analyzing. It is also essential to stop considering the changeable environment a problem for progress and use it to find new opportunities and possibilities for successful software development. This is when flexibility and readiness to adapt to constant changes play the central role in the process.

4. Technology stack

After the project has a good plan and it has been approved and greenlit by stakeholders, one of the toughest challenges in software projects is finding a sufficient technology stack. It is vital for a software development company to have experts with extensive experience and a rich palette of skills. Usually, a project manager controls a team of such professionals. Still, in big companies, employees with highly estimated expertise may work on several projects. However, getting sufficient technical stack for a project is not just the project manager's task. It is highly recommended to consult the recruiters who can advise on which type of

professional skills are missing from the team. When there is no possibility of finding a necessary expert among the in-house employees, it is time to outsource the talent pool.

5. Adapting to innovations



In addition to qualified staff, software service providers must carefully consider the technical challenges in development, particularly the difficulty of adapting new market trends to older legacy systems. While skilled developers can leverage innovative programming tools to create unique products, outdated systems can hinder progress as teams spend time enhancing and maintaining them instead. Despite the clear advantages of upgrading software and hardware, many stakeholders cling to legacy systems due to previous investments. This poses a challenge for project managers, who must weigh the pros and cons of transitioning to modern systems and effectively communicate the benefits to stakeholders. Developers are eager to embrace new solutions, but they cannot predict every issue that may arise. Many challenges can instead offer new perspectives on the project. By applying responsibility, attention, skills, and teamwork, developers can find effective solutions to any problem.

Conclusion

The way we develop and manage software projects is crucial for the success of software systems today. This work examines how to choose the right methodologies—such as Agile, Waterfall, or Scrum—to achieve project goals within quality and budget limits. Effective project management practices, including precise requirements gathering, risk management, and continuous integration, are vital for addressing common software development challenges. Technologies like JIRA for project management and Git for version control enhance team communication, progress monitoring, and complexity management. The integration of well-defined development cycles, strategic planning, and suitable tools can help mitigate issues like project delays, miscommunication, and budget overruns. The case studies in this paper provide real-world insights into the successes and failures of software projects, reinforcing the need for best practices in both development and management. Given the constantly evolving nature of software projects, ongoing learning and adaptation of methodologies are essential to keep pace with rapid technological changes. This study advances understanding of how effective practices and tools can be integrated into software project management for higher success rates and added value in future projects.

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Exploring Machine Learning Algorithms For Power-Efficient Vlsi Design: Challenges And Implementation Strategies

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Abstract

This paper explores the most significant developments in Very-Large-Scale Integration (VLSI) design, with a particular emphasis on cutting-edge technologies such as nanotechnology, 3D integration, advanced materials, System-on-Chip (SoC) design, and innovative packaging technologies. The objective of these developments is to satisfy the growing demand for compact, energy-efficient, and high-performance integrated circuits. Nevertheless, the landscape is further complicated by the impending threats of technological and economic obsolescence, as well as security concerns that arise from hardware vulnerabilities. The paper also investigates the future of VLSI design by examining emergent trends, such as the integration of artificial intelligence (AI), quantum computing architectures, neuromorphic computing, and the convergence of photonics and electronics. These technologies have the potential to transform VLSI design by facilitating the development of more energy-efficient, intelligent, and rapid systems. However, they also introduce new challenges in terms of reliability, scalability, and complexity. The paper suggests a variety of solutions to address these challenges, such as the establishment of collaborative ecosystems that unite academia, industry, and government to promote innovation in VLSI design. Integrated strategies are advised to guarantee the seamless interaction between various subsystems in intricate integrated circuits, while security-by-design principles are promoted to mitigate hardware vulnerabilities from the outset of the design process.

Keywords: *Evolvable Hardware, Computation medium, Future Technology, Scalability*

Introduction

The most pervasive technique for making composed circuits is the extremely enormous scope coordination (VLSI) plan, which includes consolidating millions or billions of semiconductors on a solitary chip.

The intricacy of the VLSI arrangement circumstance is quite possibly of the most fundamental test it presents. During the time spent VLSI arrangement, it is important to oversee mind boggling plans, data pathways, memory requesting, and interconnects while at the same time fulfilling the necessities for execution, power, and locale. The degree of intricacy of the plan likewise increments extensively with respect to the quantity of semiconductors that are stuffed into a chip. This makes various difficulties for the organizers, including the administration of the arrangement grouping, the division of the arrangement into modules, the disentanglement of the positions including rationale and figure crunching, and the affirmation that the arrangement is precise and far reaching. What's more, the intricacy of the VLSI arrangement likewise adds to the intricacy of the check interaction. Check alludes to the errand of assessing the utility, execution, and constancy of the arrangement at many degrees of reflection, going from the thinking to the system. The check cycle is a relentless and tedious undertaking that requires the utilization of contemporary confirmation instruments and strategies, like the use of proper methodologies, diversion, impersonation, and prototyping. Check is moreover fundamental for ensuring the quality and security of the result, explicitly for applications that include human lives, as clinical contraptions and autonomous cars.

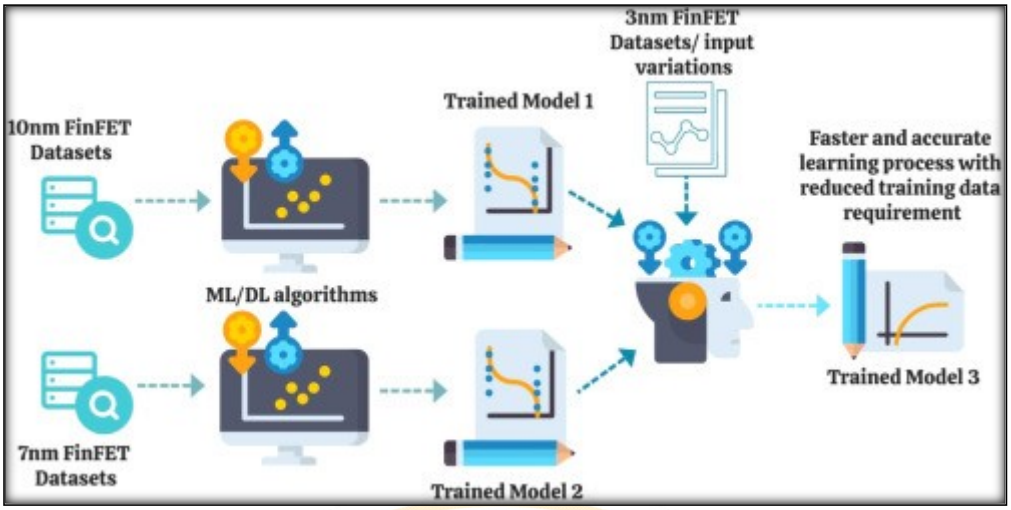


Figure 1: AI/ML algorithms and applications in VLSI design and technology

The force of the board is an extra essential test that is performed on the VLSI setup. VLSI design requires a counterbalancing of execution with energy efficiency and the work of a few cycles, including as power gating, voltage scaling, and clock gating, to improve power use. To diminish the force scattering and further develop the battery term of electronic gadgets, power the chiefs is a significant variable to consider. Nonetheless, the method involved with controlling the board likewise presents new difficulties for the organizers. These difficulties incorporate the administration of the penances that should be made among execution and power, the administration of the different sorts of force, and the guaranteeing of the enduring quality and security of the power supply.

Literaturereview

In the year 1985, Robert S. Kirk was the primary individual to show the impact that artificial intelligence had on the plan of VLSI. A brief clarification of the degree and need of man-made reasoning methodologies in computer aided design devices was given by him at different phases of VLSI plan. The article that he composed contained a compact outline of the VLSI-computer based intelligence innovations that are currently accessible and stressed the meaning of incorporating the improved capacities of simulated intelligence into computer aided design developers. An assortment of information based frameworks, including plan robotization colleague, plan guide by NCR, and Overhaul, are being utilized in the VLSI business, and Khan et al. focused their consideration on the purposes of man-made consciousness in the coordinated circuit (IC) industry, outstandingly in master frameworks. Quick progressions in the space of man-made consciousness and AI have caught the interest of scientists,

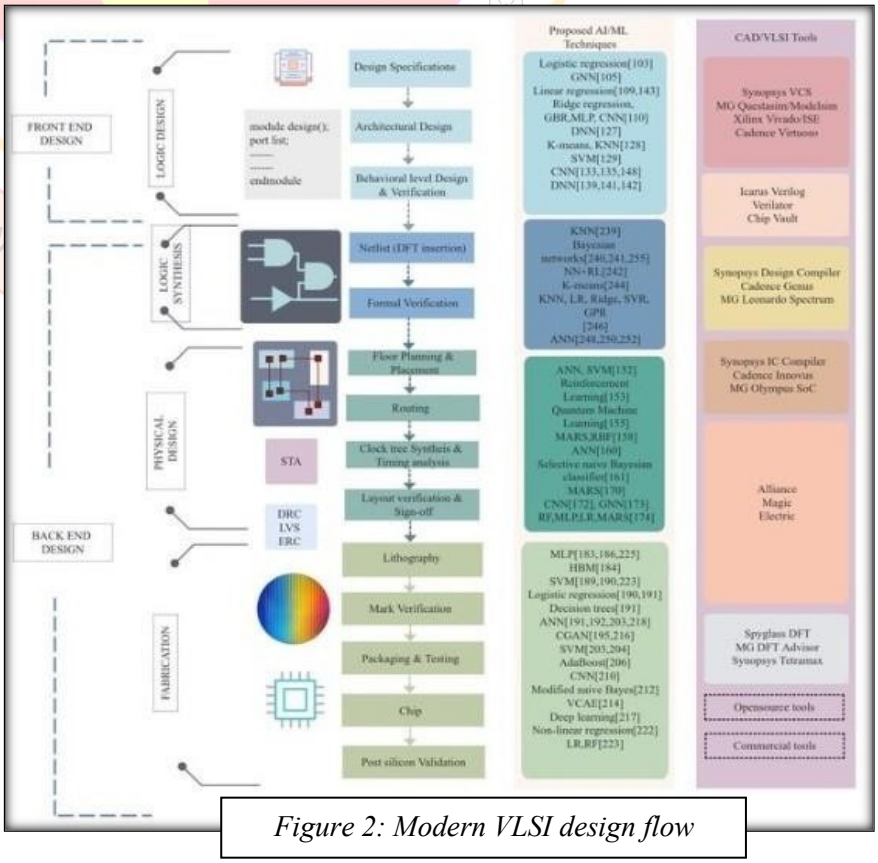


Figure 2: Modern VLSI design flow

who have embraced a huge number of spearheading endeavors to configuration, create, and apply learning systems to the plan and creation of extremely enormous scope coordinated circuits (VLSI). As per Beerel et al., there are the two difficulties and amazing open doors related with AI based calculations in nonconcurrent computer aided design/VLSI.

The aforementioned studies are broken down to give a comprehensive discussion on the artificial intelligence and machine learning methodologies that have been presented in the literature.

Methodology

Within the context of the VLSI (Very Large Scale Integration) development cycle, artificial intelligence has the potential to have a substantial influence, optimizing different phases and enhancing the overall efficiency and quality of the process. AI can have an influence on the VLSI development cycle in a number of different ways!

- **Design Exploration:**

In order to facilitate more effective exploration of the design space, artificial intelligence approaches may be used to automate the production and assessment of a variety of design choices. The effectiveness of design exploration may be improved by the use of machine learning algorithms, which can examine historical design data, performance indicators, and limitations in order to provide recommendations for best design options.

- **RTL Design Optimization:**

By automating processes like as logic synthesis, datapath optimization, and resource allocation, artificial intelligence has the potential to increase the efficiency of the Register Transfer Level (RTL) architecture. For the purpose of optimizing the RTL design, machine learning algorithms may do an analysis of the design requirements, performance objectives, and limitations. This can result in improvements in performance, power consumption, and space usage.

- **Physical Design Automation:**

Using artificial intelligence, physical design activities such as floorplanning, positioning, and routing may be improved. Chip layout can be optimized, wirelength can be reduced, and time closure can be improved with the use of machine learning techniques. Power optimization, clock tree synthesis, signal integrity analysis, and other difficulties related to physical design are all areas in which artificial intelligence might be of assistance.

RESULT

- **Nanotechnology and Scaling down**

Transition to More Modest Cycle Hubs: Efforts that are progressing in the fabrication of semiconductors include transitioning to cycle hubs that are more modest and enabling the production of semiconductors that are both more modest and more power-efficient. Quantum repercussions, leakage fluxes, and an increased resistance to assembling variety are further challenges that need to be addressed. One of the benefits is improved execution, which also results in reduced power consumption and increased mix thickness.

- **FinFET Innovation:**

The Balance Field-Impact Semiconductor, often known as FinFET, is a three-layered semiconductor architecture that helps overcome some of the challenges that are associated with traditional planar semiconductors. Using FinFETs allows for improved control over current advancement, which in turn reduces spillage and further develops energy efficiency. The use of FinFETs necessitates the development of new plan techniques and devices in order to fully capitalize on the advantages that they provide.

- **3D Incorporation**

An overview of the 3D Mix Method: The 3D Mix method involves stacking different levels of integrated circuits (ICs) in order to improve both functionality and performance. Through vertical stacking, it is possible to create a greater number of restricted interconnects, which in turn reduces signal deferrals and further develops by a significant framework speed. The challenges include the administration of heated temperatures, the positioning of items during stacking, and the complexity of the design.

- **High-level Materials**

High-k Dielectrics: High-k dielectrics are replacing silicon dioxide, which is traditionally used as a protective material in semiconductor production. These materials allow for further scaling down by reducing the thickness of the entrance dielectric while maintaining acceptable shielding. Therefore, they enable further scaling down.

Challenges include problems in reconciling differences and concerns about quality that are consistent. Metal Door Advances Metal door advancements use metals rather than polysilicon for the door anode in semiconductors. Metal door designs are becoming more popular. Entryways made of metal provide improved control over the edge voltage and reduce the amount of spilled current. Combination with high-k dielectrics is a common approach to dealing with the execution of further evolved semiconductors.

- **Framework on-Chip (SoC) Plan**

The setup of a single-chip computer (SoC) comprises a number of distinct components, including processors, memory, and peripherals, with the goal of coordinating their respective capabilities. In addition to ensuring good communication across coordinated sections, challenges include correcting conflicting plan requirements, monitoring power consumption, and ensuring that resources are used effectively.

Conclusion

The marvelous idea of facilitated gadgets in VLSI plan acts two moves like well as the amazing chance to make the most of useful open doors. Innovations like as computerized reasoning, quantum figuring, and neuromorphic displaying are instances of state of the art developments that will fundamentally affect the fate of exceptionally enormous scope incorporated circuits (VLSI) design. For the organization to find success in defeating difficulties related with power utilization, heat dissemination, and wellbeing, it will be fundamental for the organization to practice coordinated exertion. With regards to looking at the future scene of the VLSI plan, the joint effort soul, along with progressions in warm organization, security practices, and facilitated plan strategies, will assume a significant part. To open up the maximum capacity of incorporated gadgets and to meet the developing prerequisites of a general public that is driven by innovation, it will be fundamental to have serious areas of strength for an in exploration, training, and composed endeavors across a few disciplines as the organization keeps on growing.

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Hybrid Approach to Enhance the Data Security in Cloud Computing Using Aes & 3des Algorithm

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Abstract

Cloud computing is the next generation technology for IT organizations where large amounts of resources are shared as a service. Many enterprise organizations are concerned about the negative impacts of storing information in the cloud. To achieve secure information storage and access security, various encryption techniques are implemented. Utilizing cloud networks to improve data transfer is an important aspect. Cloud has many security issues, including data protection, authentication and authorization, network security, and access management. Access to data communication over public networks is critical. This system provides double protection with the help of algorithms used, making the communication of information within the network wider and more secure. In this work, implement AES and 3DES algorithm to enhance the data security. While an authorized user requests the data, then the data is decrypted and provided to the user.

KEYWORDS: Cloud computing, Encryption, Decryption, AES, 3DES

I. Introduction

Data stored in the cloud can be accessed from anywhere in the world. Therefore, many users can access the resources of the cloud system. The resources are provided to the users as a service, such as SAAS (Software as a Service), (Suganya .N, Jan. 2015) PAAS (Platform as a Service), where a platform is used to deploy, design, and test applications, IAAS (Kumar, 2016), where servers are deployed for storage.

Cloud computing desire new model of computing and related issues such as compute, storage, and software (Singh, May 2013). It provides development surroundings, on-demand resource allocation, storage, and networking capabilities. As cloud computing becomes more popular, cloud storage is becoming an ideal storage option for virtualized environments, and therefore many enterprises, such as Google's Google Drive, (Sun, 2017) Microsoft's On Drive, and Dropbox, have started offering this new service to their users. Although cloud storage has many advantages, some enterprises still refuse to store sensitive data on the cloud for security reasons.

II. Security Issues In Cloud Computing

When storing data in the cloud, security is the most important issue. Users can store their data and information in the cloud, but in some cases, the data may be lost or corrupted by third-party intruders. When storing and retrieving data in the cloud, security becomes a key issue to prevent unauthorized users from accessing this data. To solve such cloud storage problems, encryption algorithms such as integrating AES and 3DES are introduced to improve security and performance.

The problem of data security is solved by using various encryption algorithms. The data stored and shared on the cloud server is initially encrypted, and only authorized users can access this data. To improve data security, data integrity, access control, Segregation, data encryption, and data availability are used to improve the security of data on the cloud server. To prevent unauthorized users from reading the data, encryption techniques are used that make the data unreadable, and only authorized users can read the data using the management system. AES and 3DES algorithms are used to encrypt the data. Moreover, to ensure high data security, the 3DES symmetric key algorithm is used and only authorized users can access this data through the key management system.

III. Related Work

The paper is related to works in security of the user's data and the some of the works are listed below.

Faheem Gul et al. (Faheem Gul, July 2017) describe a symmetric encryption algorithm called AES. It is based on certain substitutions, permutations, and transformations. The memory required by the AES algorithm is less than that of the Blowfish algorithm. The AES algorithm uses a key of 128, 192, or 256 bits, which makes the security level of this algorithm very high. It is compatible with a variety of attacks such as square attack, key attack, differential attack, key attack, recovery attack, etc. Therefore, the AES algorithm is a highly secure encryption technique. Ahmed Albugmi et. al. (Ahmed Albugmi, 2016) focuses on data security in cloud computing. Protection techniques and methods used around the world provide maximum protection for data by mitigating risks and threats and also provide insight into the data security status of data in transit and at rest. They discussed the different data states and suitable methods for encrypting data in the cloud. Deepika Verma et al. (Deepika Verma, December 2014)proposed a secure and efficient framework for data storage in cloud environment. Two security algorithms, Diffie-Hellman algorithm and 3DES, are used to encrypt and decrypt user data while sharing and storing it in the cloud. Various types of files are successfully uploaded and stored in the cloud. Gurpreet Singh et al. (Gurpreet singh, April 2013) discussed various encryption algorithms such as RSA, DES, 3DES, AES for information security. These algorithms are used for data security which clients use when storing and sharing their data and information in cloud storage. AES, RSA, DES, and 3DES algorithms were developed considering various factors such as key length, rounds, block size, speed, encryption type, and security. From the comparison table, we can see that AES algorithm is very efficient in terms of time, speed, throughput, and avalanche effect, and applying multiple algorithms to data further improves the security provided by these algorithms. Priyadarshini Patil et al. (Priyadarshini Patil, December 2015) implemented and analyzed in detail the cost and performance of commonly used encryption algorithms such as AES, DES, 3DES, Blowfish, and RSA, providing a general performance analysis that goes beyond mere theoretical comparisons.

IV. Proposed Framework

The hybrid solution of the symmetric cryptography is improved with combining AES and 3DES. Hybrid system is a process developed for data security issue and data sharing and storing on the cloud is implemented with new techniques. Where data owner upload data and user can download it by using this system. In proposed system AES and 3DES are used to provide block wise security to data, of the data owner and data user. In AES key information contains plaintext and key which is the part of the file encryption for AES.

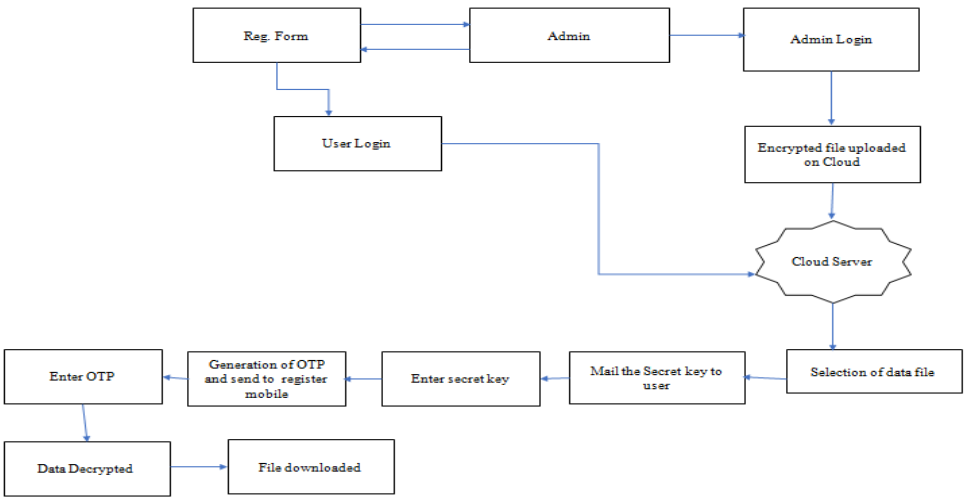


Figure: Framework for data storing and sharing on cloud

The proposed system is a combination of two different symmetric key security algorithms. AES and 3DES is a symmetric key algorithm means same key is used for encryption and decryption of data. The admin login uploads the data files in to the cloud storage. The admin login uploaded the files in the cloud server in the encrypted form and user can downloaded these files in the decrypted form.

This framework includes admin and Admin login. Admin have the right to grant the permission to users and owner panel have right to upload files and to grant permission to download files from the cloud server.

V. Methodology

The goal of data security is to achieve confidentiality by the cryptography and availability through access control. Data security involves using encryption when transmitting data to ensure that unauthorized users cannot access the data. There are two encryption methods available: symmetric and asymmetric. The framework aims to enhance security when storing and accessing data in the cloud. Before sending to the cloud, the data is encrypted using a symmetric algorithm and uploaded to the cloud in encrypted form. Hybrid combination of AES and 3DES is used for this purpose. In the proposed system, first AES generates the key and then the data file is encrypted using 3DES encryption algorithm. The private key is used for authentication which is sent via email and OTP is sent to the registered mobile number of the authorized user. If the two keys match, the data is downloaded.

VI. Results And Discussion

The various files such as text, image, pdf, docx, audio, video, and image have been successfully uploaded and stored in the cloud and downloaded. Graphs have been plotted for encryption and decryption time and average time of encryption and decryption of file.

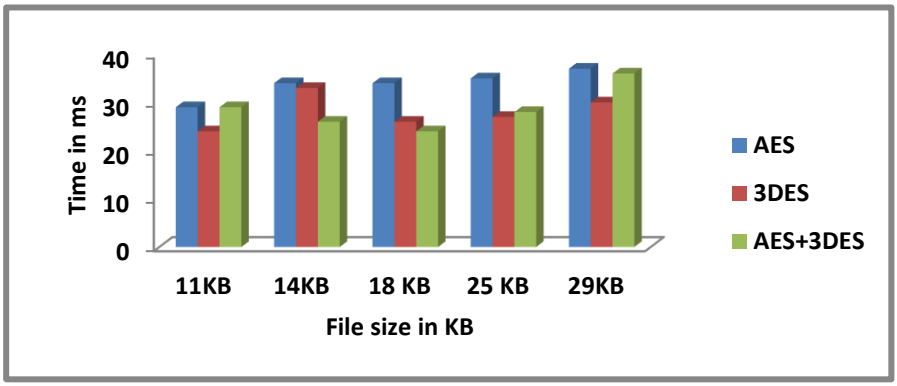
Data sets of doc file

The encryption and decryption time for doc file is high when implemented using conventional AES and 3DES but by using the integrated approach of AES+3DES is less. The memory needed for AES and 3DES when encrypting small size files is less. AES+3DES takes less memory like file sizes 11 KB, 14 KB, 18 KB and so on, finally the average time is calculated for various files size in milliseconds (ms), time may vary because of it depends upon the file size taken for uploading and rate of data transmission.

Sr. No.	File type	File size	AES Encryption time(ms)	3DES Encryption time(ms)	AES+3DES Encryption time(ms)
1	dd1.docx	11KB	29	24	29
2	dd2.docx	14KB	34	33	26
3	dd4.docx	18 KB	34	26	24
4	dd5.docx	25 KB	35	27	28
5	dd6.docx	29KB	37	30	36
Average time			33.8	28	28.6

Table 1: Comparative runtime (in milliseconds) of encryption

Whenever the doc file of different size in KB get transferred to different algorithm such as AES, 3DES and the proposed algorithm, the result get collected. As per the result it is cleared that the AES required 33.8 ms and 3DES required 28 ms and proposed algorithm 28.6 ms for encryption at uploading data to server. The proposed algorithm efficient in encryption which required less amount of time as compared to other algorithm.



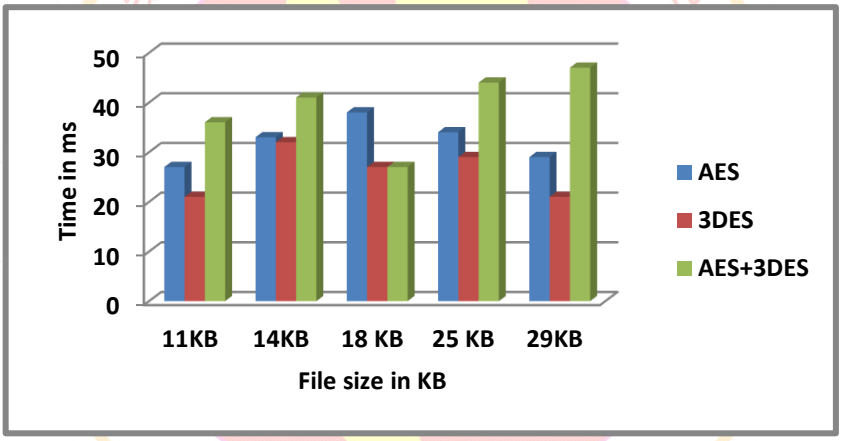
Graph 1: Comparison of encryption time with various file sizes

Doc File Decryption

Sr. No.	File type	File size	AES Decryption time(ms)	3DES Decryption time(ms)	AES+3DES Decryption time(ms)
1	dd1.docx	11KB	27	21	36
2	dd2.docx	14KB	33	32	41
3	dd4.docx	18 KB	38	27	27
4	dd5.docx	25 KB	34	29	44
5	dd6.docx	29KB	29	21	47
Average time			32.2	26	39

Table 2: Comparative runtime (in milliseconds) of decryption

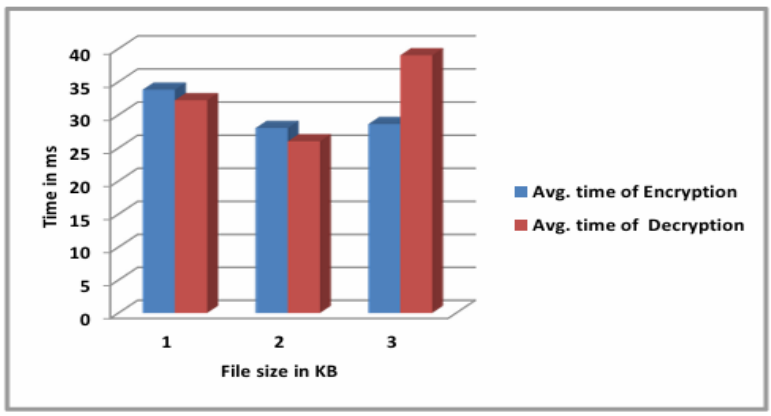
Whenever the doc file of different size in KB get transferred to different algorithm such as AES, 3DES and the proposed algorithm, the result get collected. As per the result it is cleared that the AES required 32.2 ms and 3DES required 26 ms and proposed algorithm 39 ms for decryption when downloading data from server. The proposed algorithm efficient in decryption which required less amount of time as compared to other algorithm.



Graph 2: Comparison of decryption time with various file sizes

	AES	3DES	AES+3DES
Average time	33.8	28	28.6
	32.2	26	39

Table 3: Average time of encryption and decryption in milliseconds



Graph 3: Average time of encryption and decryption

IV. Conclusion

Security is a major concern in all new technologies as users often deal with sensitive data. Users can keep their information private only if proper protection policies are in place. To achieve this, we implement the technology on the client side of the cloud. Encryption is an important threat defense tool to maintain data integrity. In the proposed methodology for data security and sharing in the cloud, a combined cryptosystem of AES and 3DES is used to encrypt and decrypt data. The proposed work to use a hybrid approach of AES and 3DES to protect user data while uploading and downloading data to the cloud.

It provides a secure system to encrypt and store original files such as text, docx, image, audio and video files on the cloud server. To decrypt the files, the user must first enter the secret key sent to the email account and then to the user's registered mobile number (OTP). Using these two keys, the user downloads the decrypted data file from the cloud server. Protecting data using encryption provides strong data security as it allows data to be transferred in an unreadable format and allows secure communication with the cloud without protecting the data from unauthorized users.

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Green Synthesis, Characterization of ZnO nanoparticles and their antimicrobial study by Passiflora edulis leaf extract

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Abstract:
In the present study, a green, sustainable and cost effectiveness method was adopted for the synthesis of ZnO NPs, by using the aqueous Passiflora edulis leaf extract. The obtained ZnO NPs were characterized using ultraviolet-visible spectroscopy (UV–VIS), Fourier transform infrared spectroscopy (FT-IR), X-ray diffraction (XRD), antimicrobial activity against Escherichia coli and Staphylococcus aureus.
Keywords: *Green Synthesis, Ultraviolet-visible spectroscopy, Infrared spectroscopy, X-ray diffraction, antimicrobial activity.*

Introduction:

The Field of nanotechnology is one of the most active areas of research in modern material sciences. Nanotechnology is a field that is developing day by day, making an impact in all spheres of human life and creating a growing sense of excitement in the life sciences especially biomedical devices and biotechnology [1]. Nanotechnology is a broad-based science involving manipulation of atoms, electrons, protons, and neutrons, in a variety of ways to generate new understanding of how materials can be developed to solve many problems in medicine, engineering agriculture, surface science, marine science and geology. It involves three dimensions at a minuscule size ranging up to 100nm [2]. The nanoparticle has potential application in various field such as healthcare, food and feed, cosmetics, environmental health, biomedical science, chemical industries, drug and gene delivery, energy science electronics, mechanics, and space industries [3]. Nanoparticle formation has been reported using chemical and physical methods. There are various methods for nanoparticle formation such as sol-gel process, chemical precipitation, hydrothermal method, microwave, chemical vapour deposition [4]. In view of an environmental sustenance, there is an urgent need to develop an ecofriendly method of synthesis of nanomaterials. Therefore, there is a growing need to develop environmentally friendly processes for nanoparticle synthesis without using toxic chemical. Biological methods for nanoparticle synthesis using microorganisms, enzymes, and plants or plant extracts have been suggested as possible ecofriendly alternatives to chemical and physical methods [5]. Several methods have been used for the preparation of zinc, copper and iron nano-particles which can be either physical, chemical or biological methods. Earlier methods used for the synthesis of zinc, copper and iron nano-particles were toxic and hazardous chemicals were used for their synthesis. Thus, the use of eco- friendly processes, for the synthesis of silver nanoparticles is known as ''green synthesis.'' Green synthesis is preferred over conventional synthesis because it is eco-friendly, cost -effective, single- step method that can be easily scaled up for large scale synthesis and does not require high pressure, temperature, energy and toxic chemicals [6]. The use of plant extracts to synthesize nanoparticles is receiving attention in recent times because of its simplicity. Also, the processes are readily scalable and may be less expensive. Plant extracts may act both as reducing agents and stabilizing agents in the synthesis of nanoparticles [7]. Many researchers and scientists have shown great interest in their unique features and found that, however, these have outstanding applications in various fields, but numerous nanoparticle material revealed toxicity, at the nanotechnology and green chemistry merge to fabricate nature-friendly nanoparticles via plants, microbes, etc [8]. NP have been received the huge attention of the scientists due to their remarkable defense against various pathogenic microorganisms. The exceptional characteristics of Ag NPs have made them applicable in various fields like biomedical, drug delivery, water treatment, agricultural [9] diabetes [10] allergy [11] infection [12] and inflammation [13].

The Zinc is a mineral which is very essential for human health and the zinc oxide nanoparticle has good biocompatibility to human cells. Among metal oxides, a zinc oxide nanoparticle [ZnO NPs] is a bio-safe material and it has wide range of applications in medical, agricultural, and environment fields [14]. The ZnO nanoparticle

has more significant in controlling the growth of bacteria. Cancer is characterized by invasive and uncontrolled cell division and the spread of abnormal cell [15]. Every year thousands of people worldwide die for different types of cancer. chemotherapy and radiotherapy are most common treatments of cancer but they evoke many serious side effects.[16]. Synthesized ZnO nanoparticles formed with the help of reducing biomolecular agents which is environmentally friendly, non-toxic and quite simple compared to other methods[17]. Alternative treatment options are very less. Medicinal plants have always been used as natural remedy for many ailments and they have been a boon for many diseases and disorders. Nanoparticles synthesizing using medicinal plants extracts furthers enhances their efficacy as natural drugs many folds [18]. The development of adequate techniques for synthesizing metal nanoparticles has become a major Focus of researchers. Diverse methods have been developed and utilized for synthesizing metal nanoparticles, Such as chemical, physical, and green methods. The chemical method involves chemical agents, resulting in a large amount of chemical waste as a byproduct, resulting in environmental contamination tissues. Physical methods such as gamma irradiation, pulse laser ablation, and spark discharge are used to synthesize nanoparticles, and these methods are effective; however, they require relatively expensive apparatus. Green methods involving plant extracts, bacterial, and fungal forms are the most considered to produce various metal nanoparticles [19][20].

The Present study reports the green synthesis of Zinc Oxide nanoparticles using the aqueous leaf extract of *Passiflora edulis* plant. The synthesized Zinc Oxide nanoparticles are characterized by X-ray diffraction [XRD], Fourier Transform infrared Spectral Analysis [FTIR], UV-Visible Spectroscopy [UV-Vis] and Antimicrobial activity.



Fig. 1: Passiflora edulis

Plant Description:

Bionomial name	–	Passiflora Incarnata
Common Name	–	Krishna Kamalam
Plant Part taken	–	Leaves
Family Name	–	Passifloraceae

Experimental Procedure:

A) Preparation of the leaf extract of Passiflora edulis plant

Passiflora edulis plant leaves were collected from the surroundings of botanical garden of Department of Botany, Shri Shivaji College of Art's, Commerce and Science, Akola, Maharashtra, India. The leaves were washed several times with water to remove the dust particles and then dried light. The dried leaves were cutted and grinded for powder. The extract used for the reduction of zinc ions (Zn^{2+}) to zinc nanoparticles (ZnO) was prepared by placing 5g of washed dried fine powdered leaves in 250 ml glass beaker along with 100ml of double distilled water. The mixture was then boiled for 60 minutes until the colour of the aqueous solution changes from watery to light yellow by using magnetic stirrer. The extract was cooled to room temperature and filtered using filter paper. The extract was stored in a refrigerator in order to be used for further experiments.

B.Preparation of Zinc Oxide nanoparticles: For the synthesis of Zinc Oxide nanoparticle, 50ml of Passiflora edulis leaves extract was taken and boiled to 60- 80 °C using a stirrer- heater. 5 g of Zinc Nitrate was added to the solution as the temperatures reached 60 °C. This mixture is then boiled until it is reduced to a deep yellow colour paste. This paste was then collected in a ceramic crucible and heated in an air heated furnace at 400 °C for 2 hours. A light-yellow colour powder was obtained and this was carefully collected and packed for characterization purposes.[21]

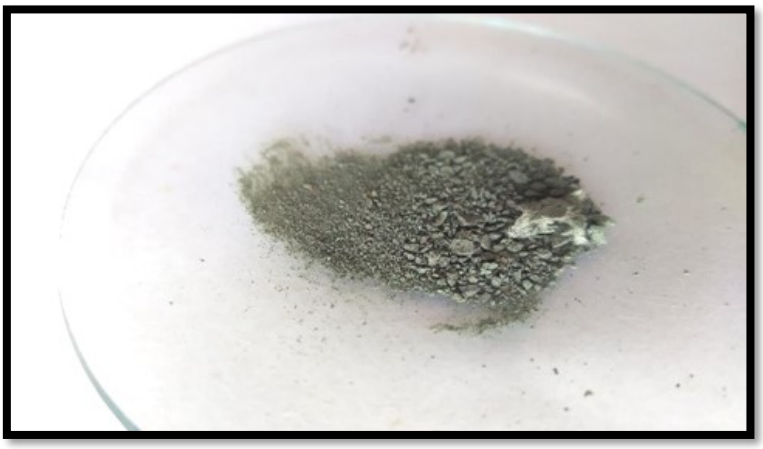
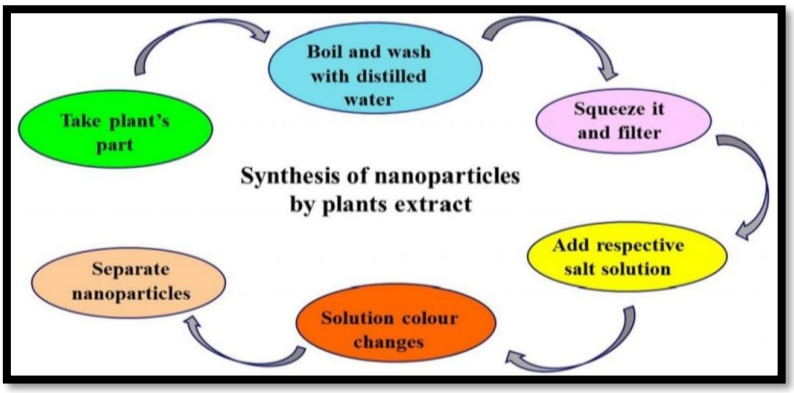


Fig. 2: ZnO nanoparticles

Synthesis of Nano Particles by Plants Extract



Characterization of Zinc Oxide Nanoparticles:

The synthesize Zn oxide nanoparticles were formed fromplant extracts & synthesize nanoparticle were confirmed and characterized by XRD, FTIR & U.V. Visible spectrophotometer. Characterization techniques help us to understand the specific properties of the substance or nano crystals to be studied in an accurate rapid manner which is reliable tounderstand to measure value.

Fig 3: - Instrument of X ray diffraction, FTIR & Uv visible spectroscopy.



Result and Discussions:

A] X-ray crystallography

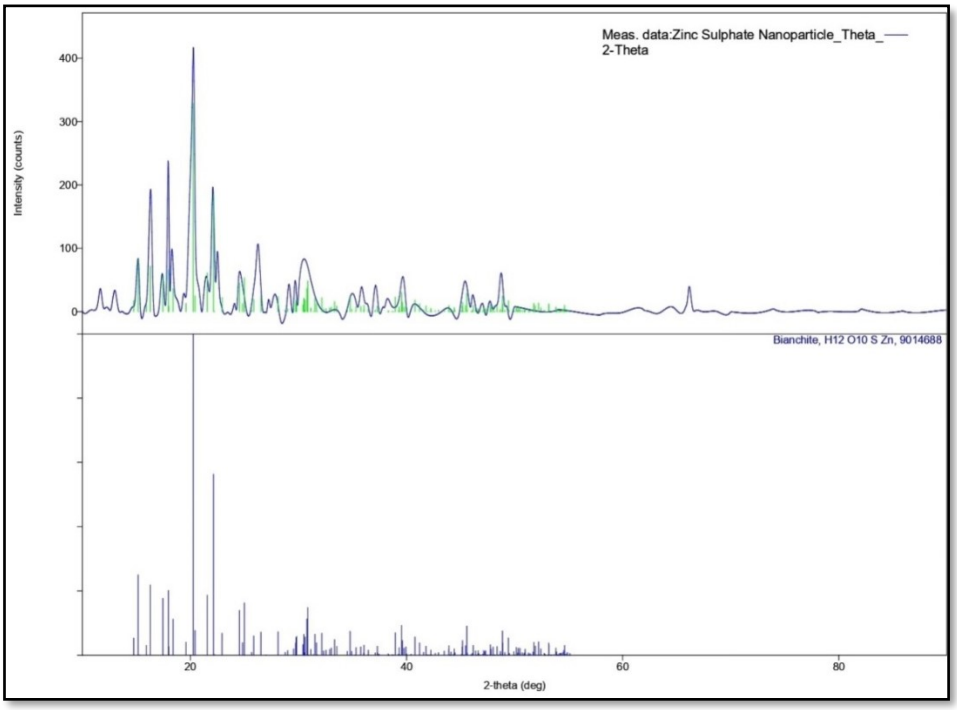


Fig. 4: XRD of ZnO nanoparticles

No	2-theta	d Value	Intensity	FWHM
1	11.687	7.566	10.6	0.25
2	12.956	6.828	8.8	0.30
3	15.14	5.846	18.2	0.277
4	15.916	5.564	1.2	0.08
5	16.326	5.425	42.6	0.308
6	17.383	5.098	13.8	0.27
7	17.939	4.941	33.2	0.152
8	18.322	4.838	18.3	0.25
9	20.312	4.369	145	0.440
10	21.50	4.130	14.2	0.36
11	22.080	4.023	40	0.282
12	22.518	3.945	17.4	0.26
13	24.75	3.595	23.1	0.55
14	26.28	3.388	39	0.51
15	29.202	3.0557	8.7	0.23
16	29.74	3.002	5.7	0.15
17	30.800	2.9007	56	0.66
18	31.45	2.8423	11	0.35
19	35.89	2.500	24	0.54
20	37.08	2.422	8.7	0.27
21	38.19	2.3546	9.1	0.26
22	39.59	2.2747	17.5	0.45
23	45.11	2.0082	3.6	0.18
24	45.49	1.9925	15.0	0.23

25	46.15	1.965	6.6	0.34
26	48.82	1.8638	23.7	0.31
27	52.95	1.7279	2.2	0.15
28	66.17	1.4111	10.0	0.21
2theta are calculated with wavelength = 1.54059				

Crystal Structure ZnO (NPS)

Cell parameters a = 9.9692 b= 7.2441 C= 24.2493 **δ = 90.000 β=98.488γ=90.000** **Volume =1732.052 Z=1**	
Monoclinic **A≠b≠ c, α = γ ≠ β**	Formula $L = \frac{K\lambda}{\beta(2\theta)\cos\theta}$ **Crystaline size = 286.44 nm**

Where K = Schrodinger constant (0.9), λ= Wavelength of X-ray (1.54×10^{-10}), β=Full Width at Half Maximum (FWHM), ∅= Bragg angle

From the above table, it shows that the values of particle size for the ZnO nanoparticles are calculated from the Scherrer's equation using four strongest peaks. Therefore, the average crystalline size is 286.44 nm and crystal structure are Monoclinic for the ZnO nanoparticle using Passiflora edulis sims leaf extract.

B] Fourier Transform Infrared Spectral Analysis (FTIR)

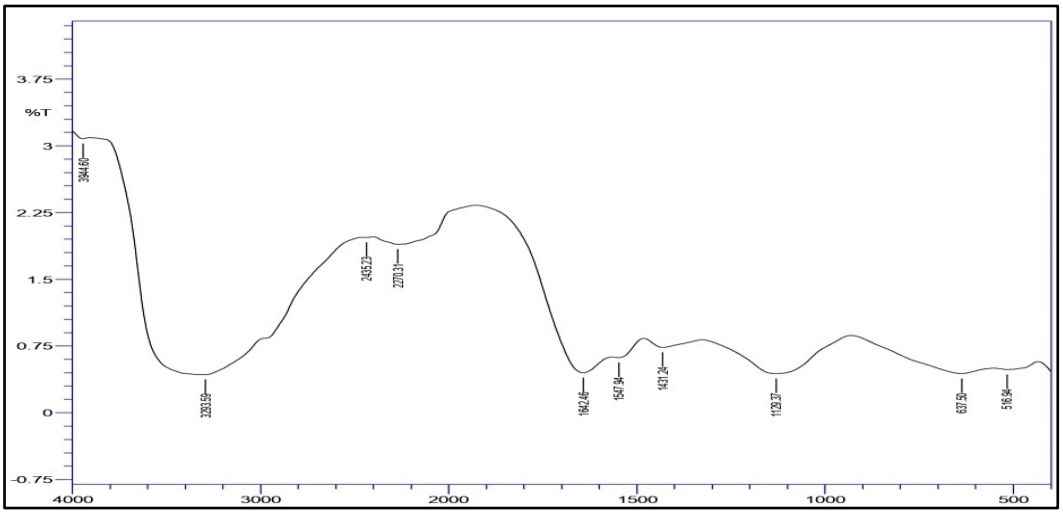


Fig. 5: FTIR of ZnO nanoparticles

The above figure shows the FTIR spectrum of Zinc oxide nanoparticles using Passiflora edulis sims leaf extract and ranges from 4000 cm^{-1} - 500 cm^{-1}. The FTIR spectrum is used to investigate the functional groups presents in ZnO nanoparticles with capping agent of leaf extract Passiflora edulis sims. The biomolecules present in the leaf extract which is responsible of reducing and capping agent for the ZnO nanoparticle. The FTIR spectrum shows the strongest and very broad peak at 3293.59cm^{-1} indicate O-H stretch of carboxylic acid. The FTIR spectrum show the strongest peak 1642.46 cm^{-1} c - c stretch alkene. The peak 1431 cm^{-1} indicates hydroxyl functional group. The peak at 516.94 cm^{-1} and 637.5 cm^{-1} C-Br and C-Cl stretching. The presence of Passiflora edulis sims leaf extract is considered as the capping ligands which gives the stability to the ZnO nanoparticles.

C] UV- Visible Spectra

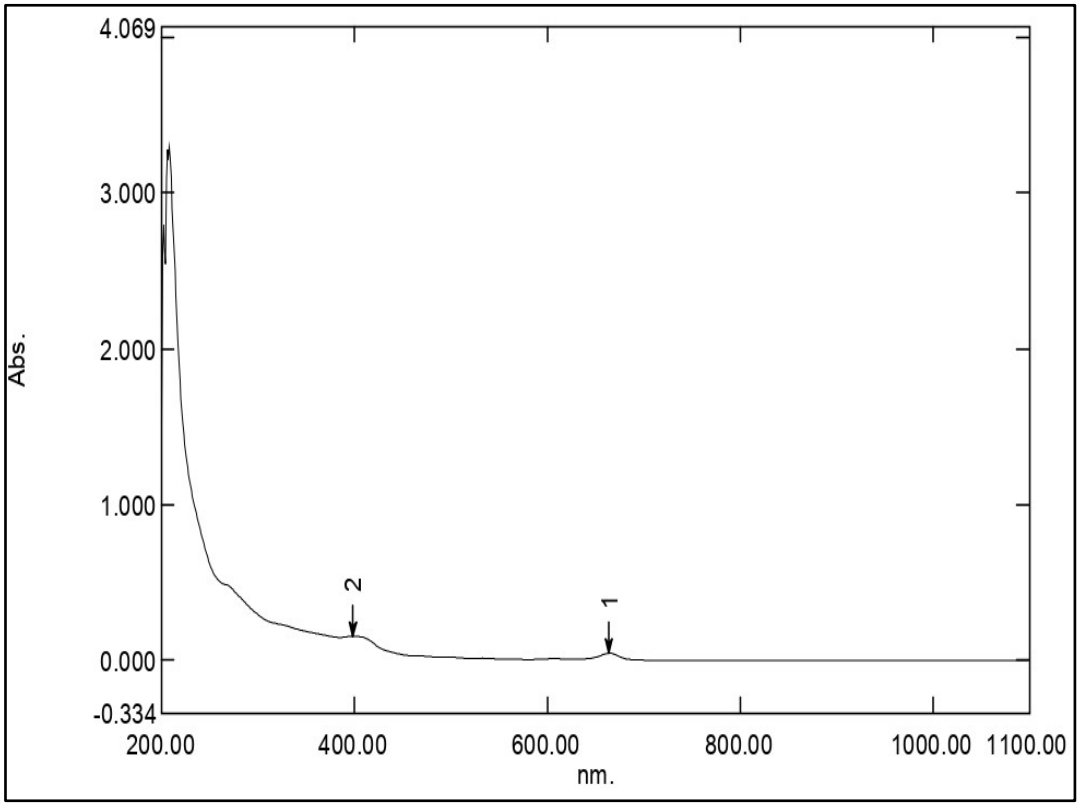


Fig. 6: UV-Visible of ZnO nanoparticles

The UV-Visible Spectroscopy is used to determine the optical properties and has wide range of applications in biomedical science. The Zinc oxide nanoparticles have attracted great attention towards the optical properties.The UV absorption spectrum of ZnO nanoparticle shows the strongest absorption peak at 665.00nm, 399.00nm and the absorbance is 0.045, 0.154. The colour of the ZnO nanoparticles is green in colour due to its surface plasmon resonance which conforms that the solution in free from impurities. The figure shows the absorption peak of ZnO nanoparticle using Passiflora edulis sims leaf extract

D] Antibacterial Activity



Streptococcus aureus *E. coli*

Fig. 7: Antibacteral activity of ZnO

The antibacterial properties of phytogenic Zinc NPS, have been tested under well diffusion method against different bacterial strains such as *Escherichia coli, Staphylococcus aureus.*

The aim of the study is to assess the antimicrobial activity and to determine the zone of inhibition of extracts on same bacterial stain. The sensitivity status of the bacteria is determined by measuring the inhibition

zone of diameter to the nearest whole millimetre. Antibacterial are one of our most important weapons in fighting bacterial infection and have greatly benefited the health-related quality of human life. The antibacterial activity of synthesized of Zinc oxide nanoparticles against pathogenic microbes was shown in fig.7A highest zone of inhibition was observed with Streptococcus aureus and Escherichia coli.

Sr. No.	Name of Bacteria	Size of zone	Time
1.	1.Staphylococcus aureus	3.5mm	36 hours
2.	2.Escherichia coli	3.2mm	36 hours

Staphylococcus aureus size of zone is 3.5mm at 36 hours. Size of zone is indicating bacteria kill at 36 hours. Escherichia coli size of zone is 3.2mm at 36 hours. Size of zone is indicating bacteria kill at 36 hours. Size of zone inhibition indicates the effect of the substance tested on the growth of the specific bacterium. The largest the clear zone, the more bacteria were killed. So, the higher the antimicrobial resistance of the ZnO nanoparticle.

Conclusion

Present study biosynthesized ZnO nanoparticles were carried out by green synthesis. The use of plants for green synthesis of nanoparticles is an exciting and developing part of nanotechnology and has a noteworthy effect on the environment toward sustainability and further development in the field of nanoscience. So, synthesis of zinc nanoparticles using leaf extract of Passiflora edulis sims provide an environmentally friendly, simple and efficient route. The characterization of Zinc nanoparticle was completed by XRD, FTIR, U.V Visible analysis and antimicrobial activity. The samples were experimented against some bacteria like Staphylococcus aureus and E.Coli. To analyze the antimicrobial activity of ZnO NPs have potential antibacterial property that may be attributed to its various structural and functional properties. Hence it is concluded that the ZnO NPs synthesized in the present research can be a potential candidate for different medicinal and biological related applications.

Acknowledgement

Authors are thankful and grateful to our Principal, Prof. Dr. R. M. Bhise Sir, IQAC Co-ordinator, Prof. Dr. A.S Raut Sir and Prof. Dr. K.N. Puri Sir Head, Department of Chemistry for providing all necessary facilities to carry out the present work successfully.

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The Critical Role of Chemistry Researchers in Addressing Global Environmental Challenges

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Abstract:

In the face of escalating environmental challenges such as climate change, pollution, and resource depletion, chemistry researchers play a pivotal role in developing sustainable solutions. This article explores the contributions of chemists in various environmental sectors, including the development of green technologies, pollution control, and renewable energy. Through interdisciplinary collaboration and innovative research, chemistry is central to mitigating environmental impact and advancing global sustainability.

Key Words: *Waste Management, sustainable materials, Climate change, Environmental Monitoring etc.*

Introduction:

Global environmental challenges, including climate change, pollution, and resource depletion, are intensifying, threatening ecosystems and human health. Chemistry researchers are at the forefront of addressing these issues by innovating sustainable practices, designing green materials, and developing clean energy technologies. Their work is crucial in mitigating the impacts of human activities on the environment, promoting sustainable practices, and fostering a deeper understanding of the underlying chemical processes that govern environmental systems. This article discusses the essential roles and contributions of chemistry in environmental protection and sustainability.

Contribution to Sustainable Energy Solutions:

Chemistry researchers play a pivotal role in the development of sustainable energy solutions, which are essential to reducing greenhouse gas emissions and combating climate change. Advances in solar cells[1], fuel cells, and batteries are largely driven by chemical innovations. For instance, the development of perovskite solar cells has shown great promise due to their high efficiency and low production costs. Additionally, research into electrochemical energy storage, such as lithium-ion and next-generation batteries, is critical for the widespread adoption of renewable energy sources. In the energy sector, chemistry researchers are developing new materials and processes for renewable energy technologies, including solar cells, batteries, and fuel cells. Advances in these areas are crucial for reducing dependence on fossil fuels and lowering greenhouse gas emissions.

Green Chemistry: Designing Sustainable Solutions for addressing Pollution and Waste Management:

Chemistry researchers are also crucial in developing methods to address pollution and improve waste management. This includes the design of catalysts for the degradation of pollutants. One of the key contributions of chemistry researchers is the development of green chemistry[2], which aims to design products and processes that reduce or eliminate hazardous substances and the creation of materials for capturing and recycling pollutants. For example, photocatalysis, a process where light is used to accelerate a chemical reaction, has been widely researched for its potential to degrade organic pollutants[3] in water and air. Principles of green chemistry include atom economy, using safer solvents, and designing energy-efficient processes. Researchers are actively working on biodegradable plastics, non-toxic dyes, and sustainable agricultural chemicals to reduce environmental footprints[4]. Researchers are exploring the synthesis of polymers from renewable resources and developing processes to break down plastics into harmless by-products, thereby reducing the environmental burden of plastic waste.

Role in Climate Change Mitigation:

Climate change mitigation is another area where chemistry researchers are making substantial contributions. The study of atmospheric chemistry[5] helps in understanding the complex interactions between pollutants and climate systems[6], leading to more accurate climate models and predictions. Additionally, chemistry research is essential in the development of carbon capture and storage (CCS) technologies, which aim to reduce

the amount of CO_2 released into the atmosphere from industrial processes[7]. The field of geoengineering, which involves deliberate large-scale interventions in the Earth's climate system, also relies heavily on chemistry. For instance, researchers are exploring the feasibility of using aerosols to reflect sunlight back into space, a technique known as solar radiation management (SRM).

Water Treatment and Desalination[8]:

Access to clean water is a critical issue in many parts of the world, and chemistry researchers are developing innovative solutions to ensure water security. Advanced water treatment techniques, including the use of nanomaterials for filtration and the development of more efficient desalination processes, are some of the key contributions from chemistry. These technologies not only provide clean water but also help in reducing the energy consumption associated with water purification.

Chemical Informatics and Environmental Monitoring:

With the advent of big data and advanced computational methods, chemical informatics has become an important tool for environmental monitoring. Chemists are instrumental in developing methods to control and remediate environmental pollution. They track the spread of contaminants, and model the potential impacts of various chemical substances on ecosystems. Innovations in catalysis, for example, have led to the creation of more efficient processes to break down pollutants. Researchers are working on advanced materials like nanomaterials[9] and photocatalysts that can degrade toxic substances[10] in water and air.

This allows for more informed decision-making and the development of targeted interventions to protect the environment.

Conclusion:

Chemistry researchers are indispensable in the global effort to address environmental challenges. Through their work in sustainable energy, pollution control, climate change mitigation, water treatment, and environmental monitoring[11], they contribute significantly to the protection and preservation of the environment. As the world continues to grapple with complex environmental issues, the role of chemistry researchers will become even more critical, driving innovation and providing solutions that are essential for a sustainable future.

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Synthesis and Analysis of Lubricants Based on Vegetable Oil and Their Esters for Optimum Oxygen Stabilty and Related Properties

MS. Dipali V. Kalne

Abstract:

A distillation technique is used to create petroleum lubricating oil from crude petroleum. Commercial engine lubricants are mineral oils made of base oil plus an additive, which is a synthetic chemical used change the base oil's properties. Interest in creating alternative lubricants has increased as a result of growing worries about the effects of oil shortages on the environment. (bio-lubricants). In addition to being used in cooking, vegetable oils are a crucial study topic in the area of biological lubricants. Due to their biodegradability and low toxicity, vegetable oils are favoured as base oils for alternative lubricants since they are renewable and environmentally beneficial.

Introduction:

Since humans have used tools, lubricating oil has been employed. A number of uses for lubricating oil have included preventing corrosion and friction on colliding surfaces, reducing heat production, maintaining object cleanliness, and producing insulating and rust prevention effects. Initially, sperm oil was used to lubricate spinning and weaving machines, but it was unintentionally discovered that mixing crude oil with sperm oil would increase the machine's lifespan to more than ten years. Since then, products based on crude oil have begun to quickly replace lubricants.

As a jet liner was developed in the 1950s, it became necessary to create lubricants that function well even at temperatures as low as 50 degrees below zero, which led to the development of synthetic oil and multifunctional oil. The 1970s saw the invention of a hydrocracking technique, and the 1990s saw the discovery of the more sophisticated hydro isomerization technique. Recently, economic and environmental factors have become more important .

Objectives and Scope:

The purpose of this endeavour is to create lubricants that are both environmentally responsible and energy efficient. Though significant progress has been achieved in this area over the last ten years, it still feels as though we haven't even begun to scratch the surface. Universities, businesses, and research organisations are working together on practical research initiatives for the responsible use of bio-based, renewable lubricating oil. Therefore, creating environmentally friendly materials for lubricating applications is a goal. Given the increased interest in sustainable technologies, we think that methods like those described in the review can continue to develop. The numerous research conducted point to a promising application of these approaches and their advancement from an industrial standpoint. Advantages and Disadvantages of biolubricants.

The study will examine various bio-oils' suitability as lubricants. The suitability of bio-ester as a lubricant will be investigated. It will look for the optimal working volume of bio-oil and bio-ester in lubricating oil made of petroleum.

Give a comparison of the applicability of bio-oil blends against bio-ester blends as lubricating oils.

Study design and methods:

The performance of vegetable oil and their ester as a blending agent for petroleum lubricants is recommended to be examined. The suggested research project will proceed in the manner outlined below.

A] The synthesis of ester from base bio-oil will be accomplished in this work using a base catalysed technique. In order to determine the best yield of ester from the bio-oil, the study will use KOH catalyzed transesterification , in which other variables affecting the ester yield, such as molar ratio, catalyst concentration reaction time, and reaction temperature, will be analysed in accordance with studies of different literature reviews. We shall compare the key characteristics of the base oil, bio-oil, to those of ASTM and TP standards for petroleum lubricant , including density, kinematic viscosity, acid value, and moisture content.

B] The following methods will be used for this planned research project: Characterization of edible and non-edible bio-lubricants made from petroleum. bio- ester production using both edible and inedible oils. creation of mixtures including both bio ester and petroleum oil and bio oil. Analyzing blended samples of bio-oil, bio-ester, and other substances against accepted norms.to find the best blend of different bio-oils and mineral oil that is workable in terms of percentage. To find the best blend of different bio-esters and mineral oil that can be used. Analyzing several bio- oils and their bio-esters side by side to see if they may be blended with

Conclusions:

Bio-lubricants have numerous valuable and useful physiochemical properties and offer several technical Advantages:

- The proposed research work will be able to give blending preparation of bio-oil and bio-ester in mineral oil which improves the physicochemical properties of lubricant oil.
- It will be able to search lubricating oil which is bio-oil based renewable source less expensive and eco-friendly.
- It will boost the socio-economical condition of farmers.
- It will develop self employment in rural areas.

Recently, economic and environmental factors have become more important than performance when choosing lubricants. As a result, metallurgists, engineers, chemists, and oil refinery workers continue to research ways to improve the performance of lubricating products and find new sources of lubricating oil.

Mineral oil makes up 90% of lubricants, whereas additives make up less than 10%. Base oils may occasionally be made from vegetable oils or synthetic fluids like hydrogenated polyolefins, ester, silicon, fluorocarbons, and many more. The effects of additives include decreased wear and friction, higher viscosity index,resistance to oxidation and corrosion, ageing or contamination, etc.

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Assessment of Drug Paracetamol in Bulk and Single Component Pharmaceuticals by Non-aqueous Conductometric Titration

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Abstract

Paracetamol is most common acidic drug used in medicines and pharmaceuticals. In present study, assessment of drug paracetamol in bulk and single component pharmaceuticals by non-aqueous conductometric titration was reported using the solvent isopropyl alcohol and the titrant KOH in isopropyl alcohol. Herein, effect of solvent and concentration on conductometric assessment of paracetamol was also studied. The conductometric breaks obtained, using the dip type of glass conductivity cell are too much prominent. Results obtained are compared to Indian Pharmacopoeia (I.P.) method. Conductometric assessment of drug in bulk and single component pharmaceuticals was observed to be quite simple and precise. Even in common laboratories, this method can be followed without the utilization of any type of sophisticated instrument. For speedy checking of spurious drugs that are feared to penetrate the markets, the non-aqueous conductometric titration will be helpful in the analysis of pharmaceutical raw materials and products.

Keywords *: Paracetamol, pharmaceuticals, non-aqueous, conductometric, assessment*

Introduction

According to literature survey, different compounds, products, medicines and pharmaceutical drugs have been assessed earlier using the conductometric method[1-3]. Literature is quite strengthened with the assessment of pharmaceutical drugs and products by non-aqueous acid-base titrations and other available methods and techniques. In all the main pharmacopoeias, non-aqueous titrations are mentioned[4-6]. Conductometric titrations using conductivity cell are also recommended in these pharmacopoeias. In literature, investigation of pharmaceuticals by non-aqueous titration method is reported by some authors[7-9].

In literature, different types of methods are given for the analysis of paracetamol[10-11]. Determination of paracetamol by spectrophotometric and colorimetric methods has been carried out by many workers[12-14]. Literature is enriched with potentiometric estimation of paracetamol[15,16]. Some coworkers have determined the paracetamol by R.P.-H.P.L.C. technique[17] whereas, others used H.P.L.C. method[18,19]. Analysis of paracetamol by solid phase extraction, gas chromatography and mass spectrometry technique is worked out earlier[20]. Potentiometric determination of paracetamol in combination with aceclofenac, mefenamic acid and diphenhydramine hydrochloride was reported in few communications[21,22]. However, the assessment of paracetamol using solvent isopropyl alcohol by conductometric titration was not reported in literature. Paracetamol is most acidic in nature and hence it cannot be titrated directly with aqueous alkali, because of its hydrolysis. Titrants, basic in nature are superior to the alkoxide solvents. These titrants are susceptible to atmospheric moisture and carbondioxide.

Herein, the simplest method for analysis of pharmaceutically potent drugs is reported. For speedy checking of spurious drugs that are feared to penetrate the markets, the non-aqueous conductometric titration will be helpful in the analysis of pharmaceutical raw materials and products. In present work, assessment of drug paracetamol in bulk and single component pharmaceuticals by non-aqueous conductometric titration using the solvent isopropyl alcohol and titrant KOH in isopropyl alcohol was given. Effect of solvent and concentration on conductometric assessment of drug paracetamol was also checked.

Results and Discussion

Effect of solvent and concentration on conductometric assessment of drug paracetamol

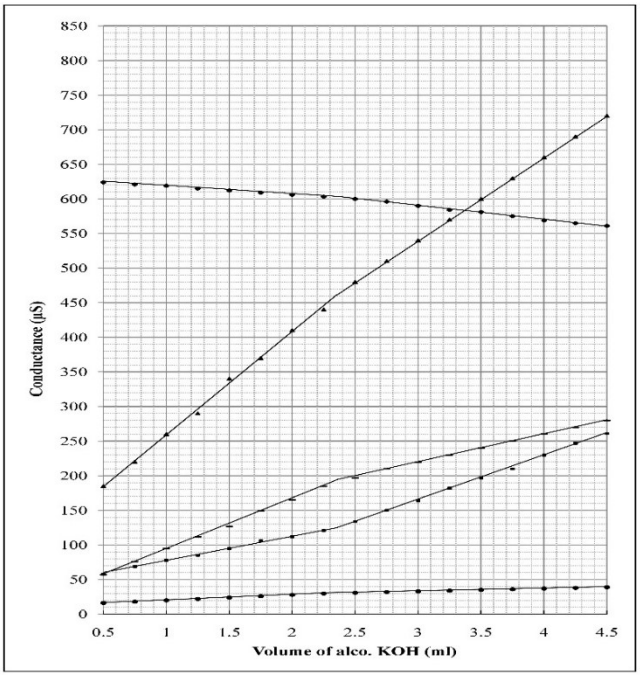
To study the effect of solvent, accuracy of results in analysis of drug paracetamol using various solvents was assessed by non-aqueous conductometric titration. Requisite volumes of stock solutions of drug paracetamol

in various solvents were diluted to 20 ml and separately titrated with KOH in isopropyl alcohol. It was observed that, accuracy of results in assessment of drug paracetamol using solvent isopropyl alcohol is much good with least % error in comparison to other solvents (**Table-1**). Using solvent isopropyl alcohol, conductometric break obtained is too much prominent (**Graph-1**). At the end point, solvent isopropyl alcohol permitted a large change in the concentration of solvated proton. Solvent isopropyl alcohol is can be purified and made anhydrous very easily and its dielectric constant is also less.

Table-1 : Effect of solvent on conductometric assessment of drug paracetamol

Solvent	Weight Titrated (mg) (±0.5%)	Weight Found (mg)	Error (%)
Acetone	30.200	30.550	+ 1.15
Dimethyl formamide	30.200	30.940	+ 2.45
Methanol	30.200	30.550	+ 1.15
Dimethyl sulphoxide	30.200	30.680	+ 1.58
Isopropanol	30.200	29.900	– 0.99

Graph-1 : Effect of solvent on conductometric assessment of drug paracetamol

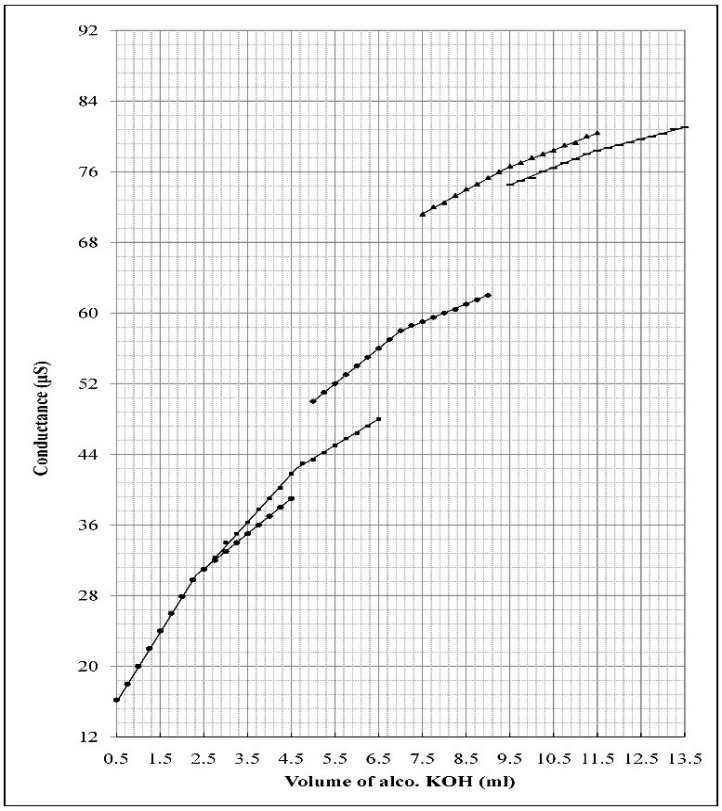


For the study of effect of concentration and to find out proper concentration range that gives good results, different volumes of stock solution of drug paracetamol were diluted to 20 ml with isopropyl alcohol and separately titrated with KOH in isopropyl alcohol. It was observed that, conductometric titration gave an accuracy of +1.15% to –1.85% for overall range of 30.200 to 151.000 mg. Here, the results are much accurate than other methods, both with positive and negative errors (**Table-2**). Method of assessment of pharmaceutical drugs by conductometric titration is observed to be good in respect of error than visual titrations given in pharmacopoeias. Conductometric breaks obtained are much prominent (**Graph-2**).

Table-2 : Effect of concentration on conductometric assessment of drug paracetamol

Weight Titrated (mg)	Weight Found (mg)	Error (%)
30.200	29.900	– 0.99
60.400	59.800	– 0.99
90.600	90.342	– 0.28
120.800	122.200	+ 1.15
151.000	148.200	– 1.85

Graph-2 : Effect of concentration on conductometric assessment of drug paracetamol



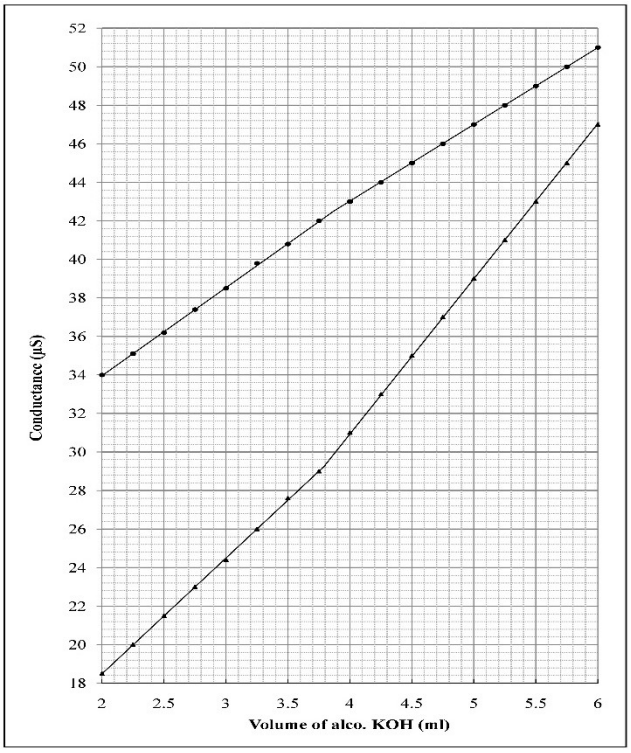
Conductometric assessment of drug paracetamol in single component pharmaceuticals

Drug paracetamol containing ten pharmaceutical tablets of same batch were weighed accurately and powdered. Requisite amount of powder was weighed accurately, extracted with isopropyl alcohol and volume was made to 100 ml. Aliquot of 10 ml of this solution was diluted to 20 ml using isopropyl alcohol and titrated with KOH in isopropyl alcohol using conductometer. Standardization of titrant was done by conductometric titration using standard benzoic acid in isopropyl alcohol. Amount of drug paracetamol present in one tablet was calculated. Same tablet was assessed by I.P. method. Results of two brands of pharmaceutical tablets are tabulated. It is observed that, conductometric titration gives much accurate results compared to those obtained by I.P. method (**Table-3)**. Non-aqueous conductometric titration is quite good, accurate and most simple than other methods found in literature. This method is free from indicator interferences and other errors. Conductometric breaks obtained are more prominent (**Graph-3**). Paracetamol gets hydrolyzed in presence of aqueous alkali, but this can be avoided using non-aqueous solvents. Calcium carbonate, sugars, gum etc. are the most common additives found in pharmaceutical tablets and as these are insoluble in isopropyl alcohol do not affect the results.

Table-3 : Conductometric assessment of drug paracetamol in single component pharmaceuticals

Sample	Label Claim (mg)	Weight Found (mg)	
		I.P. Method	Present Method
PR-01	500	495.200	500.500
PR-02	500	490.300	494.000

Graph-3 : Conductometric assessment of drug paracetamol in single component pharmaceuticals



Experimental

The digital conductometer (Systronics-304) with dip type of glass conductivity cell having outer diameter of 15 mm and cell constant 1 was used to perform titrations. Contech, CAH-123 (±0.001 g) balance was used for weighing. A.R. grade chemicals and solvents were used. Solvents were purified and made anhydrous following standard methods[13,14]. Titrants were protected from atmospheric moisture and carbondioxide. Drug paracetamol is included in pharmacopoeias[4-6] and it is obtained from pharmaceutical laboratories.

Effect of solvent and concentration on conductometric assessment of drug paracetamol

To study the effect of solvent on conductometric assessment of drug paracetamol, its stock solutions (15.100 mg/ml, ±0.5%) were prepared in solvents acetone, dimethyl formamide, methanol, dimethyl sulphoxide and isopropyl alcohol. Using same solvents, 2 ml of these solutions were diluted to 20 ml and separately titrated with KOH in isopropyl alcohol using the dip type of glass conductivity cell having cell constant 1. For the study of effect of concentration, stock solution of drug paracetamol (15.100 mg/ml) was prepared in isopropyl alcohol. Different volumes (2 to 10 ml) of this stock solution were diluted to 20 ml using isopropyl alcohol and separately titrated with KOH in isopropyl alcohol by adding titrant in portions of 0.1 ml with constant stirring using magnetic stirrer. Conductivity of the solution was noted after every addition. To get conductivity stabilized, waiting period of about ½ to 1 minute was given. Addition was continued till 0.3 to 0.5 ml excess of titrant was added. Readings were recorded near end point, for each addition of 0.02 ml of titrant and graphs of conductivity against volume of titrant were plotted were plotted to get the end points.

Conductometric assessment of drug paracetamol in single component pharmaceuticals

Drug paracetamol containing ten tablets of same batch were weighed accurately and powdered for this assessment. Powder containing 500 mg of drug was weighed accurately, treated with 50 ml of isopropyl alcohol and rapidly stirred to dissolve active component of tablet. In pharmaceutical tablets, most common additives present are calcium carbonate, sugars, gum etc. and these are insoluble in isopropyl alcohol. Solution was filtered, washed the residue for three times with little quantity of isopropyl alcohol and volume of solution was made to 100 ml with isopropyl alcohol. Aliquot of 10 ml of this solution was diluted to 20 ml with isopropyl alcohol and titrated with 0.1 M of solution of KOH in isopropyl alcohol using conductometer and the dip type of glass conductivity cell having cell constant 1. Standardization of titrant was done by conductometric titration with 0.1 M benzoic acid in isopropyl alcohol. As described earlier, by plotting graphs end points were determined and

amount of drug present in titrated weights of tablet powder was measured. Quantity of active component (drug) present in one tablet was measured from average weight of tablet. Other tablet having 500 mg of the drug was assessed in similar manner. These tablets were then assessed by method given in pharmacopoeias and results were compared.

Conclusion

Pharmaceutical drug paracetamol was selected for the given study. As it is acidic in nature, it could not be titrated directly with aqueous alkali because of its hydrolysis, but non-aqueous titration gave good results. Solvent isopropyl alcohol is found to be the excellent one for all type of titrations. KOH in isopropyl alcohol, a basic titrant was superior to alkoxide solvents which are susceptible to atmospheric moisture and carbondioxide. Using the dip type of glass conductivity cell, conductometric breaks obtained were much prominent. Herein, simple method for assessment of acidic drug paracetamol was reported. It is most efficient, precise and can be used even in common laboratories without the utilization of any type of sophisticated instrument.

Acknowledgement

Thanks are due to Principal, Shri Radhakisan Laxminarayan Toshniwal College of Science, Akola for providing all necessary facilities.

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Non-aqueous Conductometric Investigation of Drug Ibuprofen in Bulk and Single Component Pharmaceuticals

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Abstract

Drug ibuprofen is distinctly acidic and extensively used in medicines and pharmaceuticals. Herein non-aqueous conductometric investigation of drug ibuprofen in bulk and single component pharmaceuticals was reported using the solvent isopropanol and the titrant KOH in isopropanol. Effect of solvent, concentration and dilution on conductometric investigation of ibuprofen was also studied. For present study, the dip type of glass conductivity cell was used. Conductometric breaks obtained are much more pronounced and prominent. Results are comparable to those obtained by the Indian Pharmacopoeia (I.P.) method. Conductometric investigation of drug in pharmaceuticals was found to be simple, efficient and precise. It can be used even in common laboratories without use of any sophisticated instrument. This method will be useful in the analysis of raw materials and products for quick check of spurious drugs which are feared to penetrate the markets.

Keywords *: Non-aqueous, conductometric, investigation, ibuprofen, pharmaceuticals*

Introduction

Literature survey showed that, various medicines, pharmaceuticals, drugs and organic compounds were investigated using the conductometric method[1-3]. Literature is enriched with the investigation of pharmaceutical compounds by acid-base titration method using non-aqueous solvents and other methods. Non-aqueous titrations are explained in the main pharmacopoeias[4-6]. These pharmacopoeias also recommended the conductometric titration method using conductivity cell. Study of pharmaceutical compounds by non-aqueous titration method is mentioned in literature and reviewed by many authors[7-9].

For the determination of ibuprofen, various methods are given in literature[10,11]. Earlier, conductometric non-aqueous analysis of ibuprofen using perchloric acid was reported[12]. Conductometric investigation of pharmaceutically potent ibuprofen using solvent isopropanol was not found in literature. Drug ibuprofen is distinctly acidic in nature, so it could not be titrated directly with aqueous alkali, owing to its hydrolysis. Basic titrants are superior to alkoxide solvents. These are much susceptible to the atmospheric moisture and CO_2.

In present work, the simple method for investigation of pharmaceutically potent drugs is given. It will be useful in the analysis of raw materials and products for quick check of spurious drugs which are feared to penetrate the markets. Herein, non-aqueous conductometric investigation of drug ibuprofen in bulk and single component pharmaceuticals using the solvent isopropanol and titrant KOH in isopropanol was reported. Effect of solvent, concentration and dilution on conductometric investigation of drug ibuprofen was also studied.

Results and Discussion

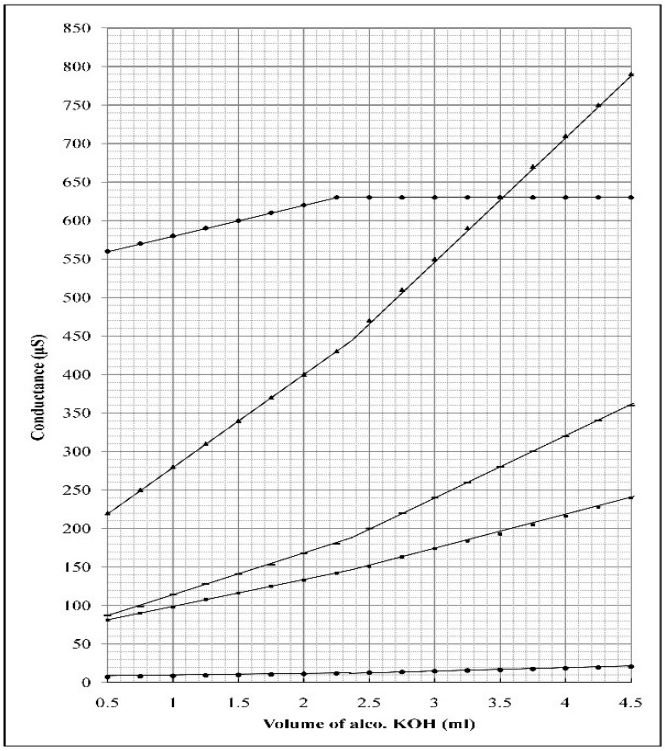
Effect of solvent, concentration and dilution on conductometric investigation of drug ibuprofen

For the study of effect of solvent, herein accuracy of results in analysis of drug ibuprofen using different solvents was investigated by non-aqueous conductometric titration. Required volumes of stock solutions of drug ibuprofen in different solvents were diluted to 20 ml and then titrated separately with KOH in isopropanol. It can be seen from the results that, accuracy of results in investigation of drug ibuprofen using solvent isopropanol is much more with minimum % error compared to other solvents (**Table-1**). Conductometric break obtained using solvent isopropanol is very much pronounced and prominent (**Graph-1**). Solvent isopropanol permitted a large change in the concentration of solvated proton at the end point. Dielectric constant of solvent isopropanol is smaller and it can be purified and made anhydrous very easily.

Table-1 : Effect of solvent on conductometric investigation of drug ibuprofen

Solvent	Weight Titrated (mg) (±0.5%)	Weight Found (mg)	Error (%)
Acetone	41.260	42.046	+ 1.90
Dimethyl formamide	41.260	39.916	– 3.25
Methanol	41.260	41.868	+ 1.47
Dimethyl sulphoxide	41.260	42.046	+ 1.90
Isopropanol	41.260	41.690	+ 1.04

Graph-1 : Effect of solvent on conductometric investigation of drug ibuprofen

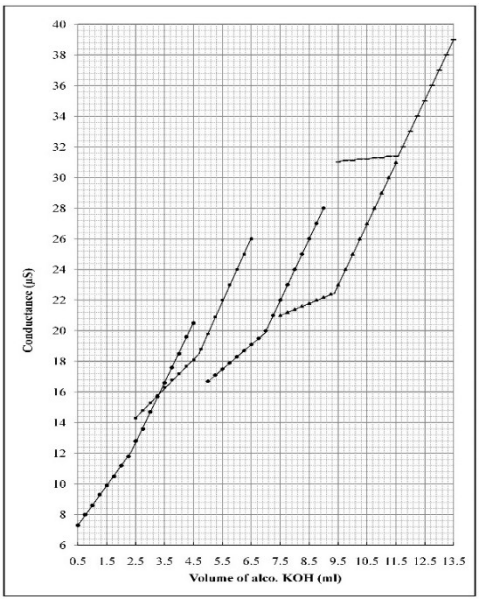


To study the effect of concentration and to determine suitable concentration range which gives better results, different volumes of stock solution of drug ibuprofen were diluted to 20 ml with isopropanol and titrated separately with KOH in isopropanol. It can be seen from results that, conductometric method gave an accuracy of +1.04% to –0.24% for entire range of 41.260 to 206.300 mg. Results obtained are better with much more accuracy than other methods having both positive and negative errors (**Table-2)**. This method of investigation is observed to be better in respect of indicator error than visual titration method shown in pharmacopoeias. Conductometric breaks obtained are much more pronounced (**Graph-2**).

Table-2 : Effect of concentration on conductometric investigation of drug ibuprofen

Weight Titrated (mg)	Weight Found (mg)	Error (%)
41.260	41.690	+ 1.04
82.520	83.380	+ 1.04
123.780	123.288	– 0.39
165.040	165.872	+ 0.50
206.300	205.790	– 0.24

Graph-2 : Effect of concentration on conductometric investigation of drug ibuprofen

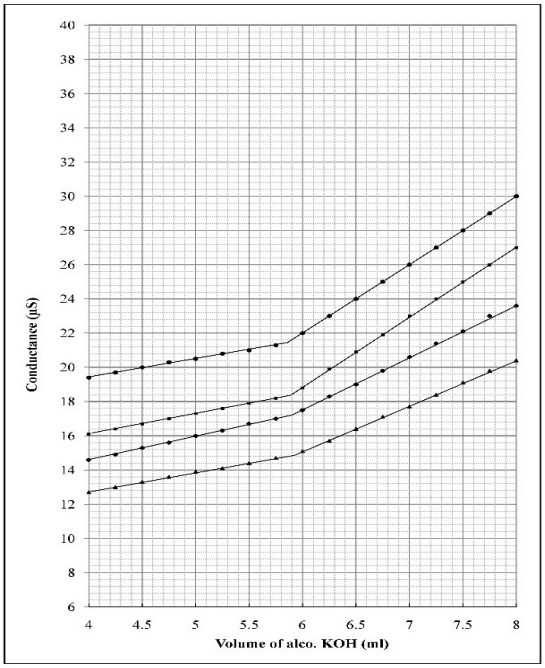


In the study of effect of dilution, accuracy of results in analysis of drug ibuprofen by diluting the solution using same solvent was investigated by non-aqueous conductometric titration. Required volume of sample solution of drug ibuprofen was diluted step by step from 15 to 30 ml using isopropanol and titrated separately with KOH in isopropanol. It can be seen from the results that, there is no appreciable effect of dilution on accuracy of results in investigation of drug ibuprofen under the present experimental condition. The % error was very much less, which ranges from +0.61% to +1.81% (**Table-3)**. Conductometric breaks obtained are quite pronounced and much more prominent (**Graph-3**).

Table-3 : Effect of dilution on conductometric investigation of drug ibuprofen

Volume of Solution (ml)	Weight Titrated (mg)	Weight Found (mg)	Error (%)
15.0	103.150	103.780	+ 0.61
20.0	103.150	104.310	+ 1.12
25.0	103.150	104.670	+ 1.47
30.0	103.150	105.020	+ 1.81

Graph-3 : Effect of dilution on conductometric investigation of drug ibuprofen



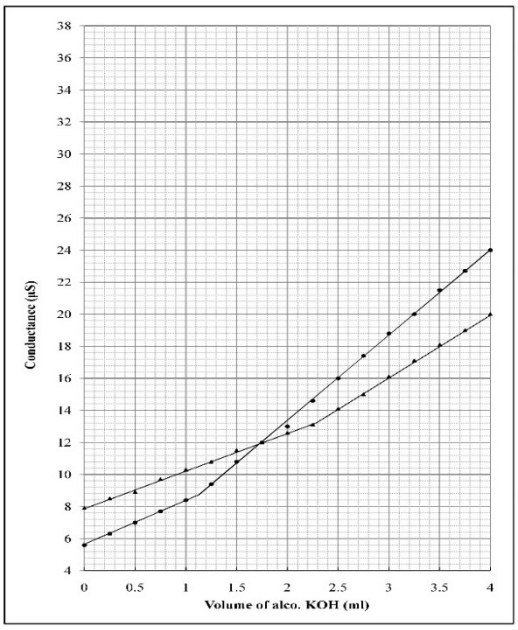
Conductometric investigation of drug ibuprofen in single component pharmaceuticals

Ten pharmaceutical tablets of same batch having drug ibuprofen were accurately weighed and powdered. Required quantity of powder was accurately weighed, it was extracted with isopropanol and volume was made to 100 ml. An aliquot of 10 ml of this solution was diluted with isopropanol to 20 ml and titrated with KOH in isopropanol using conductometer. Titrant was standardized by conductometric titration using standard benzoic acid in isopropanol. Weight of drug ibuprofen present in one tablet was calculated. Same tablet was investigated by I.P. method. Results obtained for two different brands of pharmaceutical tablets are tabulated and it is found that, conductometric method gives fairly accurate and comparable results to those obtained by I.P. method (**Table-4)**. This method is better, accurate and simple than other methods given in literature. It is free from indicator error or interferences. Conductometric breaks obtained are more pronounced (**Graph-4**). In presence of aqueous alkali, ibuprofen gets hydrolyzed but this is avoided in non-aqueous medium. Commonly found additives in pharmaceutical tablets are calcium carbonate, sugars, gum etc. and as these are insoluble in isopropanol do not affect the results.

Table-4 : Conductometric investigation of drug ibuprofen in single component pharmaceuticals

Sample	Label Claim (mg)	Weight Found (mg)	
		I.P. Method	Present Method
IB-01	200	195.450	198.600
IB-02	400	394.490	402.600

Graph-4 : Conductometric investigation of drug ibuprofen in single component pharmaceuticals



Experimental

All titrations were performed using a digital conductometer (Systronics-304) with dip type of glass conductivity cell having outer diameter of 15 mm and cell constant 1. Weighing were made on Contech, CAH-123 (±0.001 g) balance. Chemicals and solvents used were of A.R. grade. Solvents were purified and made anhydrous by standard methods[13,14]. Care was taken to protect titrant from atmospheric moisture and CO_2. Drug ibuprofen utilized for present work was obtained from pharmaceutical laboratories and it is included in pharmacopoeias[4-6].

Effect of solvent, concentration and dilution on conductometric investigation of drug ibuprofen

For the study of effect of solvent on conductometric investigation of drug ibuprofen, its stock solutions (20.630 mg/ml, ±0.5%) were prepared by dissolving it in solvents like acetone, dimethyl formamide, methanol, dimethyl sulphoxide and isopropanol. 2 ml of these solutions were diluted to 20 ml with same solvents and titrated separately with KOH in isopropanol using the dip type of glass conductivity cell with cell constant 1. To study the effect of concentration, stock solution of drug ibuprofen (20.630 mg/ml) was prepared by dissolving it in isopropanol. Different volumes (2 to 10 ml) of stock solution were diluted to 20 ml with isopropanol and titrated

separately with KOH in isopropanol adding titrant in lots of 0.1 ml with continuous stirring using magnetic stirrer. In the study of effect of dilution, 5 ml of sample solution of drug ibuprofen (103.150 mg) was diluted step by step from 15 to 30 ml using isopropanol and titrated separately with KOH in isopropanol. Conductivity of the solution was measured after each addition. Waiting period of about ½ to 1 minute was allowed to get conductivity stabilized. Addition was continued till 0.3 to 0.5 ml excess of titrant was added. Near end point readings were recorded for each addition of 0.02 ml of titrant. End points were found out by plotting graphs of conductivity against volume of titrant.

Conductometric investigation of drug ibuprofen in single component pharmaceuticals

In this investigation, drug ibuprofen containing ten tablets of same batch were accurately weighed and powdered. Powder containing 200 mg of drug was accurately weighed, treated with 50 ml of isopropanol and vigorously stirred to dissolve active component of tablet. Most common additives present in pharmaceutical tablets are calcium carbonate, sugars, gum etc. which are mostly insoluble in isopropanol. Solution was filtered, residue was washed three to four times with small portions of isopropanol and volume of solution was made to 100 ml with isopropanol. An aliquot of 10 ml of this solution was diluted to 20 ml with isopropanol and titrated with 0.1 M of solution of KOH in isopropanol by conductometric method using the dip type of glass conductivity cell with cell constant 1. Titrant was standardized by conductometric titration with 0.1 M benzoic acid in isopropanol. End points were determined by plotting graphs as described earlier; amount of drug present in titrated weights of tablet powder was calculated. Amount of active component (drug) present in one tablet was calculated from average weight of tablet. Similarly another tablet having 400 mg of the drug was investigated. Same tablets were then investigated by method of pharmacopoeias and results obtained were compared.

Conclusion

For present study, pharmaceutical drug selected was ibuprofen. Being distinctly acidic, it could not be titrated directly with aqueous alkali owing to its easy hydrolysis but non-aqueous titration of ibuprofen gave better results. For all titrations, solvent isopropanol is found to be the excellent one. Basic titrant, KOH in isopropanol was superior to alkoxide solvents that are more susceptible to atmospheric moisture and CO_2. Conductometric breaks obtained, using the dip type of glass conductivity cell were quite larger. In present work, method for investigation of acidic drug ibuprofen was developed. It is simple, efficient and precise. It can be used even in common laboratories without use of any sophisticated instrument.

Acknowledgement

Authors are thankful to Principal, Shri Radhakisan Laxminarayan Toshniwal College of Science, Akola for providing required facilities.

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Synthesis of Nitrogen Containing Heterocyclic Chalcones and Its Derivatives with the Investigation of their Anti-inflammatory Activity.

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Abstract:
In the present work we have been synthesized some nitrogen containing heterocyclic chalcones by using 4-formyl pyrazole (1), treated with 4-morpholinoacetophenone (2), in the presence of aq. KOH by grinding method to gives Chalcones (3) in first step. In the second step, Chalcones react with malanonitrile using sodium methoxide in ethanol to give pyridine-3-carbonitriles (4). The well-known carrageenan-induced rat paw edema method was used to investigate the anti-inflammatory properties of the synthesized product i.e. pyridine-3-carbonitrile derivatives. In comparison to the usual diclofenac drugs, the derivatives 3a, 3e, and 4e showed good biological activity. The synthesized product were confirmed by using spectral techniques like Infra-Red, ^{1}H-NMR, and Mass spectroscopy.
Keywords: *4-formyl pyrazoles, 4-Morpholinoacetophenone, Chalcones, Pyridine-3-carbonitriles, Grinding.*

Introduction:

A chalcone backbone and a heterocyclic ring combine to generate a class of chemical compounds known as heterocyclic chalcones. Chalcones are composed of two aromatic rings (A and B) joined by a three-carbon α, β-unsaturated carbonyl system that defines their core structure. One or both of these aromatic rings are swapped out with heterocyclic rings in heterocyclic chalcones; these rings may include atoms of nitrogen, oxygen, sulfur, or other elements. Heterocyclic chalcones are important in the realm of medicinal chemistry because of the various biological functions that these structural changes impart.

The presence of a heterocyclic ring enhances the electronic properties and interactions of chalcones with biological targets. Such modifications are known to influence various pharmacological properties, including antimicrobial, antitumor, antioxidant, anti-inflammatory, antimalarial, and anti-diabetic activities. Chalcones, due to their unique conjugated systems and the ability to form hydrogen bonds with enzymes or receptors, have gained attention for potential drug development.

It has been observed that heterocyclic chalcones inhibit the growth of cancer cells by focusing on multiple biological pathways, such as angiogenesis, apoptosis, and cell cycle control. These chemicals become more effective against cancer cells when heterocyclic moieties like pyridines, quinolines, and thiophenes are added.[1] Chalcones that have heterocycles like imidazole and thiazole substituted for them show improved antibacterial activity against strains of bacteria and fungi. Chalcones' ability to interact with microbial enzymes is influenced by the heterocyclic rings' electron-donating or electron-withdrawing groups.[2] The capacity of heterocyclic chalcones to bind metal ions and scavenge free radicals is what is thought to give them their antioxidant potential. Furan and thiophene, two modifications in the heterocyclic core, significantly improve their ability to counteract oxidative damage.[3] Heterocyclic chalcones with rings of pyrazole or isoxazole exhibit encouraging anti-inflammatory properties. In different animals, they reduce inflammation by blocking the production of pro-inflammatory cytokines and enzymes like COX-2.[4]These limitations creates some challenges for organic and medicinal chemist to design and develop more useful anti-inflammatory drugs[5,6].

The biologically active scaffold utilized in the production of different heterocyclic compounds is called a chalcone. Additionally, pharmacological activities including tyrosine inhibition7, anti-inflammatory[8] anticancer[9] antioxidant[10] and nitric oxide inhibition[11] are reported to be present in them. The pyrazole moiety was added to heterocyclic compounds to create pharmaceuticals like rimonabant[13] and celecoxib[12]. Additionally, they have biological activities that include anti-inflammatory[14], antiviral[16], antifungal[17], and A3 adenosine receptor

antagonist [15]. These heterocyclic compounds, which contain N-functionalized morpholine, are known to have anti-diabetic, antiemetic, anti-inflammatory, and central nervous system effects. They are considered biologically significant motifs.

Pyridine is a heterocyclic molecule with pharmacological properties that include hypoglycemia, dopamine transporter inhibitors, and anti-inflammatory effects. It can be found in many natural and manufactured compounds.[21, 22] They are also used in light-emitting devices[24], electroluminescence devices [25], and dyes for synthetic fabrics [23, 24]. The synthesis of chalcones and pyridine-3-carbonitriles or (4-(1,3-diphenyl-1H-pyrazol-4-yl)-2-methoxy-6-(4-morpholinophenyl) nicotinonitrile), as well as their anti-inflammatory properties, are reported here in continuation of our continuing research on the biological applications of chalcone, pyridine, pyrazole, and morpholine. [26–29]

In the present work we have been synthesized nitrogen containing chalcone and its derivatives by using mixing of 4-formyl pyrazole (1a-e), and 4-morpholinoacetophenone 20 ml EtOH and 10 ml 20% KOH solution in mortal-pestle grinding at room temperature to form chalcone derivatives (3a-e). And the chalcone 3 (0.01 mol) and malononitrile (0.01 mol) was taken in methanol (10 mL) in a mortar-pestle and grinding for 5 min and then add sodium methoxide in to the reaction mixture were grinding for the completion of the reaction to synthesized derivatives of 4-(1,3-diphenyl-1H-pyrazol-4-yl)-2-methoxy-6-(4-morpholinophenyl) nicotinonitrile (4a-e).

The synthesized compounds (3a-e) and (4a-e) was investigate anti-inflammatory bioactivity of synthesized chalcones derivatives (3a-e) and 4-(1, 3-diphenyl-1H-pyrazol-4-yl)-2-methoxy-6-(4-morpholinophenyl) nicotinonitrile (4a-e) by using carrageenan-induced paw edema test in rats. The study was carried using wistar rats of 150-200 g weight. Standard pellet diet and water ad libitum was fed to the study animals.

Methods and Materials

General

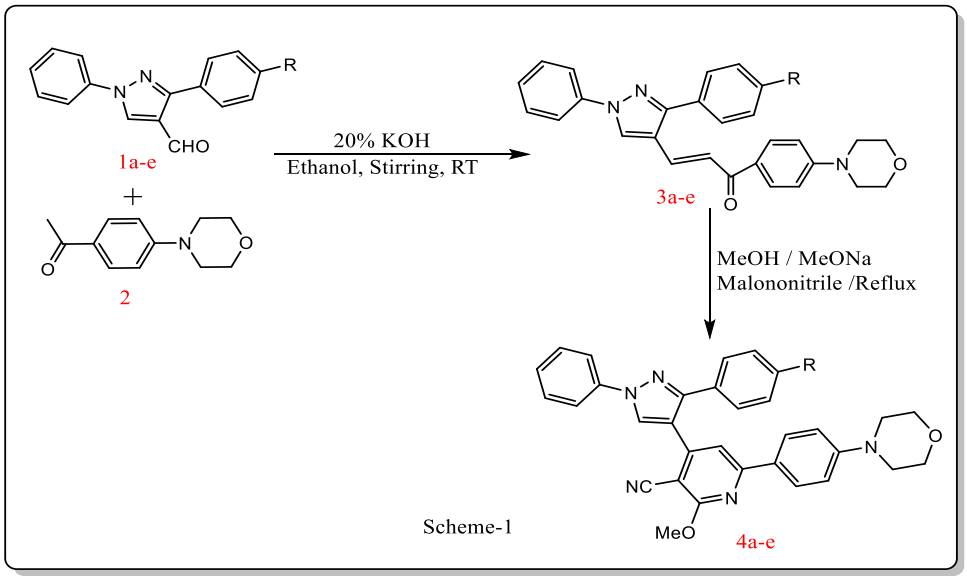
All of the synthetic grade reagents and chemicals were made using Merck and Sigma Aldrich chemicals in India. They were put to use without being cleansed. Thin layer chromatography was used to visualize the reaction on silica plates using an iodine chamber. A Buchi Melting point B-450 device was used to record melting points in open capillaries. A Bucker DRX-400 instrument was used to record 1H NMR spectra, a Nicolet Impact 410 was used to record IR in KBr, and high resolution mass spectroscopy was used to record mass spectra. ESI-MS. Anti-inflammatory study by using in carrageenan-induced paw edema test in rats.

General synthesis of 3-(1,3-diphenyl-1H-pyrazol-4-yl)-1-(4-morpholinophenyl)prop-2-en-1-one (chalcones): (3a-e)

A mixture of 4-formyl pyrazole (0.01 mol) and 4-morpholinoacetophenone (0.01 mol), 20 ml EtOH and 10 ml 20% KOH solution was added in mortar-pestle and grinding at room temperature for the completion of the reaction. The reaction progress monitor by TLC, after the completion of the reaction, reaction mixture was added in crushed ice and neutralized by acetic acid. The precipitated product was separated by filtration and dried. The product was purified by recrystallization using ethanol to furnish chalcones (3a-e). The synthesized compounds was confirmed by TLC, Physical and spectroscopic analysis.

General protocol for synthesis of 4-(1,3-diphenyl-1H-pyrazol-4-yl)-2-methoxy-6-(4-morpholinophenyl) nicotinonitrile: (4a-e)

The chalcone 3 (0.01 mol) and malononitrile (0.01 mol) was taken in methanol (10 mL) in a mortar-pestle and grinding for 5 min and then add sodium methoxide (0.01 mol) in to the reaction mixture were grinding for the completion of the reaction. The progress and completion of reaction was monitored by TLC. Then the reaction contents were allowed to attain the room temperature. The precipitated product was filtered, washed with water and dried it. The products were purified by recrystallization using ethanol to furnish pure 4-(1,3-diphenyl-1H-pyrazol-4-yl)-2-methoxy-6-(4-morpholinophenyl) nicotinonitrile derivatives (4a-e). The synthesized compounds was confirmed by TLC, Physical and spectroscopic analysis.



Scheme-1

Result and Discussion:

The chalcones was synthesized i.e. (3a-e) and 4-(1,3-diphenyl-1H-pyrazol-4-yl)-2-methoxy-6-(4-morpholinophenyl) nicotinonitril (4a-e) (Table 1) derivatives are shown in scheme 1. The chalcones 3a-e is synthesized by well-known Claisen-Schmidt condensation of 4-formyl pyrazole (1a-e) with 4-morpholinoacetophenone (2) in presence 20% KOH as a base and ethanol as a solvent under room temperature grinding. The formation of chalcones 3a-e was confirmed on the basis of the spectral techniques. The Infra-Red spectrum of synthesized chalcone 3a show characteristic stretching frequencies at 1687 cm-1 for C=O, 1655 cm-1 for C=N, 1626 cm-1 for C=C and 1236 cm-1 for C-O groups. The 1 H-NMR spectra of compound 3e shows two triplets at 3.32 d and 3.83 d each for four protons are due to -N-CH_2 - and -O-CH_2 - groups of morpholine ring respectively. The aromatic as well as C=C group protons appeared in 6.93-7.94 d while the pyrazole ring proton exhibited singlet at 8.23 d. The mass spectrum of compound 3e shows m/z 469 peak corresponding to its molecular weight.

In the second step the chalcones give rise to derivatives 4-(1,3-diphenyl-1H-pyrazol-4-yl)-2-methoxy-6-(4-morpholinophenyl) nicotinonitrile (4a-e), when they react with malononitrile in methanol solvent with freshly made sodium methoxide base present. Using spectroscopic methods, the production of 4-(1,3-diphenyl-1H-pyrazol-4-yl)-2-methoxy-6-(4-morpholinophenyl) nicotinonitrile (4a-e) was verified. The Infra-Red spectra of compound 4e exhibited peaks at 2214 cm-1 for CN and 1663 cm-1 due to C=N functional groups. The 1 H-NMR spectrum of compound 4d exhibited two triplets at 3.25 d and 3.86 d each for four protons are due to -N-CH_2- and -O-CH_2- groups of morpholine ring respectively. The new signal appeared at 4.18 d as a singlet for three protons is due to -OCH_3 group. The aromatic ring protons show multiplet between 6.90-7.81 d. The proton of pyrazole ring shows a singlet at 8.47 d. The mass spectrum of compound 4e showed m/z 543 peak corresponding to its molecular weight which confirm its formation.

The findings of the anti-inflammatory activity investigation are shown in Table No. 2, which shows that compound 3a, compound 3b, and compound 4b showed good activity in comparison to the usual diclofenac medication. Moderate activity profile is possessed by the other compounds. Chalcone 3a and 3e shows strong biological activity is ascribed to the para methoxy substituent in 3e and the no substituent in 3a on the phenyl ring of the pyrazole moiety. The presence of a methoxy group on the phenyl ring of pyrazole in the 4b 4-(1,3-diphenyl-1H-pyrazol-4-yl)-2-methoxy-6-(4-morpholinophenyl) nicotinonitrile (4a-e) may have increased its activity.

Table 1: The physical data of synthesized derivatives 3a-e and 4a-e

Entry	R	Time in Hrs. Min	Melting Point	% of yield
3a	H	3.00	280-281	86
3b	4-OMe	5.00	239-240	80
3c	4-Me	4.00	250-251	85
3d	4-F	1.00	231-232	89
3e	4-Cl	0.50	221-222	91
4a	H	2.00	259-260	84
4b	4-OMe	3.00	285-286	77
4c	4-Me	2.30	262-263	80
4d	4-F	2.00	259-260	83
4e	4-Cl	1.00	264-265	87

Table 2: The anti-inflammatory activity study results of chalcones (3a-e) and 4-(1, 3-diphenyl-1H-pyrazol-4-yl)-2-methoxy-6-(4-morpholinophenyl) nicotinonitrile (4a-e)

Entry	R	Control (Paw Volume in ml)	Test (Paw Volume in ml)	Difference
Control	-	9.5	-	-
Diclofinac	-	9.5	8.2	1.3
3a	H	9.5	8.3	1.2
3b	4-OMe	9.5	7.5	2.0
3c	4-Me	9.5	9.0	0.5
3d	4-F	9.5	9.1	0.4
3e	4-Cl	9.5	9.2	0.3
4a	H	9.5	9.3	0.2
4b	4-OMe	9.5	8.4	1.1
4c	4-Me	9.5	9.2	0.3
4d	4-F	9.5	9.1	0.4
4e	4-Cl	9.5	9.2	0.3

Anti-inflammatory activity study:-

Rats with paw edema caused by carrageenan were used to investigate the anti-inflammatory properties of chalcones and 4-(1,3-diphenyl-1H-pyrazol-4-yl)-2-methoxy-6-(4-morpholinophenyl) nicotinonitrile according to a technique that has been documented in the literature. A 150–200 g weight range of wistar rats were used for the investigation. The experimental animals were fed a standard pellet meal and given unlimited access to water. The animals were kept in a 12 h light and 12 h dark cycle at 25 o C. The IAEC/CPCSEA approved the animal experiment. Three rats each group were used to fast the rats for the entire night. The only treatment given to the control group was a vehicle (1% CMC in water at a volume of 10 mL/kg). Diclofenac (10 mg/kg) and test samples (10 mg/kg) were suspended in vehicle (10 mL/kg) and given orally to the appropriate groups. All animals had an injection in the sub-planter region of their right hind paw, following a 30-minute interval, with 0.1 ml of 1% carrageenan solution produced in normal saline. After three hours, the amount of edema that had developed in the paw was quantified using a digital vernier caliper from Mitutoyo, Japan. Carrageenan alone was thought to

be 100% inducing edema. A significant reduction in paw volume relative to the control group was interpreted as an anti-inflammatory effect. Table 2 displays the results of the investigation.

Spectroscopic analysis of the synthesized derivatives.

3a) (E)-3-(1,3-diphenyl-1H-pyrazol-4-yl)-1-(4-morpholinophenyl)prop-2-en-1-one

Yield 86 %, m.p. 280-281°C; IR (KBr, cm-1): 1687 (Carbonyl), 1655 (C=N), 1626 (C=C), 1236 (C-O); 1 H NMR ($CDCl_3$, d): 3.36 (triplet, 4H, -N-CH_2-), 3.71 (triplet, 4H, -O-CH2 -), 6.93 (doublet, 2H, J=8 Hz, H-Aromatic), 7.30-7.85 (multiplet, 12H, H-Aromatic & CH=CH), 7.94 (d, 2H, J=8 Hz, H-Aromatic), 8.23 (s, 1H, proton of pyrazole ring); Mass m/z 435 $[M]^+$.

3b) (E)-3-(3-(4-methoxyphenyl)-1-phenyl-1H-pyrazol-4-yl)-1-(4-morpholinophenyl) prop-2-en-1-one

Yield 80 %, m.p. 221-222 °C; IR (KBr, cm-1): 1681 (Carbonyl), 1652 (C=N), 1619 (C=C), 1213 (C-O); 1 H NMR ($CDCl_3$, d): 3.32 (triplet, 4H, -N-CH_2 -), 3.85 (multiplet, 4H of -O-CH_2 - & 3H of Aromatic methoxy group proton), 6.91 (doublet, 2H, J=8 Hz, H-Aromatic), 7.00-7.90 (multiplet, 11H, H-Aromatic & CH=CH), 7.96 (doublet, 2H, J=8 Hz, H-Aromatic), 8.33 (singlet, 1H, proton of pyrazole ring); Mass m/z 465 $[M]^+$.

3c) (E)-1-(4-morpholinophenyl)-3-(1-phenyl-3-(p-tolyl)-1H-pyrazol-4-yl)prop-2-en-1-one

Yield 85 %, m.p. 239-240 °C; IR (KBr, cm-1): 1691 (Carbonyl), 1649 (C=N), 1628 (C=C), 1231 (C-O); 1 H NMR ($CDCl_3$, d): 2.16 (singlet, 3H, CH_3 of Aromatic ring), 3.45 (triplet, 4H, -N-CH_2 -), 3.91 (triplet, 4H, -O-CH_2 -), 7.09 (doublet, 2H, J=8 Hz, H-Aromatic), 7.29-7.99 (multiplet, 11H, H-Aromatic & CH=CH), 8.02 (doublet, 2H, J=8 Hz, H-Aromatic), 8.36 (singlet, 1H, proton of pyrazole ring); Mass m/z 449 $[M]^+$.

3d) (E)-3-(3-(4-fluorophenyl)-1-phenyl-1H-pyrazol-4-yl)-1-(4-morpholinophenyl)prop-2-en-1-one

Yield 89%, m.p. 231-232°C; IR (KBr, cm-1): 1686 (Carbonyl), 1647 (C=N), 1631 (C=C), 1245 (C-O), 1189 (Ar-F); 1 H NMR ($CDCl_3$, d): 3.33 (triplet, 4H, -N-CH2 -), 3.88 (triplet, 4H, -O-CH_2 -), 6.88 (doublet, 2H, J=8 Hz, H-Aromatic), 7.17-7.89 (multiplet, 11H, H-Aromatic & CH=CH), 7.94 (doublet 2H, J=8 Hz, H-Aromatic), 8.34 (singlet, 1H, proton of pyrazole ring); Mass m/z 453 $[M]^+$.

3e) (E)-3-(3-(4-chlorophenyl)-1-phenyl-1H-pyrazol-4-yl)-1-(4-morpholinophenyl)prop-2-en-1-one

Yield 91%, m.p. 250-251 °C; IR (KBr, cm-1): 1684 (Carbonyl), 1653 (C=N), 1622 (C=C), 1221 (C-O), 1092 (Ar-Cl); 1 H NMR ($CDCl_3$, d): 3.31 (triplet, 4H, -N-CH_2 -), 3.84 (triplet, 4H, -O-CH_2 -), 6.92 (doublet, 2H, J=8 Hz, H-Aromatic), 7.35-7.85 (multiplet, 11H, H-Aromatic & CH=CH), 7.95 (doublet, 2H, J=8 Hz, H-Aromatic), 8.34 (singlet, 1H, proton of pyrazole ring); Mass m/z 469 $[M]^+$.

4a) 4-(1,3-diphenyl-1H-pyrazol-4-yl)-2-methoxy-6-(4-morpholinophenyl)nicotinonitrile

Yield 84%, m.p. 259-260 °C; IR (KBr, cm-1): 2231 (CN), 1662 (C=N), 1603 (C=C), 1235 (C-O); 1 H NMR (CDCl3 , d): 3.32 (triplet, 4H, -N-CH2 -), 3.86 (triplet, 4H of -O-CH_2 -), 4.18 (singlet, 3H, Aromatic methoxy group proton), 6.90 (doublet, 2H, J=8 Hz, H-Aromatic), 7.35-7.91 (multiplet, 11H, H-Aromatic), 7.94 (doublet, 2H, J=8 Hz, H-Aromatic), 8.53 (singlet, 1H, proton of pyrazole ring); Mass m/z 513 $[M]^+$.

4b)2-methoxy-4-(3-(4-methoxyphenyl)-1-phenyl-1H-pyrazol-4-yl)-6-(4-morpholinophenyl) nicotinonitrile

Yield 77 %, m.p. 285-286 °C; IR (KBr, cm-1): 2236 (CN), 1648 (C=N), 1596 (C=C), 1241 (C-O); ^{1} H NMR ($CDCl_3$, d): 2.40 (singlet, 3H, CH_3 of Aromatic ring), 3.24 (triplet, 4H, -N-CH_2 -), 3.89 (triplet, 4H of -O-CH_2-), 4.16 (singlet, 3H, Aromatic methoxy group proton), 6.93 (doublet, 2H, J=8 Hz, H-Aromatic), 7.13 (singlet, 1H, H-Aromatic), 7.20-7.74 (multiplet, 9H, H-Aromatic), 7.80 (doublet, 2H, J=8 Hz, H-Aromatic), 8.49 (singlet, 1H, proton of pyrazole ring); Mass m/z 527 $[M]^+$.

4c) 2-methoxy-6-(4-morpholinophenyl)-4-(1-phenyl-3-(p-tolyl)-1H-pyrazol-4-yl) nicotinonitril

Yield 80 %, m.p. 262-263 °C; IR (KBr, cm-1): 2217 (CN), 1658 (C=N), 1598 (C=C), 1256 (C-O), 1076 (Ar-Cl); 1H NMR ($CDCl_3$, d): 3.30 (triplet, 4H,-N-CH_2-), 3.93 (triplet, 4H of -O-CH_2-), 4.19 (singlet, 3H, Aromatic-methoxy group proton), 7.03(doublet, 2H, J=8 Hz, H-Aromatic), 7.12 (singlet, 1H, H-Aromatic), 7.36-7.82 (multiplet, 11H, H-Aromatic), 8.45 (singlet, 1H, proton of pyrazole ring); Mass m/z 548 $[M]^+$.

4d)4-(3-(4-fluorophenyl)-1-phenyl-1H-pyrazol-4-yl)-2-methoxy-6-(4-morpholinophenyl) nicotinonitrile

Yield 83 %, m.p. 259-260 °C; IR (KBr, cm-1): 2223 (CN), 1651 (C=N), 1606 (C=C), 1233 (C-O), 1127 (Ar-F); 1 H NMR ($CDCl_3$, d): 3.25 (triplet, 4H, -N-CH2-), 3.86 (triplet, 4H of -O-CH2-), 4.18 (singlet, 3H, Aromatic-

methoxy group proton), 6.91 (doublet, 2H, J=8 Hz, H-Aromatic), 7.07 (singlet, 1H, H-Aromatic), 7.09-7.81 (multiplet, 11H, H-Aromatic), 8.47 (singlet, 1H, proton of pyrazole ring); Mass m/z 531 $[M]^+$.

4e)4-(3-(4-chlorophenyl)-1-phenyl-1H-pyrazol-4-yl)-2-methoxy-6-(4-morpholinophenyl) nicotinonitrile

Yield 87 %, m.p. 264-265 ^oC; IR (KBr, cm-1): 2214 (CN), 1663 (C=N), 1611 (C=C), 1253 (C-O); 1 H NMR ($CDCl_3$, d): 3.25 (triplet, 4H, -N-CH_2-), 3.83 (triplet, 4H of -O-CH_2 -), 3.94 (singlet, 3H, Aromatic methoxy group proton), 4.19 (singlet, 3H, Aromatic methoxy group proton), 6.97 (doublet, 2H, J=8 Hz, H-Aromatic), 7.11 (singlet, 1H, H-Aromatic), 7.32- 7.82 (multiple, 11H, H-Aromatic), 8.50 (singlet, 1H, proton of pyrazole ring); Mass m/z 543 $[M]^+$.

Conclusion:

In Conclusion, We have reported the synthesis of Nitrogen-containing Heterocyclic chalcones 3a-e and 4-(1,3-diphenyl-1H-pyrazol-4-yl)- 2-methoxy-6- (4-morpholinophenyl) nicotinonitrile 4a-e (Table 1) using chalcone, malononitrile and sodium methoxide by grinding method with good % of yield operationally simplicity and uses a straightforward workup approach. The Synthesized compounds 3a-e and 4a-e out of these synthesized compounds the compounds 3a, 3b, and 4b show the strong anti-inflammatory activity (Table 2).

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A Short Review on synthesis and biological applications of Isoxazoles

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Abstract

In Isoxazole and its derivatives are five-membered ring heterocyclic compounds which are aromatic with one oxygen atom and one nitrogen atom at adjacent positions. This class of compounds in agriculture can act as herbicides, insecticides. These compounds shows various medicinal properties, such as antimicrobial, anticancer, antitumor, antitubercular, analgesic, anti-inflammatory, antidepressant, and anticonvulsant activities. In organic materials, these compounds have been applied as semiconductors, single-walled nanotubes, liquid crystals, chiral ligands, scaffolds for peptidomimetics, dyes, and high-temperature lubricants. Isoxazole derivatives also play an important role in organic synthesis because they can be converted into several important synthetic units such as β-hydroxy ketones, γ -amino alcohols, α , β-unsaturated oximes, β -hydroxy nitriles, α-hydroxy-β-diketones, and β - dicarbonyl compounds. Because of wide range of application, the synthesis of isoxazole and its derivatives has attracted the chemists to focus on the synthesis of isoxazole and its derivatives. This review will focus the synthesis of isoxazole.

Keywords : Isoxazole, herbicides, anticancer, antitumor.

Introduction

Isoxazoles play a significant role in the field of medicinal chemistry among the wide range of heterocycles that have been explored for developing pharmacologically important molecules,. Isoxazole is an azole in which N and O are placed adjacent to each other. Isoxazoles are heterocyclic aromatic ring compound containing three hetero atoms[1]. Hantszch proposed "isoxazole" as it was the isomer "oxazole". Isoxazole rings are found in some natural products, such as ibotenic acid and also found in a number of drugs, including COX-2 inhibitor valdecoxib. Furoxan, a nitric oxide donor is containing isoxazolyl group & found in many betalactamase-resistant antibiotics, such as cloxacillin, dicloxacillin and flucloxacillin. The synthetic androgenic steroid danazol also has an isoxazole ring.

Isoxazoles are an important class of heterocycles, which are largely employed in the area of pharmaceuticals and therapeutics such as insecticidal, antibacterial, antibiotic, antitumour, antifungal, antituberculosis, anticancer and ulcerogenic. The naturally occurring antibiotic cycloserine which is known as antibiotic drug that possess antitubercular, antibacterial activities and also used in treatment of leprosy[2]; muscimol isolated from Amanita muscaria [3]; and isoxazoline-5-one 7 isolated from Legume seed [4] are potential isoxazole derivatives. Oxacillin, sulfamethoxazole , acivicin, sulfisoxazole, has been commercially used as a drug for antitumour and antileishmanial.. In addition, isoxazoles are also formed the basis for a number of drugs like COX-2 inhibitor such as valdecoxib , nitric oxide donor furaxan [5]. Isoxaflutole exhibit herbicidal activity. Therapeutic and pharmacophore activities mostly shown by a five membered heterocylces containing a nitrogen and oxygen atoms. isoxazole nucleus has been prepared by the chemists using various methods. This review paper focuses on synthesis and various biological activities of isoxazoles.

isoxazoles exhibiting anticancer activities :

Hamama et al. [6] reported the synthesis and biological evaluation of some novel isoxazole derivatives. The reaction of 5-amino-3-methylisoxazole with formalin and secondary amines gave the corresponding Mannich bases. Moreover, the coupling reaction of isoxazoles with different diazonium salts gave the corresponding mono and bis-azo dyes of isoxazole derivative. The newly synthesized compounds were screened for their antitumor activity. Mostafa et al. [7] prepared thiophenes having biologically active sulfonamide, 3-methylisoxazole, 4-methoxybenzo[d]thiazole, quinoline, benzoyl phenylamino, and anthracene-9,10-dione moieties. All newly synthesised compounds were evaluated for their in vitro anticancer activity against human breast cancer cell line

(MCF7). Kalirajan et al. [8] reported a convenient synthesis of novel isoxazole-substituted 9-anilinoacridine derivatives and were screened for in vitro antioxidant activit\y.

isoxazoles exhibiting Antitubercular activities :

Shantaram et al. [9] prepared isoxazole derivatives containing 1,2,4- triazole moiety and screened for antibacterial, antimycobacterial and anticancer activities. 1-(3,5-dipheny-1H-1,2,4-triazole-1-yl) ethanone was treated with different aromatic aldehydes to get substituted chalcones then subsequently cyclized with hydroxylamine hydrochloride to yield 1-[5-(substituted aryl)-1,2-oxazol-3-yl]-3,5- diphenyl-1H-1,2,4-triazoles. Compounds were screened for in vitro antimicrobial activity against b. subtillis, e. coli, c. albicans and a. niger. The enantioselective deacetylation reactions on 5-acetoxy-3-aryl-2-phenylisoxazolidines using candida rugosa lipase reported by Virinder et al. [10] . These compounds exhibit antioxidant and antimycobacterial activities.

Isoxazoles exhibiting Analgesic and anti-inflammatory activities

Lincy *et al.* [11] reported the evaluation of *in vivo* and *in vitro* antiinflammatory activity of novel isoxazole series. Isoxazole derivatives were prepared by the reaction of aromatic aldehydes with aromatic ketones in aqueous alcoholic alkaline medium produced chalcones and then it is treated with hydroxylamine hydrochloride in presence of sodium acetate. The prepared isoxazole compounds were screened for inflammatory activity by *in vitro* and *in vivo* methods. Panda *et al.* [12-13] reported the synthesis, anti-inflammatory and antibacterial activity of novel indolylisoxazoles. In this method, Vilsemeir Haack reaction in which 4-substituted acetophenone in ethanolic potassium hydroxide solution produces chalcones by reacting with indole-3-aldehyde,. These chalcones were immediately reacted with hydroxylamine hydrochloride in presence of glacial acetic acid to obtain the corresponding isoxazole derivatives. These compounds were screened for anti-inflammatory, antibacterial, analgesic, anti-inflammatory activities.. Synthesis of some new diphenylaminoisoxazolines derivatives were reported by Bhusari *et al.* [14] and screened for anti-inflammatory activity. Sahu *et al.* [15] reported the synthesis of substituted aryl-*N*-chalcone aminophenols by base catalysed condensation of an equimolar mixture of *N*-(4-hydroxyphenyl)acetamide and appropriate araldehydes. The newly synthesized compounds were tested for their analgesic and antimicrobial activities. Compound containing 4-chlorophenyl substitution at C-5 of isoxazole ring was found to be the most potent compound of the series. Naphtha-[2,1-*b*]-furopyrazolines, isoxazoles and isoxazolines were reported by Vagdevi *et al.* [16] and evaluated its various biological activity.

Antioxidant isoxazoles

Totally twenty-seven 3,5-substituted-4,5-dihydroisoxazole derivatives including 3-(2-fuorneyl)-5-(substituted phenyl)-4,5-dihydroisoxazole have been synthesized by fly-ash: H2SO4 catalyzed intramolecular cycloaddition of hydroxylamine hydrochloride and aryl chalcones under solvent free conditions by Ganesamoorthy *et al.* [17]. The yields of the isoxazoles are more than 90 %. The antimicrobial and antioxidant activities of the synthesized isoxazoles were evaluated using cup plate and DPPH radical scavenging methods, respectively. Similarly totally thirty-one 3,5-substitutedaryl-4,5-dihydroisoxazole derivatives including 3-(2-naphthyl)-5-(substituted phenyl)-4,5-dihydroisoxazole have been synthesized by fly-ash: H2SO4 catalyzed cyclization of hydroxylamine hydrochloride and aryl chalcones under solvent-free conditions by Thirunarayanan *et al.* [18]. The yields of the isoxazoles are more than 94 %. The antimicrobial, antioxidant and insect antifeedant activities of the synthesized isoxazoles have been evaluated using a cup plate, DPPH radical scavenging and castor leaf disc bioassay of 4th instar larvae Achoea Janata L methods, respectively. Madhavi *et al.* [19] reported the synthesis and evaluation of antioxidant, anti-inflammatory and analgesic activities of a series of 3-methyl-4-nitro-5-(substituted styryl) isoxazoles with a view to evaluating the effect of nitro substitution on styryl isoxazoles. Compounds with sterically hindered phenolic groups exhibited good anti-inflammatory activity.

CNS active isoxazoles

Jagesh et.al. prepared 5-substituted phenyl-3-(thiophen-2-yl)-4,5-dihydro-1,2- oxazoles using appropriate chalcones of 2-acetyl thiophene with hydroxylamine hydrochloride in the presence of dry pyridine. All the compounds were evaluated for their antidepressant and antianxiety activities in mice by forced swimming test and elevated plus maze method, respectively.

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Apparent Molar Volume and Related Parameters of Some Aqueous Potassium Salt of Amino Acids

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Abstract:
In this work, the densities and viscosities of aqueous potassium salt solutions of L-Cysteine, and L-Valine were measured at various temperatures and for their concentrations range (0.01 to 0.15) mol L^{-1} . On the basis of measured experimental density values, the apparent molar volumes (V_ϕ) the partial molar volumes (V^0□), expansion coefficient (E), Hepler's constant ($\partial^2 V^0$□$/\partial T^2$) were determined.
Keywords: L-Valine; CO_2; Density; Apparent molar volume.

1. Introduction

Global warming is the most alarming environmental problem for whole world. It is the concerns for corresponding climate change and its potential impact on humankind. Excess CO_2 (carbon dioxide) emissions from a number of sources, including the combustion of fossil fuels for energy production and other industrial and human activities, is the primary contributor to global warming [1,2].

Thus, the removal of CO_2 from a process gas stream becomes a vital step in various CO_2 producing industries and can be required for operational, economical and/or environmental reasons. CO_2 capture technologies comprise ways to separate CO_2 from flue gas, before the flue gas is released in the atmosphere.

Alkanolamine-based absorbents and their mixtures are widely used in such procedures [3]. Alkanolamines degrades in oxygen-rich environments, producing very hazardous degradation compounds[4]. These demerits of amine-based solvents create limitations for their use in CO_2 removal processes.

Alkali salts of amino acid have been found as attractive alternatives to alkanolamine and various research have proved their interaction with CO_2[5,6]. Amino acids behave similarly to amines and contain the same functional group, which makes them effective CO_2 capture agents. However, there are a number of advantages to using amino acids in this capacity. Though amino acids are more expensive than alkanolamines, they have certain unique advantages like more stability against oxidative degradation[7], negligible volatility, higher surface tension and fast absorption rates[8].

For designing gas–liquid contactors, process modelling, and working of the equipments for a particular absorbent, its physico-chemical properties like density and viscosity are needed[9-12]. These details are also required to predict chemical reaction kinetics from experiments on CO_2 absorption rates[13,14].

For aqueous potassium salt solutions of L-Cysteine and L-Valine, such properties have not yet been reported in the open literature by using this technique and at lower concentrations. Thus, in these work, a new experimental data is presented on density, apparent molar volumes (V_ϕ) the partial molar volumes (V^0_ϕ), expansion coefficient (E^∞) and Hepler's constant ($\partial^2 V^0_\phi / \partial T^2$), of aqueous potassium salt solutions of above mentioned amino acids.

2. Experimental Section:

2.1. Materials and amino acid salt preparation.

The amino acids, L-Cysteine were purchased from Sigma-Aldrich and Loba Chemie Pvt. Ltd. and L-Valine were supplied by S D Fine-Chem Ltd, India. While potassium hydroxide was purchased from Merck. The aqueous salt solutions of amino acid were made by dissolving equimolar amount of KOH and amino acid in triply distilled water[15].

2.2. Density measurements

Density measurements were undertaken by using 15 cc bi-capillary Pycnometer[16,17]. Triply distilled water and pure solvents were used to calibrated Pycnometer. At temperatures 298.15, 303.15, 308.15, and 313.15 K, the measurements were done for amino acid salt concentrations ranging from 0.01 to 0.15 m. All the measurements were performed at atmospheric pressure. For measurements of density of aqueous solutions at various temperatures, transparent glass thermostat was used.

3. Results and discussion

The measured density for aqueous potassium salt of L-Cysteine and L-Valine solutions at concentration range (0.01 to 0.15) m and at temperatures (298.15, 303.15, 308.15, and 313.15) K are presented in Table 1. Densities are observed to increase with concentration and decrease with increasing temperature. From Table 1, Figure 2, Figure 3 it is observed that, density increases with the molality of the solutions whereas decrease with increasing temperature.

Equation 1 was used to determine the apparent molar volumes[18] of K-amino acid solutions from experimental density data.

$$V_\phi = M/\rho - \{(\rho - \rho_0)/(m\rho\rho_0)\} \qquad (1)$$

where ρ_0 and ρ represents density of solvent and the solution while M, m, are the molar mass of the solute and molality of the studied solutions, respectively. From Table 2, Figure 4 and Figure 5 it has been found that the apparent molar volume increases with both temperature and molality of the solution.

Using Equation 2, the calculated V_ϕ is correlated with molal concentration[19].

$$[V_\phi = V^0_\phi + S_V\, m^{0.5}] \qquad (2)$$

where m, S_V and V^0_ϕ are the molality, solute-solute interaction parameter and partial molar volume, respectively.

The values of V_s and V^0_ϕ were calculated using the least square method. Both V^0_ϕ and S_V values are directly proportional to the temperature. This indicates that as temperature goes up, the electrostriction action of water decreases. The partial molar volume is a key indicator that shows the solute-solvent interactions. The positive values of V^0_ϕ indicate strong potassium amino acids -water interactions.

The partial molar volumes of the potassium salt amino acids increase in the order:

V^0_ϕ(Potassium Cysteinate) < V^0_ϕ (Potassium Valinate) at same temperature.

The V^0_ϕ values varies with temperature according to the Equation 3.

$$[V^0_\phi = a_0 + a_1 T + a_2 T^2] \qquad (3)$$

where a_0, a_1 and a_2 are constants. For the calculations of a_0, a_1 and a_2 values, Scilab application was used. Equation 3, on differentiation with respect to temperature gives the partial molar expansion (E^∞).

$$E^\infty = (\partial V^0_\phi / \partial T) = (a_1 + a_2 T) \qquad (4)$$

E^∞ values are positive and increases with respect to temperature. For all of the investigated amino acid salt solutions, the positive values of E^∞ indicates significant solute-solvent interactions.

To get the information regarding structure making/breaking behavior of the solute the Hepler's constant[20] can be helpful which is calculated by the following expression 5.

$$[(\partial^2 V^0_\phi / \partial T^2) = 2a_2\,] \qquad (5)$$

Table 3 show the values of Hepler's constant. All the values of Hepler's constants are positive which is an indication of structure making behavior of solute in solution.

Table 1.

Densities (□□□□kg□m^{-3}) of potassium salt of cysteine and valine at different temperatures.

m (kg.mol^{-1})	ρ (kg.m^{-3})				m (kg.mol^{-1})	ρ (kg.m^{-3})			
	298.15 K	308.15 K	308.15 K	313.15 K		298.15 K	303.15 K	308.15 K	313.15 K
Potassium Cysteinate					Potassium Valinate				
0.01028	997.815	996.416	994.800	992.975	0.01175	997.695	996.294	994.676	992.849
0.03090	999.354	997.953	996.333	994.500	0.02839	998.612	997.207	995.583	993.747
0.05152	1000.885	999.482	997.857	996.016	0.05285	999.951	998.539	996.907	995.058
0.07217	1002.410	1001.005	999.376	997.527	0.07062	1000.918	999.501	997.863	996.005
0.09081	1003.781	1002.374	1000.741	998.885	0.09194	1002.071	1000.649	999.003	997.134
0.10944	1005.145	1003.736	1002.100	1000.236	0.11155	1003.126	1001.699	1000.046	998.167
0.13096	1006.714	1005.303	1003.663	1001.790	0.12812	1004.013	1002.582	1000.923	999.035
0.15248	1008.276	1006.863	1005.219	1003.338	0.15264	1005.319	1003.882	1002.215	1000.314

Table 2.
Apparent molar volume (V_ϕ /m^3·mol^{-1}) of potassium salt of cysteine and valine in water at different temperatures.

m (kg.mol^{-1})	$10^6 \cdot V\phi$ (m^3·mol^{-1})				m (kg.mol^{-1})	$10^6 \cdot V\phi$ (m^3·mol^{-1})			
	298.15 K	308.15 K	308.15 K	313.15 K		298.15 K	303.15 K	308.15 K	313.15 K
Potassium Cysteinate					Potassium Valinate				
0.01028	84.2110	84.3213	84.5322	84.9436	0.01175	99.8990	100.2186	100.6355	101.2371
0.03090	84.3249	84.4355	84.6467	85.0580	0.02839	99.9816	100.2928	100.7222	101.3427
0.05152	84.4001	84.5110	84.7422	85.1540	0.05285	100.0744	100.4047	100.8233	101.4463
0.07217	84.4731	84.5844	84.8103	85.2225	0.07062	100.1257	100.4607	100.8791	101.4968
0.09081	84.5220	84.6357	84.8634	85.2734	0.09194	100.1907	100.5181	100.9454	101.5622
0.10944	84.5725	84.6879	84.9077	85.3257	0.11155	100.2396	100.5664	100.9959	101.6113
0.13096	84.6229	84.7375	84.9551	85.3779	0.12812	100.2793	100.6040	101.0356	101.6547
0.15248	84.6681	84.7821	84.9983	85.4179	0.15264	100.3303	100.6535	101.0817	101.7029

Table 3.
Partial molar volume (V^0_ϕ), solute-solute interaction parameter (S_V), expansion coefficient (E^ω), Hepler's constant ($\partial^2 V^0_\phi / \partial T^2$).

Parameter	298.15 K	308.15 K	308.15 K	313.15 K		298.15 K	303.15 K	308.15 K	313.15 K
	Potassium Cysteinate					Potassium Valinate			
10^6 $V^0\phi$	84.04	84.15	84.37	84.77		99.72	100.04	100.46	101.06
10^6 S_V	1.5889	1.6069	1.6282	1.6641		1.5409	1.5711	1.6087	1.6464
10^6 E^ω	0.0240	0.0338	0.0436	0.0533		0.05192	0.07776	0.10359	0.12943
10^6 $(\partial^2 V^0\phi / \partial T^2)_p$	0.00195					0.00517			

Conclusion

The positive values of V^0_ϕ indicate strong potassium amino acids -water interactions. Positive values of E^∞ suggest the strong solute-solvent interactions. Hepler's constants have positive values which suggest structure making behavior potassium amino acids in solution. As a result, it can be said that potassium salt of cysteine and valine is a water structure maker.

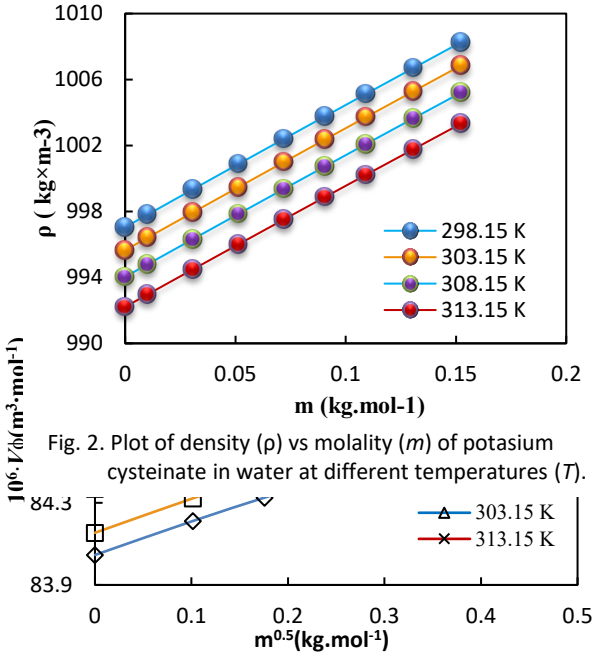


Fig. 2. Plot of density (ρ) vs molality (*m*) of potasium cysteinate in water at different temperatures (*T*).

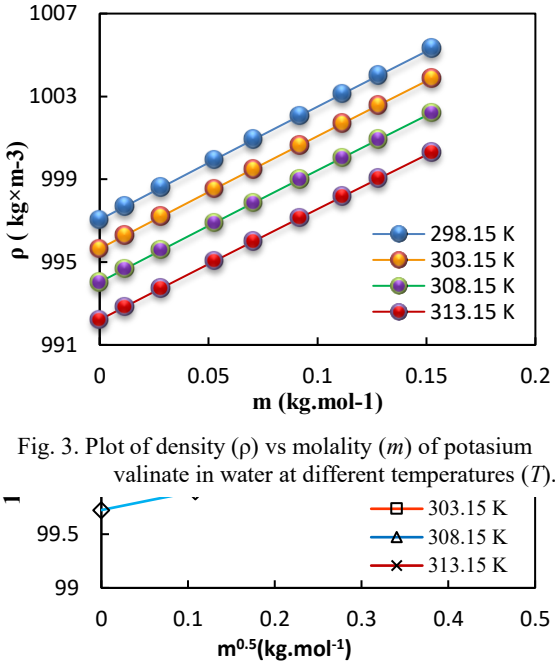


Fig. 3. Plot of density (ρ) vs molality (*m*) of potasium valinate in water at different temperatures (*T*).

Fig. 4. Plot of V_ϕ vs $m^{0.5}$ of potasium cysteinate in water at different temperatures (*T*).

Fig. 5 Plot of V_ϕ vs $m^{0.5}$ of potasium valinate in water at different temperatures (*T*).

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Isocyanates: A Review of Their Chemical Properties, Industrial Uses, And Health Effects

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Abstract:
Isocyanates are a class of highly reactive chemicals widely used in the production of polyurethane foams, coatings, adhesives, and elastomers. Their unique chemical properties make them valuable in various industrial applications, yet they pose significant health risks, particularly in occupational settings. This review explores the chemical structure and reactivity of isocyanates, their industrial uses, and the associated health impacts, including respiratory issues, skin sensitization, and potential carcinogenicity. The paper also examines current regulatory frameworks, exposure limits, and mitigation strategies aimed at reducing occupational hazards and environmental contamination. Understanding the balance between industrial utility and health risks is critical for the safe handling and regulation of isocyanates.
Keywords: Isocyanates, Polyurethane production, Occupational health, Chemical reactivity, Respiratory sensitization, Industrial safety etc.

1. Introduction:

Isocyanates are a group of highly reactive chemicals that play a crucial role in the production of various industrial products, particularly polyurethanes used in foams, coatings, adhesives, and elastomers. Polyurethanes are commonly found in products such as foams, coatings, adhesives, sealants, and elastomers, making isocyanates critical to industries ranging from construction to automotive manufacturing. The two most common types of isocyanates are toluene diisocyanate (TDI) and methylene diphenyl diisocyanate (MDI), both of which are used extensively in polyurethane production. Isocyanates are known for their reactivity with compounds containing active hydrogen atoms, such as alcohols and amines, which facilitate the formation of durable and versatile polyurethane products.

1.1 Scope And Objectives Of The Review:

This review aims to provide a comprehensive analysis of isocyanates, focusing on their chemical properties, industrial uses, and associated health risks. The scope of the review encompasses a detailed examination of the reactivity and behavior of isocyanates in various industrial processes, with a particular emphasis on their role in polyurethane production. Additionally, the review will highlight the diverse applications of isocyanates across multiple industries, from construction to automotive manufacturing, demonstrating their economic importance. By exploring both the beneficial uses and the hazards posed by isocyanates, this review seeks to offer a balanced perspective on their role in modern industrial practices.

2. Chemical Properties Of Isocyanates:

Isocyanates are characterized by the presence of the isocyanate functional group (-N=C=O), which imparts high reactivity, particularly with compounds containing active hydrogen atoms, such as alcohols, amines, and water. This reactivity makes isocyanates essential intermediates in the production of polyurethanes and other polymers, where they facilitate the formation of strong urethane bonds. The reactivity of isocyanates can be influenced by the chemical structure of the compound; for example, aromatic isocyanates like toluene diisocyanate (TDI) tend to be more reactive than their aliphatic counterparts, such as hexamethylene diisocyanate (HDI). This difference in reactivity plays a critical role in determining the specific applications and performance characteristics of the isocyanate compounds.

There are two main types of isocyanates: monoisocyanates, which contain one isocyanate group, and diisocyanates, which contain two. Diisocyanates, such as TDI and methylene diphenyl diisocyanate (MDI), are widely used in the production of polyurethanes due to their ability to create cross-linked polymers with high

durability and versatility. Isocyanates are generally volatile and can be released as vapors during industrial processes, posing inhalation risks. Additionally, isocyanates can react with moisture in the air, leading to the formation of amines and carbon dioxide, which can create foams or cause other unwanted side reactions. Understanding the chemical behavior of isocyanates is crucial for both optimizing industrial processes and managing the health risks associated with exposure.

2.1 Chemical Structure And Reactivity:

Isocyanates are defined by their chemical structure, which features a highly reactive isocyanate functional group (-N=C=O), comprising a nitrogen atom doubly bonded to a carbonyl group. This structure renders isocyanates highly reactive with compounds containing active hydrogen atoms, such as alcohols and amines, facilitating the formation of strong covalent bonds. This reactivity is pivotal in polymer chemistry, enabling the creation of durable polyurethanes through cross-linking, particularly with diisocyanates like toluene diisocyanate (TDI) and methylene diphenyl diisocyanate (MDI). The inherent reactivity of isocyanates also makes them prone to unwanted side reactions, such as hydrolysis with moisture, which can lead to the formation of by-products and impact material properties. Understanding these chemical properties is essential for optimizing their industrial use and managing associated health risks.

2.2 Stability And Degradation:

Isocyanates exhibit varying degrees of stability depending on their chemical structure and environmental conditions. Generally, they are reactive and prone to degradation, particularly when exposed to moisture. In the presence of water, isocyanates undergo hydrolysis, leading to the formation of carbon dioxide and corresponding amines or carbamic acids. This reaction can affect the performance of isocyanate-containing materials by altering their chemical properties and reducing their effectiveness in polymerization processes. Additionally, isocyanates can degrade under UV light or elevated temperatures, which can impact the longevity and stability of polyurethane products. Understanding these stability and degradation characteristics is essential for optimizing the storage, handling, and application of isocyanates, as well as for ensuring the durability and safety of the final products.

3. Industrial Applications Of Isocyanates:

Isocyanates are indispensable in a wide range of industrial applications, primarily due to their critical role in the production of polyurethanes. Polyurethane materials are versatile and can be engineered into rigid and flexible foams, coatings, adhesives, sealants, and elastomers. One of the most significant applications of isocyanates is in the manufacture of polyurethane foams, which are widely used for insulation in buildings, refrigeration systems, and automotive components. Flexible polyurethane foams are commonly found in furniture, bedding, and automotive seating, where their cushioning properties are highly valued. In coatings and adhesives, isocyanates provide durability, chemical resistance, and flexibility, making them essential in industries such as construction, automotive, and aerospace.

3.1 Polyurethane Foams And Elastomers:

Polyurethane foams and elastomers are key applications of isocyanates, leveraging their reactivity to create versatile and durable materials. Polyurethane foams, produced through the reaction of isocyanates with polyols, are widely used for insulation, cushioning, and structural applications due to their lightweight, insulating properties, and adaptability to various densities. Polyurethane elastomers, formed by the reaction of isocyanates with polyols and chain extenders, are prized for their flexibility, abrasion resistance, and resilience, making them ideal for use in seals, gaskets, and industrial components. The ability of isocyanates to form cross-linked networks within these materials imparts their strength and durability, which is crucial for their performance in diverse industrial and consumer applications.

3.2 Coatings And Adhesives:

Isocyanates play a vital role in the formulation of coatings and adhesives due to their ability to create strong, durable bonds and enhance performance characteristics. In coatings, isocyanates are used to cross-link with polyols, forming polyurethane-based finishes that offer superior resistance to abrasion, chemicals, and weathering. These properties make them ideal for protective coatings in automotive, industrial, and architectural applications, where durability and longevity are essential. Similarly, in adhesives, isocyanates contribute to the

formation of robust bonds with various substrates; including metals, plastics, and wood, providing high shear strength and flexibility. Isocyanates are involved in the formulation of specialty chemicals, such as isocyanate-based curing agents for epoxy resins, which are used in high-performance coatings and composites. The broad applicability of isocyanates across different industrial sectors highlights their significance in enhancing material properties and performance, though it also emphasizes the need for stringent safety measures to manage the health risks associated with their use.

4. Health Effects Of Isocyanates:

Isocyanates pose significant health risks primarily due to their high reactivity, which can lead to adverse effects when they come into contact with the human body. The most common health issues associated with isocyanate exposure include respiratory sensitization and asthma. Inhalation of isocyanate vapors or aerosols can trigger allergic reactions in the respiratory system, leading to symptoms such as coughing, wheezing, and shortness of breath. Chronic exposure can result in persistent asthma and other respiratory conditions, which can severely impact an individual's quality of life and ability to work. Direct contact with isocyanate-containing materials or vapors can lead to dermatitis, characterized by redness, itching, and inflammation of the skin. Long-term skin exposure may result in more severe reactions, including chronic eczema. There is also concern about the potential carcinogenicity of isocyanates, as some studies suggest a possible link to cancer, although more research is needed to fully understand these risks.

As such, it is crucial to implement rigorous safety measures and continuous research to better understand and mitigate these risks, ensuring effective protection for workers and reducing potential long-term health effects.

5. Occupational Exposure And Risk Factors:

Occupational exposure to isocyanates is a significant concern in industries where these chemicals are used or manufactured, such as in polyurethane production, automotive repair, construction, and painting. Workers in these environments are at higher risk of exposure due to direct handling of isocyanate-containing materials or inhalation of vapors and aerosols. The risk of health effects, including respiratory sensitization and skin irritation, is heightened in workplaces with inadequate ventilation, insufficient use of personal protective equipment (PPE), and poor adherence to safety protocols.

5.1 Routes Of Exposure:

Isocyanates can enter the body through several routes of exposure, primarily inhalation, skin contact, and, to a lesser extent, ingestion. Inhalation is the most common route, as isocyanate vapors or aerosols can be inhaled during industrial processes such as spraying, mixing, or handling of isocyanate-containing materials. This can lead to respiratory issues, including asthma and other chronic respiratory conditions. Skin contact with isocyanate-containing substances, either through direct handling or accidental spills, can cause dermatitis and sensitization, leading to allergic reactions upon subsequent exposures.

In Case studies of occupational exposure to isocyanates highlight the significant health risks faced by workers in various industries. For example, in the polyurethane manufacturing sector, numerous cases have been reported where workers developed severe respiratory conditions, including occupational asthma and chronic bronchitis, due to prolonged exposure to isocyanate vapors.

6. Regulations And Safety Guidelines:

Regulations and safety guidelines for isocyanates are designed to protect workers and the environment from the associated health risks. Regulatory agencies such as the Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH) have established permissible exposure limits (PELs) and recommended exposure limits (RELs) for various isocyanates to minimize health risks. These guidelines include requirements for proper ventilation, use of personal protective equipment (PPE), and regular monitoring of isocyanate concentrations in the workplace. Additionally, safety data sheets (SDS) must be provided to inform workers about the hazards of isocyanates and the necessary safety precautions. Compliance with these regulations, along with comprehensive training programs and effective safety practices, is essential to reduce exposure and prevent occupational illnesses associated with isocyanates.

6.1 Regulatory Standards (Osha, Niosh, Etc.):

Regulatory standards for isocyanates are set by various agencies to ensure workplace safety and minimize health risks. The Occupational Safety and Health Administration (OSHA) establishes permissible exposure limits (PELs) for isocyanates, such as toluene diisocyanate (TDI) and methylene diphenyl diisocyanate (MDI), which are designed to limit the concentration of these chemicals in the air and reduce the risk of respiratory and skin ailments. The National Institute for Occupational Safety and Health (NIOSH) provides recommended exposure limits (RELs) and emphasizes the need for appropriate protective measures, including personal protective equipment and engineering controls. Additionally, the Environmental Protection Agency (EPA) regulates isocyanates under various environmental laws to manage their impact on public health and the environment. Adherence to these regulatory standards is crucial for mitigating exposure risks and safeguarding workers' health in industries where isocyanates are used.

6.2 Exposure Limits And Monitoring:

Exposure limits and monitoring are critical components of occupational safety practices concerning isocyanates. Regulatory agencies like OSHA and NIOSH set permissible exposure limits (PELs) and recommended exposure limits (RELs) for different isocyanates to ensure that their concentrations in the workplace air do not exceed levels that could pose health risks. Regular monitoring of isocyanate levels is essential for maintaining compliance with these limits and identifying potential overexposure incidents. This involves using specialized air sampling and analytical methods to measure isocyanate concentrations and ensure they remain within safe thresholds. Implementing effective monitoring programs helps in promptly detecting and addressing elevated exposure levels, thereby reducing the risk of adverse health effects and ensuring a safer working environment.

6.3 Mitigation Strategies For Workers' Safety:

Mitigation strategies for workers' safety in environments where isocyanates are used involve a multifaceted approach to reduce exposure and protect health. Key strategies include implementing effective engineering controls, such as proper ventilation systems and enclosed workspaces, to minimize airborne concentrations of isocyanates. Personal protective equipment (PPE), such as respirators, gloves, and protective clothing, should be used to shield workers from direct contact and inhalation of isocyanates. Additionally, regular training and education programs are essential to inform workers about the hazards of isocyanates and the correct use of safety measures. Routine monitoring and maintenance of safety equipment, coupled with adherence to established exposure limits and safety guidelines are crucial for ensuring ongoing protection and preventing health issues related to isocyanate exposure.

7. Environmental Impact Of Isocyanates:

The environmental impact of isocyanates is a concern due to their potential for pollution and adverse effects on ecosystems.

7.1 Environmental Contamination And Persistence:

Environmental contamination and persistence of isocyanates pose significant challenges due to their chemical properties and potential for long-lasting effects. Isocyanates can contaminate air, soil, and water through industrial emissions, spills, and improper disposal. Once released, they can react with moisture in the environment, forming by-products like carbon dioxide and amines that can persist and impact ecosystems. While isocyanates themselves may degrade over time, their by-products can contribute to long-term environmental issues, including soil and water contamination. The persistence of these substances necessitates careful management and remediation strategies to prevent long-term environmental damage and protect ecological and human health.

7.2 Impact On Ecosystems:

Isocyanates can have detrimental impacts on ecosystems when they enter the environment, affecting both terrestrial and aquatic systems. In soil, isocyanates and their by-products can disrupt microbial communities, potentially impairing soil fertility and plant health. In aquatic environments, contamination can harm aquatic life by altering water chemistry and affecting the health of fish and other organisms. The reactive nature of isocyanates means they can form secondary pollutants that may persist and accumulate in ecosystems, leading to long-term ecological damage. Additionally, the toxicity of isocyanates to various species underscores the need for stringent

controls and effective waste management practices to minimize their environmental impact and protect ecosystem health.

8. Emerging Research And Future Directions:

Emerging research on isocyanates is focusing on understanding their long-term health effects, environmental impacts, and developing safer alternatives. Research is advancing in the area of environmental impact, aiming to develop more effective methods for monitoring and reducing isocyanate emissions and contamination. Future directions also include the development of novel, less hazardous materials and processes to replace traditional isocyanates, enhancing both worker safety and environmental protection. Continued research is essential for improving safety standards, mitigating health risks, and addressing the ecological challenges associated with isocyanates.

8.1 Advances In Safer Alternatives:

Advances in safer alternatives to isocyanates are emerging as a crucial area of research to reduce health and environmental risks associated with these chemicals. Innovations include the development of non-isocyanate polyurethane systems that utilize alternative cross-linking agents, such as cyclic carbonates or amines, which offer similar performance characteristics without the hazardous properties of isocyanates. Additionally, researchers are exploring bio-based and environmentally friendly materials that can replace traditional isocyanates in various applications, from coatings to adhesives. These alternatives not only aim to maintain or improve product performance but also focus on minimizing toxicity and reducing environmental impact. The ongoing advancement of these safer alternatives is essential for achieving sustainable industrial practices and enhancing worker and environmental safety.

9. Conclusion:

Isocyanates are critical components in the production of polyurethanes and other industrial materials, offering valuable properties such as durability, flexibility, and chemical resistance. Their extensive use across various industries underscores their importance in modern manufacturing and construction. However, the inherent reactivity of isocyanates also presents significant health risks, including respiratory sensitization, skin irritation, and potential long-term health effects such as asthma and dermatitis. These risks are particularly pronounced in occupational settings where exposure can be high.

The review highlights the necessity for stringent safety measures and regulatory oversight to mitigate these health risks. Effective strategies include proper ventilation, the use of personal protective equipment, and adherence to established safety guidelines. Despite existing regulations, ongoing vigilance and research are essential to address gaps in knowledge and improve workplace safety. As industries continue to rely on isocyanates, advancing safer handling practices and exploring alternatives will be crucial in balancing industrial benefits with the health and safety of workers and the environment.

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Insights into the Acidic and Basic Characteristics of modified Y- Zeolite in a Coupling Reactions

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Abstract:

Various Coupling reactions have been studied by using modified Y-Zeolite (Mg, Ca, Cu, Ni, etc.) heterogeneous catalysts. The structural, morphological and textural properties of catalysts were inspected by various physico-chemical procedures, for example ICP-OES, XRD, CO_2-TPD, NH_3-TPD, H_2-TPR, N_2sorption, Electron Microscopy (SEM, FE-SEM, TEM and HR-TEM), XPS, Raman Spectroscopy, FT-IR spectroscopy, NMR Spectroscopy, CHNS elemental analysis, etc. The study suggested that acidic as well as basic attributes of catalysts in addition to their strength (weak, moderate, moderately-strong, strong) have a vital role in coupling reaction performance and product selectivities. These modified Y-zeolite catalysts were explored for various organic coupling reactions to attain valuable desired products. The used catalysts were further analyzed by different techniques to understand insights into the materials stability and recyclability.

1. Introduction

Zeolites play important role in various types of heterogeneous catalytic conversion processes because of their characteristic topology, thermal stability, adsorption capacity, pore size, etc. NaY zeolite is composed of elements with high percentage of carbon, oxygen, aluminum and silicon and with trace amounts of calcium and sodium. It is commonly use as a good catalyst in petroleum industry. Zeolites with acidic and basic properties can be prepared by modification of NaY-Zeolite by alkaline earth and transition metals. By comparing catalyst acidic and basic characteristics, basic zeolites have so far gained little importance in industrial catalysis. The goal of our research is to prepare different heterogeneous catalysts using NaY Zeolite by utilizing various metals like Mg, Ca, Ni, Cu, etc. All the modified NaY Zeolites having acidity, basicity, pore structure, and metal ion location will be scrutinized for catalysis.

2. Experimental Section

2.1 Preparation of catalysts

Synthesis of alkaline earth metal exchanged NaY. About 2 g of NaY was dispersed in 40 mL of 1 M $MgNO_3$ solution in a 100 mL round bottom flask under continuous stirring and allowed to heat at 80 ^{O}C for 3 h. The resulting suspension was cooled to room temperature, followed by filtration, washed with deionized water and dried at 100 ^{O}C for 12 h. The material was further subjected to calcination at 300 ^{O}C for 4 h to obtain Mg exchanged NaY Zeolite. The above outlined procedure was also adopted for the synthesis of Ca exchanged NaY Zeolite.

Synthesis of Transition metal exchanged NaY catalysts. About 2 g of NaY was dispersed in 40 mL of 1 M Copper Nitrate solution in a 100 mL round bottom flask under continuous stirring and allowed to heat at 80°C for 3 h. The resulting suspension was cooled to room temperature, followed by filtration, washed with deionized water and dried at 100 ^{O}C for 12 h. The material was further subjected to calcination at 300 ^{O}C for 4 h to obtain Cu exchanged NaY Zeolite. The above outlined procedure was also adopted for the synthesis of Ni exchanged NaY.

3. Results and discussion

3.1. Catalyst characterization

3.1.1. X-ray diffraction (XRD). The powder-XRD pattern of the modified NaY zeolite and parent NaY zeolite clearly confirmed the crystalline nature of the pure Y-type zeolite with no impurities (Figure 1). However, the diffraction intensity of the NaY zeolite partly decreased after metal exchange, but the similarity in the diffraction pattern indicates that the NaY zeolite retained its crystalline structure after metal exchange. No characteristic diffraction peaks pertaining to Mg, Ca, Ni and Cu metal were observed, pointing to well dispersed metal nanoparticles on the NaY zeolite support. The XRD results confirmed that the Mg, Ca, Ni and Cu metal nanoparticles were well decorated into the zeolite framework structure.

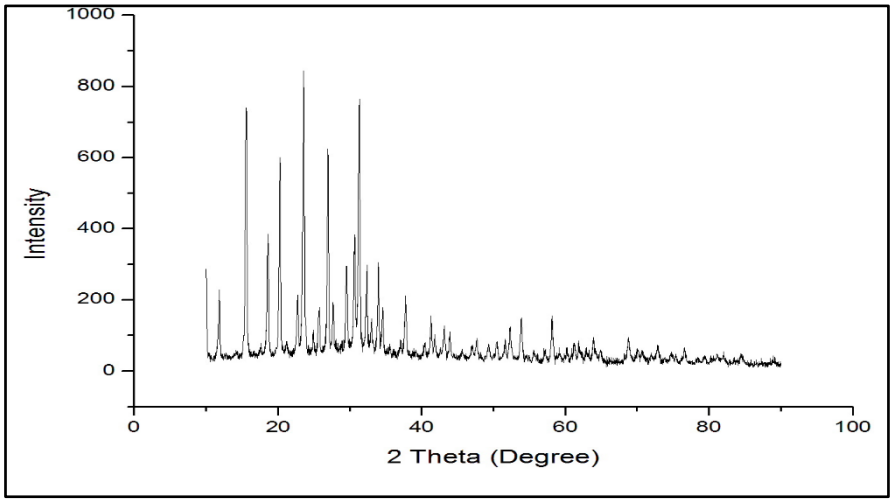


Figure 1. XRD Spectra of NaY Zeolite

3.1.2. FT-IR Spectroscopy

The absorption peak that appeared at 995–1180 cm^{-1} can be correlated with Si–O–Si linkage of the NaY zeolite framework. In addition to this, the sharp absorption peak that appeared in the frequency range of 3390–3696 cm^{-1} was due to the isolated surface hydroxyl (O–H) group present on the support.

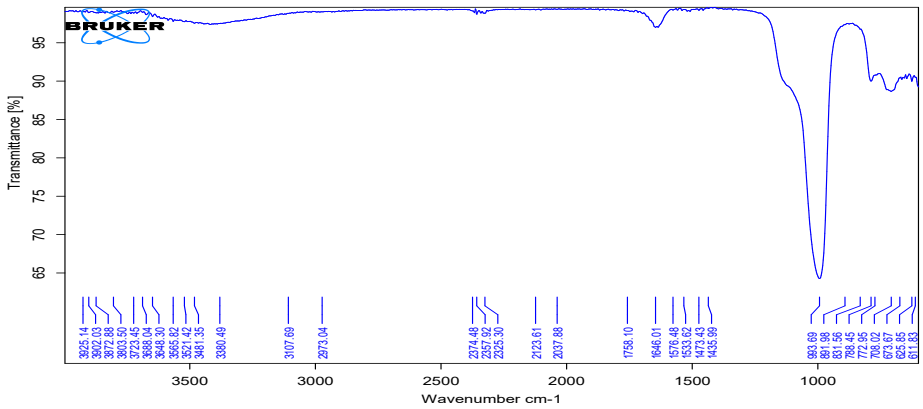


Figure 2. FT-IR Spectra of NaY Zeolite.

4. Applications of Zeolite materials in catalytic processes

Zeolites are commonly used as catalysts for several important reactions involving organic molecules as well as inorganic compounds. The most important are catalytic reactions, cracking, isomerization and also hydrocarbon synthesis. Zeolites can promote a diverse range of catalytic reactions including acid-base and metal induced reactions.

5. Conclusions

Alkaline earth metal as well as transition metals (Mg, Ca, Cu and Ni) exchanged NaY catalysts synthesized via a simple ion exchanged method are found to be excellent catalysts. The Acidic and Basic

characteristic of modified Y-zeolites along with its strength is a deciding factor in catalytic performance and product selectivity in coupling reactions.

Conflicts of interest

There are no conflicts to declare.

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Study of physicochemical parameters of soil samples from Sangrampur region, District Buldhana, Maharashtra

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Abstract :

Physico chemical characteristics of different soils vary in space and time due to variation in topography, climate, physical weathering processes, vegetation cover, microbial activities and several other biotic and abiotic variables. Different factors create different type of soil. The properties of soil along with its type have a great importance in agriculture. A soil physico chemical property deteriorates to the change in land use especially from agriculture and forest. The physicochemical characterization of farmland soil is important to agriculture for plants growth and soil management. The physicochemical studies of ten different soil samples from five sites of the each farmland in the Sangrampur Region of Buldhana district from the different 10 Villages such as Dhamangaon, Marod, Sangrampur, Palshi-Zashi, Nivana, Sawala, Shewaga, Nirod, Karmoda and Lohagaon. In the present study it will be preferred to investigate the soil samples for its physico-chemical analysis of some parameters. Ten representative samples will be collected and analyzed for its physicochemical parameter like pH, electrical conductivity, moisture content, organic carbon, available nitrogen, available phosphorus, available potassium, available calcium carbonate.

Keywords: *Sangrampur region, Soil analysis, Physicochemical parameters*

Introduction

Soil is not only important for agriculture but also have more useful for living organisms. Soil as a component of the terrestrial ecosystem fulfills many function including those that are essential for sustaining plant growth[1]. Soil is the source of the essential nutrients required by the crops. In determining the goodness of the soil, soil nutrient composition plays an important role. Soil analysis is well recognized as a sound scientific tool to assess inherent power of soil to supply plant nutrients. Soil analysis provides information which can be used to improve the fertility through management. Soil analysis is important in organic farming, for nutrient management planning to prevent long-term nutritional and health problems. Any parts of earth surface that support vegetation also bears a covering of soil. Vegetation distribution and development largely depends on the soil condition[2]. It is important to study the physicochemical parameters of soil to know its quality. The crop quality, productivity and environmental quality is dependent on the physicochemical properties of soil hence it is very important to study the physicochemical properties of soil[3]. Nitrogen (N), Potassium (K) and Phosphorus (P) are very essential for plant growth and also for the strengthening of reproductive parts, activation of enzymes and carbohydrate metabolism. Calcium (Ca) and Magnesium (Mg) interferes in soil activity also activate number of plant enzyme systems. The deficiency of any of these elements has retarding effect on the growth of plant[4].

The Nitrogen (N), phosphorus (P), Potassium (K) commonly referred to as NPK. Physicochemical parameters like pH, EC, moisture content, organic carbon, available nitrogen, available phosphorus, available potassium and available calcium carbonate were studied in the present work. Considerable research work has been done regarding the study of nutrients and physico-chemical assessment of various types of soil in Maharashtra as well as in India[5-9] but the investigation of nutrients and parameters of soil of Sangrampur region in Buldhana district in Maharashtra was still lacking.

Materials and Method:-

Collection and Preparation of Soil Samples-

The analyses of soil samples can be used for qualifying the level of soil fertility. For any soil analysis, soil sampling is the most important step. The present study was carried out for 10 villages located in Sangrampur region. Sangrampur region, Buldhana District, Maharashtra, India was selectedas the study site. All the samples

were collected from the 10 different villages located in Sangrampur region such as Dhamangaon, Marod, Sangrampur, Palshi-Zashi, Nivana, Sawala, Lohagaon, Shewaga, Nirod and Karmoda.

Soil sampling will be carried out as per well known procedure. Soil samples were collected randomly taken by digging a V-shaped pit of 10-30cm soil depth from four different sites of a farmland. For each sampling sites, five subsamples from four cornersand one center of a grid by quartering method were used to prepare one composite sample[10]. Thus,the ten representative soil samples were collected from each sites of following the standard procedure and stored in ten different clean polythene bags labeled as BS_1, BS_2, BS_3, BS_4, BS_5, BS_6, BS_7, BS_8, BS_9, BS_{10}. In laboratory, these samples were analyzed for different physicochemical properties of soil like pH, EC, moisture content, organic carbon, available nitrogen, available phosphorus, available potassium and available calcium carbonate by standard methods.

Measurement of pH, electrical conductivity (EC), moisture content, organic carbon, available nitrogen, available phosphorus, available potassium and available calcium carbonate done by using digital pH meter, digital conductivity meter, heating method, titration method, Kelplus Elite EX VA instrument, Equiptronix EQ-822A Spectrophotometer, Flame photometer, titration method respectively.

Results and Discussion

The investigations demonstrated that all the soil samples are black gray in colour. The physicochemical analysis of soils from 10 villages of Sangrampur region, Buldhana District, Maharashtra, India such as Dhamangaon, Marod, Sangrampur, Palshi-Zashi, Nivana, Sawala, Lohagaon, Shewaga, Nirod and Karmoda are as given in the Table 1.

Table 1: Physicochemical analysis of soil samples from Sangrampur region

S.N.	Villages	H	EC	% moisture content	% C	N Kg/ha	P Kg/ha	K Kg/ha	% $CaCO_3$
1	Dhamangaon	6.50	0.63	0.25	0.18	206.4	18.0	40.32	16
2	Marod	9.10	0.72	1.5	0.36	351.7	17.3	66.08	17
3	Sangrampur	7.26	0.52	0.5	0.66	550.8	20.2	45.92	14
4	Palshi-Zashi	7.49	0.35	3.5	0.96	470.4	21.6	60.48	13
5	Nivana	6.10	0.33	4	0.31	115.5	20.9	43.68	12
6	Sawala	6.68	0.30	3	0.79	220.1	24.4	140.0	15
7	Lohagaon	6.50	0.30	2	0.85	330.7	16.3	191.52	12
8	Shewaga	7.22	0.39	2	0.13	270.3	17.3	122.08	12
9	Nirod	7.35	0.28	12.5	0.12	130.5	18.1	128.8	13
10	Karmoda	8.10	0.64	2.5	0.69	550.7	15.9	178.08	19

The value of pH ranges from 6.10 to 9.10 indicating that all the soil samples are alkaline. Electrical conductivity (EC) is used to estimate the concentration of soluble salts in the soil and to measure the salinity at any temperature. The soil with electrical conductivity less than $1dSm^{-1}$ is normal. The EC for all the soilsamples was in the normal approximate range indicated non-saline of soils. The organic carbon content ranges from 0.12-0.96%. In villages samples Nitrogen varies from 115.5-550.8 Kg/ha which is medium to high. Phosphorus ranges from 16.3 to 24.4kg/ha which is slightly low. Use of phosphate fertilizers, manures can be recommended in a suitable amount. Available Potassium in all soil samples found to be high which might be due excess use of potassium fertilizer. Ca content in the studied samples varies from 12-19%. Suitable use of organic manure can be recommended to all the sites.

Acknowledgement

The author is grateful to the Principal, Shri Shivaji College of Arts, Commerce and Science, Akola for providing laboratory facilities. The author is also thankful to Principal, Swatantraya Vir Ganpatrao Ingle College of Agriculture, Jalgaon for providing an opportunity to work in their laboratory.

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Examination of New Bis-isoxazoline and Bis-pyrazoline Nanoparticle

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Abstract: -

In recent years the chemistry of Heterocyclic moiety and related compounds has been attached increasing attention. Physiological and potential chemotherapeutic properties of numerous derivatives have been studied, and possible technical applications, particularly in the field of plastic and resins are embedded in an intensive patent literature. Substituted bis-isoxazoline and bis-pyrazolines are known for their clinical importance. Bis-isoxazoline and Bis-pyrazoline have been synthesized by the condensation of Bis-chalcone with hydroxylamine hydrochloride and phenylhydrazine hydrochloride in alc.KOH medium respectively. Structure of these compounds have been established by chemical properties and spectral analysis.

Keywords :- Bis-chalcone, hydroxylamine, hydrochloride, Phenyl hydrazine hydrochloride, .KOH

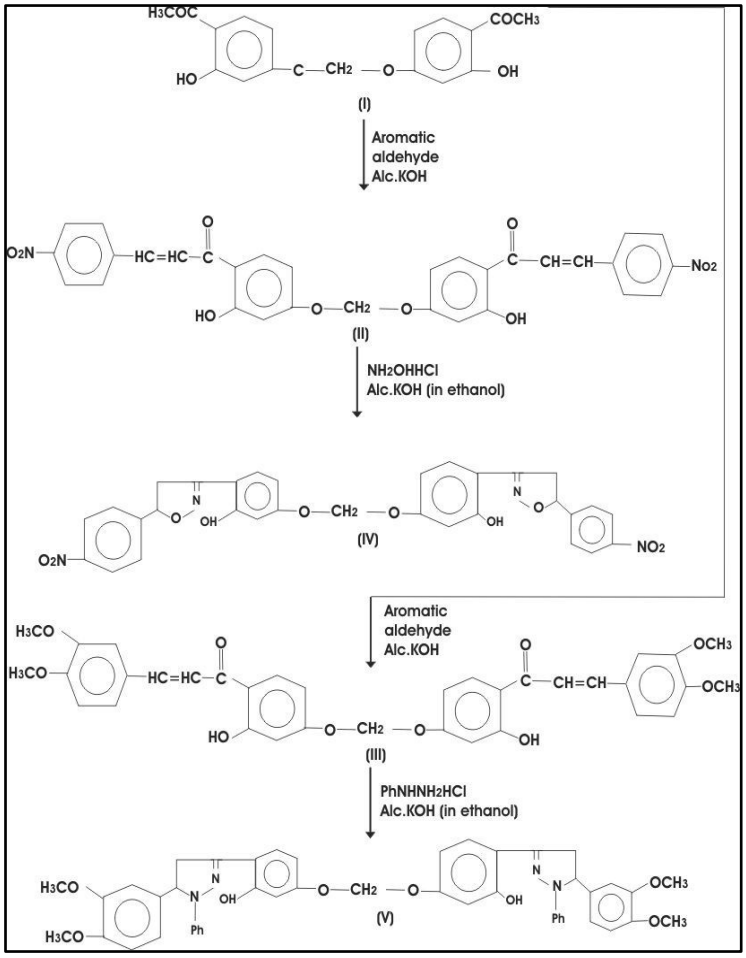
Introduction:

Because of its small scale, nanotechnology encompasses a wide range of scientific disciplines, including energy storage, surface science, organic chemistry, molecular biology, semiconductor physics, microfabrication, and molecular engineering. The related research and applications are just as varied, ranging from novel materials with dimensions on the nanoscale to direct control of matter on the atomic scale, from extensions of traditional device physics to whole new techniques based upon molecular self-assembly. Nanotechnology has the potential to produce a wide range of novel materials and technologies with a variety of uses, including consumer goods, biomaterial energy generation, nanomedicines, and nanoelectronics.The design, stability, selectivityand recyclability of several nanocatalysts produces lower toxicbyproducts and making the reactions more environmentallyfriendly, which is indeed a step towards the green approach ofsyntheses of N-heterocyclic compounds[1] Severalnitrogen containing heterocyclic compounds exhibit manybiological activities like as antibacterial, antiarthritis, antiasth-amatic [2-7]. Nitrogen containing heterocycles also show theirimportant role as ligands, explosives, stabilizers in photography,etc. [8-13]. Other nitrogen containing heterocycles viz. dihydro-pyrimidinones and diazepines show biological and medicinalimportance such as calcium channel blocker, antihypertensiveagents, antitumor compounds [14-19], antibiotics [20,21],

Because the produced compounds' -(OH) group is tightly hydrogen confined, they did not colour when exposed to $FeCl_3$ solution. It is soluble in NaOH yielding yellow hue suggesting the presence of phenolic -(OH) group. The bis-pyrazoline compounds displayed (green) colouration with conc. H2SO4, showing pyrazoline nucleus not possessing –CO-CH=CH-grouping, whereas the bis-isoxazoline compounds displayed yellow colouration with conc. H2SO4.

The methylene dixoxy test was performed by heating bis-isoxazoline and bis- pyrazline compounds with gallic acid and conc. H_2SO_4 when embraled green and blue coloration respectively was observed which indicate the presence of –O –CH_2-O-linkage in the compounds.

Reaction Scheme: -



Chemical Reaction:

I) 1,1-Bis-{3-hydroxy-4-acetyl-oxyphenyl]-methane

II) 1,1{Bis-[3-hydroxy-4-3-(-4□-nitrophenyl)prop-2-ene-1-one]–oxyphenyl}-methane.

III) 1,1{Bis-[3-hydroxy-4-3-(3□-4□-dimethoxyphenyl)prop-2-ene-1-one]–oxyphenyl}- methane.

IV) 1,1{Bis-[3-hydroxy-4(-4-nitrophenyl-isoxazolin-3-yl)-oxyphenyl}methane.

V) 1,1{Bis-[3-hydroxy-4(1-phenyl-5□-(3□-4□-dimethoxy phenyl)-pyrazolin-3-yl] Oxyphenyl} methane.

Experimental :-

I) General Procedure for Preparation of bis-chalcone:

Compound I (0.01 mole) and aldehyde (0.02 mole) disolved in 40 ml of Ethanol. The reaction mixture was warmed up to 50^0C. KOH (0.04 mole) was added to reaction mixture with constant stirring. The reaction mixture waskept overnight. The crude product obtained was decomposed by 50% Ac-OH.

II) Preparation of bis-isoxazoline:

A mixture of bis-chalcone (0.0025 mole) alc(KOH) and NH_2OHHCl (0.005 mole)wasrefluxedin(20ml)in40mlethanolroundbottomflaskforabout5hours. The reaction mixture was poured into water and acidified with HCl. A white crude product obtained was crystallized from dilute ethanol.

III)Preparation of Bis-pyrazoline:

A mixture of bis chalcone (0.0075 mole) and phenyl hydrazine hydrochloride (0.005 mole) was refluxed in alc.KOH(10 ml) in 40 ml ethanol for 4 hours. The reaction mixture was cooled and poured in to water. It was acidified with 50% Acetic acid.

A yellowish crude product obtained was crystallized frome thanol.

Table No.1:Yield and Meltingpoints of prepared compounds.

Sr.No.	Compounds	Yield	M. P.
1	Bisketone	50%	**146^{0}C**
2	Chalcone	60%	**190^{0}C**
3	Isoxazoline	58%	**252^{0}C**
4	**Pyrazoline**	**59%**	**220^{0}C**

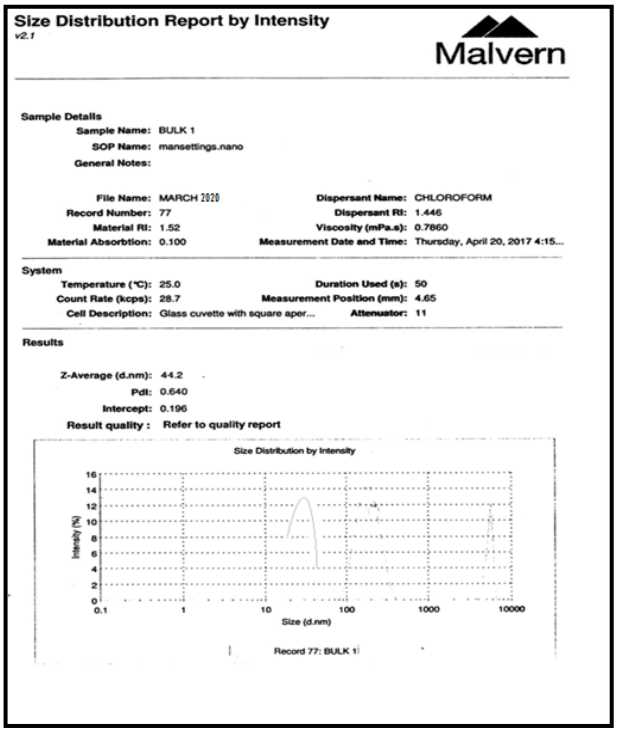
Preparation of Nanoparticles of1,1{Bis-[3-hydroxy-4(1-phenyl-5□-(3□-4□-dimethoxy phenyl)-pyrazolin-3-yl] Oxyphenyl} methane:

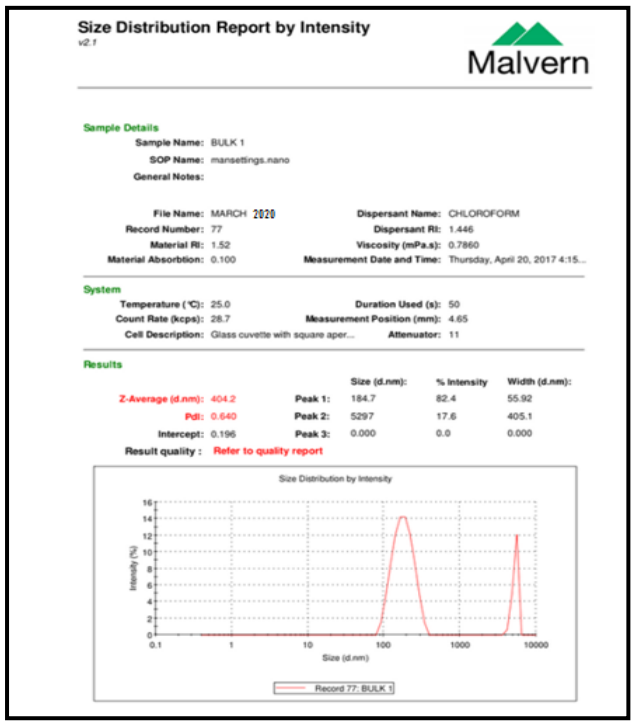
Take about 1 gm of 1,1{Bis-[3-hydroxy-4(1-phenyl-5□-(3□-4□-dimethoxyphenyl)-pyrazolin-3-yl] Oxyphenyl} methaneand dissolve it completely in the 20ml of solvent in a 250 ml beaker and add poly vinyl alchole as a stibilizer 1.5ml . Now put this beaker in a sonicator. The highly penetrating acoustic waves are passed through the mixture, which creates high-pressure bubbles in the beaker due to which breakdown of the bulk material took place and desired sized nanoparticles are formed. The size determination of nanoparticlesis done by the partical size analysizer studies

Characterization of Nanoparticles:

1. Characterization using UV-Spectrophotometer: Single Beam UV-Spectrophotometer with software BI/CI/SP/SB-S-03 of Bio Era make. The UV-Visible Spectroscopy reveals the formation of Nanoparticles Characterization of Nanoparticles was done using a visible Spectrophotometer by using a model by showing different absorption those from bulk material.

2. Size determination 1,1{Bis-[3-hydroxy-4(1-phenyl-5□-(3□-4□-dimethoxy phenyl)-pyrazolin-3-yl] Oxyphenyl} methane): From the X-ray diffraction, it comes to know that size of nano Glucose Penta Acetate is 238.57 nm





Conclusion

Heterocyclic compound nanochemistry is essential to many biological processes, and its N-linked derivatives have a broad spectrum of medicinal applications. A physiologically active molecule's potency is usually enhanced when it is combined with another one. These findings encouraged researchers to combine other N-linked derivatives with different reagents and investigate their biological activity in the hopes of discovering a new, powerful nanomolecule with potential applications in industry and medicine.

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Synthesis and Characterization of 3-aryl-2, 6-diphenylimino-4-*S*-hepta-*O*-benzoyl lactosyl-2, 3-dihydro-1, 3, 5-thiadiazine hydrochloride

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Abstract:

S-hepta-O-benzoyl-lactosyl-1,5-disubstituted-2,4-isodithiobiurets were cyclized by the action of phenyl isocyanodichloride to yield 3-aryl-2,6-diphenylimino-4-S-hepta-O-benzoyl-lactosyl-2,3-dihydro 1,3,5-thiadiazine hydrochlorides. The structure elucidation of above titled compounds is done on the basis of usual chemical transformations and IR, NMR and Mass spectral studies. The exclusive formation of products was also supported by TLC. These newly synthesized thiolactosides are also tested for antibacterial and antifungal activity.
Key words: *Lactosyl isodithiobiurets, phenyl isocyanodichloride, Lactosyl thiadiazines,*

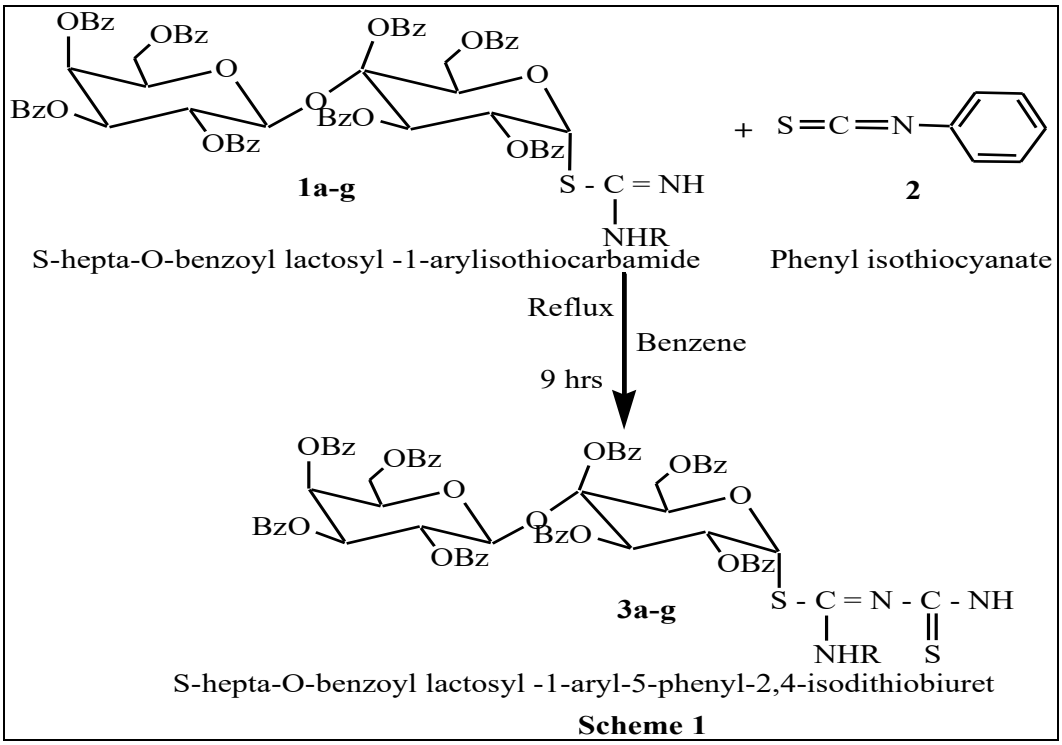
Introduction

Now a days the traditional view of heterocyclic derivatives has expanded. Today heterocycles are known to have wide variety of biological functions. Sulphur containing glycolipids[1], derivatives of imidazole[2], thiadiazines[3-5], triazines[6] have pharmaceutical importance. Some reports showing general routes for preparation of -1,3,5-thiadiazines are found. Such N and S lactosylated derivatives exhibit a wide range of medicinal activities, such as antiviral, antidiabetic, analgesic, antitumor and some other activities[7]. The chemistry of organo-sulphur systems[8-9] prompted us to extend our work into a series of lactosyl-1,3,5-thiadiazine hydrochlorides. The preparation of this heterocyclic ring is mostly achieved by heterocyclisaton of lactosyl-2,4-isodithiobiurets[10]. we report here in the simple method for the synthesis of 1,3,5-thiadiazine by the interaction of *S*-hepta-*O*-benzoyl-lactosyl-1,5-disubstituted-2,4-isodithiobiurets and phenyl isocyanodichloride. The required *S*-hepta-*O*-benzoyl-lactosyl-1,5-disubstituted-2,4-isodithiobiurets have been obtained by the interaction of *S*-hepta-*O*-benzoyl lactosyl-1-arylisothiocarbamides and aryl thiocarbamides.

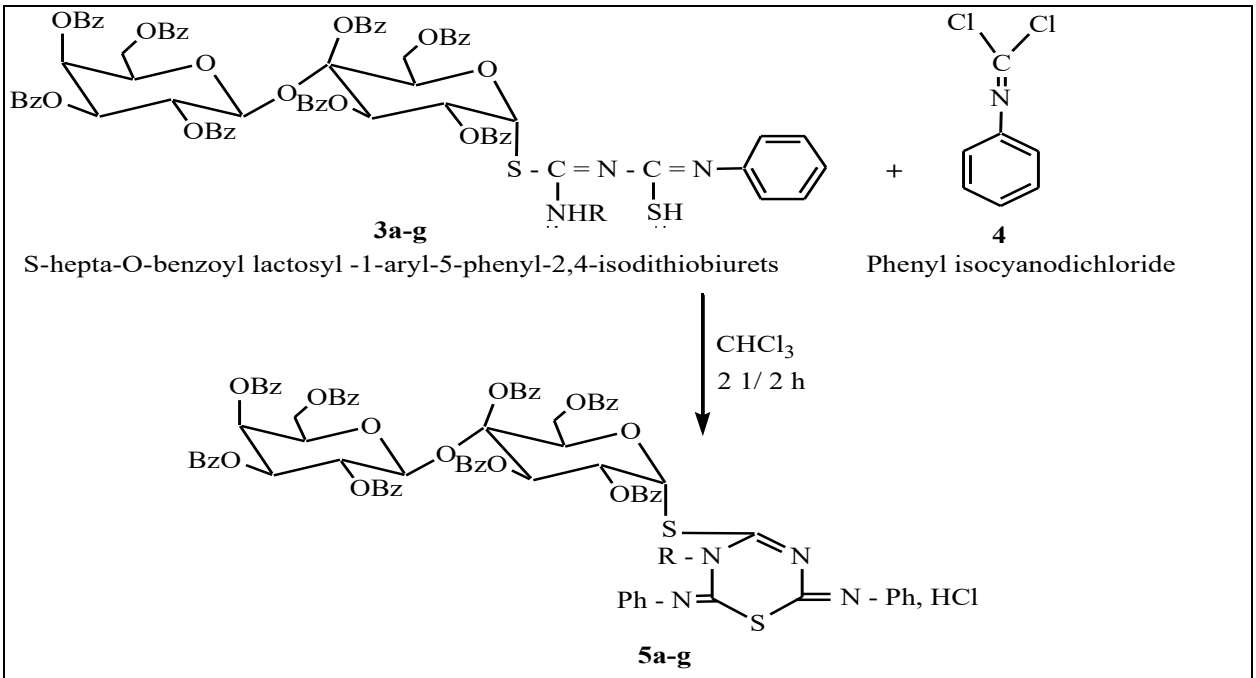
Results and Discussion

Several 3-aryl-2,6-diphenylimino-4-*S*-hepta-*O*-benzoyl lactosyl-2,3-dihydro 1,3,5-thiadiazine hydrochlorides **(5a-g)** have been prepared by the condensation of *S*-hepta-*O*-benzoyl-lactosyl-1,5-disubstituted-2,4-isodithiobiurets (3a-g) and phenyl isocyanodichloride (4) was carried $CHCl_3$ medium, evolution of HCl was noticed. After condensation the solvent was distilled off and the resulting syrupy mass was triturated several times with petroleum ether (60-80^{0}C) to afford a pale yellow solid. The products were purified by ethanol- water.

The structure of the products was confirmed by spectral analysis (IR[11], NMR[12]and Mass[13]). The specific rotation of the products was also recorded[14]. All the compounds have been screened for both antibacterial and antifungal activity.



Scheme 1



Scheme 2

Where, **Bz** = COC_6H_5

R = a) phenyl, b) *o*-Cl-phenyl, c) *m*-Cl-phenyl, d) *p*-Cl-phenyl.e) *o*-tolyl, f) *m*-tolyl, g) *p*-tolyl,

Experimental

All the melting points recorded are found uncorrected. IR Spectra were recorded on Perkin-Elmer spectrum RXI FTIR Spectrometer. ^{1}H NMR was obtained on Bruker DRX-300 NMR Spectrometer. Samples were prepared

in $CDCl_3$ with TMS as an internal reference. The mass spectra were obtained on Thermo Fennigan LCQ Advantage max ion trap mass spectrometer. Optical rotations $[\alpha]_D^{31}$ were measured on the Equip-Tronics EQ-800 Digital Polarimeter at 31 ^{o} c in $CHCl_3$.

General Procedure

Preparation of 1-Aryl thiocarbamide[15]*:*

The required 1-Aryl thiocarbamides were prepared by already known method i.e. by interaction of appropriate aryl amine hydrochloride and ammonium thiocyanate.

Synthesis of S-hepta-O-benzoyl lactosyl -1,5-diphenyl-2,4-isodithiobiuret **(3a) (Scheme1)**

A mixture of *S*-hepta-*O*-benzoyl lactosyl -1-phenyl isothiocarbamide **(1)** (0.0025M, 3.01 g) with phenyl isothiocyanate **(2)** (0.0025M, 0.33 g) in dry benzene. The reaction mixture was refluxed for 9 hrs. The benzene was distilled off. The sticky mass obtained was triturated with petroleum ether (60-80^0) furnished a crystalline solid **(3a)** (3 g). It was purified with ethanol-water, (2.7 gm, 87.53%) m.p 145-147^{0}C **(scheme 1).**

Preparation of phenyl isocyanodichloride[16] **(4)**:

The phenyl isocyanodichloride was prepared by the interaction of phenyl isothiocyanate and excess of chlorine. Details of a typical experiment are as follows –

Through a chloroform solution of phenyl isothiocyanate (7 ml in 15 ml chloroform) chlorine (generated from 10 g $KMnO_4$) and 70 ml conc. HCl was passed maintaining the temperature below 10 ^{o}C. After complete addition of chlorine, the yellow reaction mixture was diluted with (40 ml) dry petroleum ether (60-80°) and filtered to remove suspended impurities. The solvent was then removed by distillation under vaccum. The whole operation was repeated with (40 ml) petroleum ether (60-80°) and finally the petroleum ether solvent was distilled off. Phenyl isocyanodichloride (7 ml) in the form of pale-yellow oil was collected (found: N – 1.95, $C_7H_5NCl_2$, required N- 8.04%).

Synthesis of 3-phenyl-2, 6-diphenylimino-4-S-hepta-O-benzoyl lactosyl-2, 3-dihydro-1, 3, 5-thiadiazine hydrochloride. **(5a) (Scheme 2)**

Condensation of *S*-hepta-*O*-benzoyl lactosyl-1, 5-diphenyl-2, 4-isodithiobiuret **(3a)** (0.002 M, 2.678 g) with phenyl isocyanodichloride **(4)** (0.002M, 0.358 gm) in chloroform (40 ml) was carried out for 3 hr. The evolution of hydrogen chloride was noticed the excess of chloroform was distilled off the viscous residue then obtained was triturated several times with petroleum ether (60-80°C) to afford a pale yellow solid **(5a)**. It was purified with ethanol water. (2.2 g, 79%) m.p 159°C **(Scheme2)**

On extending the reaction of *S*-hepta-*O*-benzoyl-lactosyl-1,5-disubstituted-2,4-isodithiobiurets with phenyl isocyanodichloride several 3-aryl-2,6-diphenylimino-4-*S*-hepta-*O*-benzoyl-lactosyl-2,3-dihydro 1,3,5-thiadiazine hydrochlorides have been isolated **(5b-g) (Table 1).**

Spectral data: -

3a. m.p. 159^{0}C; yield 79%, $[\alpha]_D^{30}$ +113^0 (c,0.156 in $CHCl_3$); IR(KBr): υ 3453 (N-H), 3067.5 (Ar-H stretching), 2970 (ali. C-H), 1729.1 (C=O), 1541.7 (C=N), 1270.4 cm^{-1} (C-O), 708 (C-S), 1026, 858 (Characteristic of lactose) cm^{-1} ; ^{1}H NMR (δ in ppm, $CDCl_3$) : δ 8.09-7.16 (50H,m,7COC_6H_5, 3C_6H_5 protons), 5.78-3.71 (14H,m, lactosyl protons), ;MS(*m/z*):1476.5 (M^+),1477.5 (M^++1),1440 (M^+-HCl),1053 (HBL^+), 948 (HBL^+-COC_6H_5), 932 (HBL^+-COC_6H_5), 579 (TBG^+), 391 (TBG^+-$C_{12}H_{12}O_2$), 335 (TBG-$C_{14}H_{12}O_4$), 105($C_6H_5CO^+$) (Found : C, 66.43; H, 4.18; N, 3.02; S, 4.13% ; Calcd for $C_{82}H_{64}O_{17}N_4S_2$. HCl. requires: C, 66.64; H, 4.33; N, 3.7; S,4.33%).

3b. m.p. 129-130^0 C; yield 72%, $[\alpha]_D^{30}$ + 86^0 (c,0.156 in $CHCl_3$); IR(KBr): υ 3443 (N-H), 3068.0 (Ar-H stretching), 2972.5 (ali.C-H), 1724.3 (C=O), 1484 (C=N), 1272.2 cm^{-1} (C-O), 710 (C-S), 1026, 858 (Characteristic of lactose) cm^{-1} ; ^{1}H NMR (δ in ppm, $CDCl_3$) : δ 8.02-7.17 (50H,m,7COC_6H_5, 2C_6H_5, C_6H_4), 5.78-3.68 (14H,m, lactosyl protons), ;MS(*m/z*):1511 (M^+),1512 (M^++1),1474.5 (M^+-HCl),1053 (HBL^+), 948 (HBL^+-COC_6H_5), 932 (HBL^+-COC_6H_5), 579 (TBG^+), 391 (TBG^+-$C_{12}H_{12}O_2$), 335 (TBG-$C_{14}H_{12}O_4$), 105($C_6H_5CO^+$) (Found : C,65.04; H, 4.08; N, 3.21; S, 4.15% ; Calcd for $C_{82}H_{63}O_{17}N_4S_2Cl$. HCl. requires: C,65.12; H, 4.16; N, 3.70; S,4.23%).

3c. m.p. 134-136^0 C; yield 79%, [α] $^{30}_D$ + 118^0 (c,0.156 in $CHCl_3$); IR(KBr): υ 3452 (N-H), 3068.0 (Ar-H stretching), 2974 (ali.C-H), 1729.6 (C=O), 1494 (C=N), 1272.2 cm^{-1} (C-O), 708 (C-S), 1026, 858 (Characteristic of lactose) cm^{-1} ; ^{1}H NMR (δ in ppm, $CDCl_3$) : δ 8.02-7.17 (50H,m,7COC_6H_5, 2C_6H_5, C_6H_4), 5.78-3.68 (14H,m, lactosyl protons), ;MS(*m/z*):1511 (M^+),1512 (M^++1),1474.5 (M^+-HCl),1053 (HBL^+), 948 (HBL^+-COC_6H_5), 932 (HBL^+-COC_6H_5), 579 (TBG^+), 391 (TBG^+-$C_{12}H_{12}O_2$), 335 (TBG-$C_{14}H_{12}O_4$), 105($C_6H_5CO^+$) (Found : C,65.08; H, 4.13; N, 3.56; S, 4.18% ; Calcd for $C_{82}H_{63}O_{17}N_4S_2Cl$. HCl. requires: C,65.12; H, 4.16; N, 3.70; S,4.23%)

3d. m.p. 146-148^{0}C; yield 71%, [α] $^{30}_D$ +95^0 (c,0.156 in $CHCl_3$); IR(KBr): υ 3449 (N-H), 3067.6 (Ar-H stretching), 2973.3 (ali.C-H), 1728.3 (C=O), 1487 (C=N), 1272.2 cm^{-1} (C-O), 710 (C-S), 1026, 858 (Characteristic of lactose) cm^{-1} ; ^{1}H NMR (δ in ppm, $CDCl_3$) : δ 8.12-7.49 (50H,m,7COC_6H_5, 2C_6H_5, C_6H_4), 5.73-3.84 (14H,m, lactosyl protons), ;MS(*m/z*):1511 (M^+),1512 (M^++1),1474.5 (M^+-HCl),1053 (HBL^+), 948 (HBL^+-COC_6H_5), 932 (HBL^+-COC_6H_5), 579 (TBG^+), 391 (TBG^+-$C_{12}H_{12}O_2$), 335 (TBG-$C_{14}H_{12}O_4$), 105($C_6H_5CO^+$) (Found : C,65.02; H, 4.12; N, 3.43; S, 4.12% ; Calcd for $C_{82}H_{63}O_{17}N_4S_2Cl$. HCl. requires: C, 65.12; H, 4.16; N, 3.70; S,4.23%).

3e. m.p. 114-116^{0}C; yield 68%, [α] $^{30}_D$ +65^0 (c,0.156 in $CHCl_3$) IR(KBr): υ 3469.0 (N-H), 3055.2 (Ar-H stretching), 2948.2 (ali.C-H), 1724.5 (C=O), 1495.5 (C=N), 1274.8 cm^{-1} (C-O), 710.1 (C-S), 1026.2 (Characteristic of lactose) cm^{-1} ; ^{1}H NMR (δ in ppm, $CDCl_3$) : δ 8.08-7.19 (49H,m,7COC_6H_5, 2C_6H_5, C_6H_4), 5.78-3.71 (14H,m, lactosyl protons), 2.26 (3H, s, Ar-CH_3); MS(*m/z*):1511 (M^+),1512 (M^++1),1474.5 (M^+-HCl),1053 (HBL^+), 948 (HBL^+-COC_6H_5), 932 (HBL^+-COC_6H_5), 579 (TBG^+), 391 (TBG^+-$C_{12}H_{12}O_2$), 335 (TBG-$C_{14}H_{12}O_4$), 105($C_6H_5CO^+$) (Found : C,66.52; H, 4.18; N, 3.22; S, 4.03% ; Calcd for $C_{83}H_{66}O_{17}N_4S_2$. HCl. requires: C,66.82; H, 4.42; N, 3.75; S,4.29%).

3f. m.p. 106-108^{0}C; yield 74%, [α] $^{30}_D$ +72^0 (c,0.156 in $CHCl_3$) IR(KBr): υ 3458.3 (N-H), 3043.7 (Ar-H stretching), 2934.6 (ali.C-H), 1722.4(C=O), 1462.5 (C=N), 1272.3 cm^{-1} (C-O), 708.1(C-S), 1026.2 (Characteristic of lactose) cm^{-1} ; ^{1}H NMR (δ in ppm, $CDCl_3$) : δ 8.08-7.19 (49H,m,7COC_6H_5, 2C_6H_5, C_6H_4), 5.78-3.71 (14H,m, lactosyl protons), 2.26 (3H, s, Ar-CH_3) MS(*m/z*):1511 (M^+),1512 (M^++1),1474.5 (M^+-HCl),1053 (HBL^+), 948 (HBL^+-COC_6H_5), 932 (HBL^+-COC_6H_5), 579 (TBG^+), 391 (TBG^+-$C_{12}H_{12}O_2$), 335 (TBG-$C_{14}H_{12}O_4$), 105($C_6H_5CO^+$) (Found : C,66.42; H, 4.19; N, 3.12; S, 4.18% ; Calcd for $C_{83}H_{66}O_{17}N_4S_2$. HCl. requires: C,66.82; H, 4.42; N, 3.75; S,4.29%).

3g. m.p. 138^{0}C; yield 78%, [α] $^{30}_D$ +118^0 (c,0.156 in $CHCl_3$); IR(KBr): υ 3466.5 (N-H), 3066.2 (Ar-H stretching), 2972.2 (ali.C-H), 1728.8 (C=O), 1492.7 (C=N), 1271.8 cm^{-1} (C-O), 710.1 (C-S), 1026.2 (Characteristic of lactose) cm^{-1} ; ^{1}H NMR (δ in ppm, $CDCl_3$) : δ 8.19-7.02 (49H,m,7COC_6H_5, 2C_6H_5, C_6H_4), 5.65-3.40 (14H,m, lactosyl protons), 2.29 (3H, s, Ar-CH_3) ;MS(*m/z*):1490.5 (M^+),1491.5 (M^++1),1454 (M^+-HCl), 1385.5 (M^+-COC6H5), 1369.5 (M^+-COOC6H5), 1355.5(M^+-CH2COOC6H5), 1053 (HBL^+), 948 (HBL^+-COC_6H_5), 932 (HBL^+-COC_6H_5), 579 (TBG^+), 391 (TBG^+-$C_{12}H_{12}O_2$), 335 (TBG-$C_{14}H_{12}O_4$), 105($C_6H_5CO^+$) (Found : C,66.48; H, 4.28; N, 3.22; S, 4.03% ; Calcd for $C_{83}H_{66}O_{17}N_4S_2$. HCl. requires: C, 66.82; H, 4.42; N, 3.75; S,4.29%).
HBL^+ = Hepta-O-benzoyl-β-D-lactosyl, TBG^+ = Tetra-O-benzoyl-β-D-galactosyl.

Table 2. 3-aryl-2,6-diphenylimino-4-S-hepta-O-benzoyl lactosyl-2,3-dihydro-1,3,5-thiadiazine hydrochlorides **(5a-g) Scheme 2**

Reactants-

I) *S*-hepta-*O*-benzoyl lactosyl-1-aryl, 5-phenyl-2, 4-isodithiobiurets **(3a-g) (0.002M)**

II) Phenyl isocyanodichloride **(4) (0.002 M in 15ml $CHCl_3$)**

Product	Melting point ^{0}C	Yield %	Analysis found (requires)		$[\alpha]^D_{28}$(c,0.156, $CHCl_3$)
			N(%)	S(%)	
3a	159 ^{0}C	79	3.02 (3.7)	4.13 (4.33)	+113^0
3b	129-130^{0}C	72	3.21 (3.70)	4.15 (4.23)	+95^0
3c	134-136^{0}C	79	3.56 (3.70)	4.18 (4.23)	+130^0
3d	146-148^{0}C	71	3.43 (3.70)	4.12(4.23)	+105^0
3e	114-116^{0}C	68	3.22 (3.75)	4.03 (4.29)	+118^0
3f	106-108^{0}C	74	3.12 (3.75)	4.18(4.29)	+98^0
3g	138^{0}C	78	3.22 (3.75)	4.03(4.29)	+110^0

Satisfactory C and H analysis were found in all cases.

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Glucose containing 2,4 dithiocarbamide: Synthesis, Characterization and spectral interpretation

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Abstract

Isothiocyanates are important intermediates belonging to the family of compounds known as heterocumulenes. Isothiocyanates are versatile synthetic intermediates in organic chemistry due to their availability and their tendency to undergo nucleophilic addition and cycloadditions[1-3]. Serial of the "1-tetra-O-Benzoyl-β-D-glucosyl-5-aryl 2,4 dithiocarbamide"was prepared by the interaction of the of Tetra-O-Benzoyl-β-D-glucosyl isothiocyanate and Phenyl thiocarbamide in Benzene Medium. The Reaction was refluxed for 3-hours in benzene medium and the benzene is evaporated and then the product is recrystalised by the pertroleum ether (60-80^{0}C). The identities of these new compounds have been established on the basis of usual chemical transformations and IR, 1HNMR and Mass spectral studies.

The polarimetric study of all compounds was carried out. The study of S-and N-glycosides is important in carbohydrate chemistry. Sugar isothiocyanate is good precursors and versatile intermediate for synthesis of S- and N-glycosides. Carbohydrates play an important role in the number of biological events and play an important role in their synthetic strategy as well. Similarly the amino sugars are an important class of glycosidase inhibitors and are arousing great interest as potential therapeutic agents.

***Key words**: Glucosyl isothiocyanate, Phenyl thiocarbamide, 2,4 dithiocarbamide etc.*

Introduction

Isothiocyanates are important intermediates belonging to the family of compounds known as heterocumulenes. Isothiocyanates are versatile synthetic intermediates in organic chemistry due to their availability and their tendency to undergo nucleophilic addition and cycloadditions[1-3].Literature survey reveals that synthesis of amino, diamino derivatives which exhibit biological and pharmaceutical activities such antimalerial effect[4,5]. Acylureas and biurets are noncyclic compounds which upon replacement of one or both oxygen with sulphur results into the formation of thiobiurets and dithiobiurets respectively. Isodithiobiuret derivatives[6-7] shows potent biological activities such as anticonvulsant, hypnotic, analgesic, antifungal, insecticidal activity. Glycosyl thiourea has been widely used as important intermediate in the synthesis of nucleoside anologs Nitroso urea have shown to be alpha-glycosidase inhibitors, possesses antitumor activity. In the last years the intensive use of antibiotic has lead to an increase of the emergence of resistant bacteria.[8]. There is a growing need for new class of antibacterial compounds having different mechanism of action compared to existing drugs.

Materials And Methods

Experimental

Melting points of all synthesized compounds were determined using open capillary tube on Mac digital melting point apparatus and were uncorrected. The reagent grade chemicals were obtained from commercial sources and purified by either distillation or recrystallization before use. IR spectra were recorded in solid phase KBr disks on SHIMADZU IR affinity-1 FTIR spectrometer and 1H NMR spectra in CDCl3 on Bruker DRX-300 of NMR spectrometer 300 MHz. The Mass spectra were recorded on Waters UPLC-TQD Mass Spectrometer. Optical rotations were measured on Equip-Tronics EQ 800 Digital Polarimeter in $CHCl_3$. Purity of synthesized

compounds has been checked by thin layer chromatography. It was performed on E. Merck pre-coated silica gel plates.

General Procedure

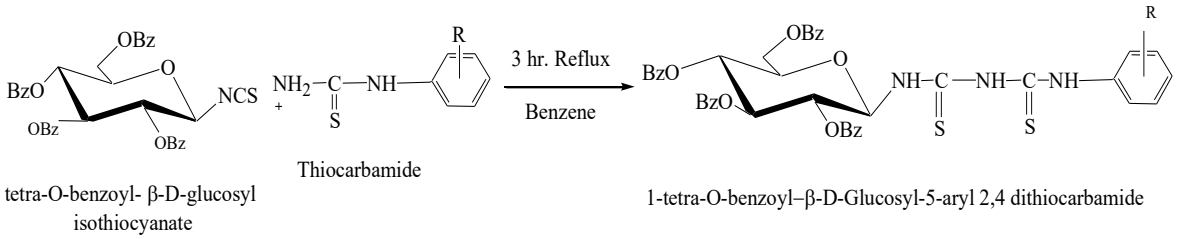


Figure 1: 1-tetra-O-Benzoyl-β-D-glucosyl-5-aryl 2,4 dithiocarbamide

Where, OBz = Benzoyl

R = a) Phenyl b) *o*- Toluidine c) *m*- Toluidine d) *p*- Toluidine

Preparation of 1-tetra-O-Benzoyl-β-D-glucosyl-5- o- Toluidine 2,4 dithiocarbamide

A benzene solution of Tetra-O-Benzoyl-β-D-glucosyl thiocyanate (0.002 M, 1.358g in 10 mL) was added to a benzene solution of *o*- Toluidine thiocarbamide (0.002M, 0.304 g in 10 mL). The reaction mixture was refluxed for 3 hr and monitored by TLC afterwards, solvent was removed under reduced pressure to obtain sticky residue. This was triturated with petroleum ether (60 – 80°C) to afforded a pale yellow solid (80%). The crude product was 1.21 g crystallized by ethanol water m.p. 150°C, Anal. Calcd. For $C_{43}H_{38}O_9N_3S_2$, Required: C, 65.31; H, 4.81; N, 3.54; S, 8.10: Found C, 65.38; H, 4.90; N, 3.60; S,8.18 %

(Scheme-III).

Results And Discussion

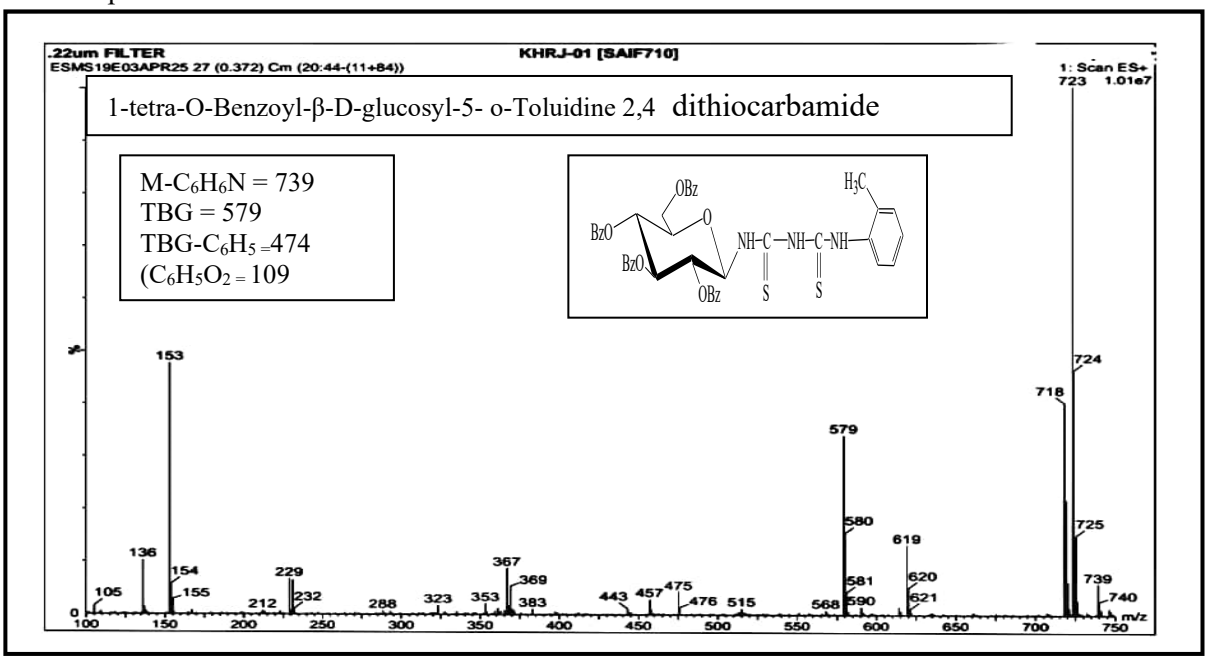
Herein, we report the synthesis of various 1-tetra-O-Benzoyl-β-D-glucosyl-5-aryl 2,4 dithiocarbamide **III (a-d)** have been synthesized by the interaction of Tetra-O-Benzoyl-β-D-glucosyl thiocyanate **(I)** with several aryl thiocarbamide **II(a-d)** in benzene medium. All products were crystallized from ethanol before recording the physical data (Table-1). The purity of compounds was checked by TLC. The spectral analysis[9,11] IR, 1H NMR and Mass spectra of the product were observed. Optical rotation of the product was also recorded **III (a-d) (Scheme-II).**

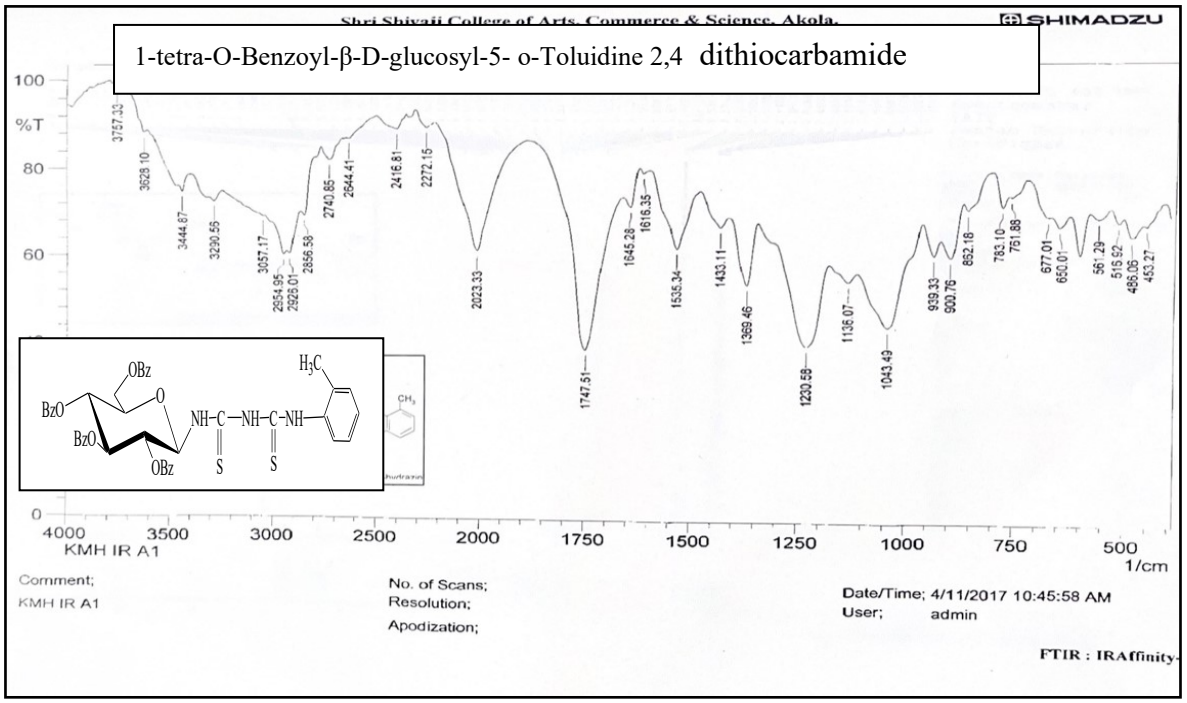
Table 1: **Physical characterization of 1-tetra-O-Benzoyl-β-D-glucosyl-5-aryl 2,4 dithiocarbamide III (a-d) (Scheme III).**

Reactants: i) 1-tetra-O-Benzoyl-β-D-glucosyl-5-aryl 2,4 dithiocarbamide, ii) aryl thiocarbamide

Sr. No	1-tetra-O-Benzoyl-β-D-glucosyl-5-aryl 2,4 dithiocarbamide	Comp.	Yield %	m. p. °C	Elemental analysis Found (Required)		R_f Petroleum ether:EtoAc,7: 3)
					N	S	
1	-Phenyl-	IIIa	80%	150°C	5.01(5.05)	7.68 (7.70)	0.58
2	- o-Toluidine	IIIb	60%	142° C	3.60(3.54)	8.18 (8.10)	0.63
3	- m-Toluidine	IIIc	50%	165°C	3.63(3.54)	8.15 (8.10)	0.55
4	- p-Toluidine	IIId	50%	155°C	3.50(3.54)	8.08 (8.10)	0.68

Spectral interpretation





IIIa) 1-tetra-O-Benzoyl-β-D-glucosyl-5-phenyl 2,4 dithiocarbamide: m.p.: 150ºC; Yield: 80.00%;

IR (KBr, cm-1): υ, 3458 (N-H stretch), 3051 (Ar-H stretch), 2954 (Ali C-H stretch) 1720(C=O), 1645 (C=N), 1230 (C=S),1222 (C-O), 1376.5 (C-O), 1090 (characteristic of glusose), 700 (C-S); **1H NMR ($CDCl_3$, ppm):** δ8.9- 7.18 ppm (m, Ar-H), 6.60 -6.40 (2H, m, NH),

δ 6.22 – 3.69 (m, glucosyl protons); (Anal. Calcd. For $C_{42}H_{35}O_9N_3S_2$, Required: C, 60.64; H, 4.21; N, 5.05; S, 7.70: Found C, 60.62; H, 4.25; N, 5.01; S,7.68 %)

IIIb) 1-tetra-O-Benzoyl-β-D-glucosyl-5- o-Toluidine 2,4 dithiocarbamide: m.p.: 142ºC; Yield: 60.00%;

IR (KBr, cm-1): υ, 3444 (N-H stretch), 3057 (Ar-H stretch), 2968 (Ali C-H stretch) 1747 (C=O), 1650 (C=N), 1136 (C=S),1230 (C-O), 1043 (characteristic of glusose), 783 (C-S); **1H NMR ($CDCl_3$, ppm):** δ8.10- 7.18 ppm (m, Ar-H), 6.70 -6.60 (2H, m, NH), δ 6.22 – 3.69 (m, glucosyl protons); (Anal. Calcd. For $C_{43}H_{38}O_9N_3S_2$, Required: C, 65.31; H, 4.81; N, 3.54; S, 8.10: Found C, 65.38; H, 4.90; N, 3.60; S,8.18 %)

IIIc) 1-tetra-O-Benzoyl-β-D-glucosyl-5- m-Toluidine 2,4 dithiocarbamide: m.p. : 165°C; Yield : 50.00%; (Anal. Calcd. For $C_{43}H_{38}O_9N_3S_2$, Anal. Calcd. For $C_{43}H_{38}O_9N_3S_2$, Required: C, 65.31; H, 4.81; N, 3.54; S, 8.10: Found C, 65.35; H, 4.95; N, 3.63; S,8.15 %)

IIId) 1-tetra-O-Benzoyl-β-D-glucosyl-5-p-Toluidine 2,4 dithiocarbamide: m.p. : 155°C; Yield : 50.00%; (Anal. Calcd. For $C_{43}H_{38}O_9N_3S_2$, Required: C, 65.31; H, 4.81; N, 3.54; S, 8.10: Found C, 65.38; H, 4.90; N, 3.50; S,8.08 %)

Applications:

The synthesized 2,4 dithiocarbamide lead for the development of new drugs due to the presence of sulphur and nitrogen in it. The applicability of synthesized compounds is also supported by the various references quoted in the script.

Conclusion:

In the present work derivatives were synthesized and characterized for their structure elucidation. As outline in synthesis process, important novel 1-tetra-O-Benzoyl-β-D-glucosyl-5-aryl 2,4 dithiocarbamide has been synthesized. All the structure of the above compounds was in good agreement with Spectral and Analytical data. Various chemical and spectral data supported the structures.

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Seasonal Variations of Certain Physico-Chemical Parameters in Mahan Dam Water of Akola, Maharashtra

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Abstract

Dams serve as a crucial source of water for drinking, irrigation, and various domestic purposes. This study investigates the seasonal variations of physico-chemical parameters and assesses salinity intrusion in the Mahan Dam located in Akola district. The primary objectives were to analyze parameters including temperature, pH, transparency, salinity, carbon dioxide, dissolved oxygen, biological oxygen demand, ammonia, hardness, and chemical oxygen demand. The findings indicate that the water quality of the dam has been adversely affected, primarily due to the discharge of waste from residential areas, sewage outlets, solid waste, and detergents. Among the two study sites, sites 1 is found to be marginally polluted. Changes in these parameters could serve as early warning indicators of degradation in this vital ecosystem.

Keywords*: Physico-chemical parameters, salinity, BOD, COD*

Introduction

Water is essential for the survival of all forms of life. Although 80% of the Earth's surface is covered by water, the supply of freshwater has increasingly become a limiting factor due to various reasons[1]. The rapid expansion of industrialization and a growing population are significant contributors to this alarming situation. Additionally, acute shortages of heavy rainfall, poor watershed management, and excessive water use for household and agricultural purposes have led to the overexploitation of surface water sources, particularly from river systems[2-3].

The Mahan dam is also known as Katepurna reservoir situated at Mahan of Barshitakli taluka of Akola district. Its full capacity of 86,350 million litres of water and this reservoir provides water to over 8 lakh citizens of Akola and 64 nearby villages.

Man has changed the nature of rivers by controlling theirfloods, by constructing large impoundments by over exploiting their living and non-living resources but lakes are very important in determining human progress by providing drinking water, generation of foods[4].

The certain physico-chemical parameters such as Temperature, pH, Transparency, Turbidity, Hardness, Salinity,Ammonia, Carbon dioxide, Dissolved oxygen, Biological oxygen demand and Chemical oxygen demand are necessary for the proper understanding of flora and fauna and their abundance and distribution with time. The changes in these parameters provide valuable information on the quality of water, the sources of the variations and their impacts on biodiversity.

Materials and methods

Collection of samples: The samples of lake water were collected at Wai and Wagha sites as study area during each season (2023-24) for assessment of physicochemical parameters.

Location of Sampling Sites of Mahan Dam.



Site-1, Wai



Site-2, Wagha

Results and discussion

The study of physico-chemical parameters of selected two sites of Mahan Dam, Akola district, (site-1) Wai and (site-2) Wagha of three seasons were analysed and compared. The physico- chemical parameters of each sites exhibited variations in each period.

1) **Temperature :** At (sight 1) Wai, in summer, temperature showed a minimum range of 26-28^{0}C and exhibited maximum range of 34-35^{0}C. In winter period, temperature showed a minimum range of 22-23^{0}C and exhibited maximum range of 29-31^{0}C. In monsoon period, the low temperature ranges from27^{0}C-29.5^{0}C and a high range of temperature was observed of 31- 34^{0}C at Wagha (sight 2).
2) **pH :** From the study, in summer and winter season the pH ranged from 5 to 6. A higher level of pH 6 was observed in (sight 1) Wai and lower pH 5 was observed at Wagha (sight 2). In monsoon period pH ranged from 5 to 6. A higher level of pH 6 was observed in (sight 1) Wai and lower pH 5 was observed in at Wagha (sight 2) was slightly acidic.
3) **Turbidity:** Turbidity range showed variations in all the seasons. A higher turbidity value was noticed about 100 cm in site 2 of monsoon season. The lower range was 60 cm. In winter season the turbidity of water ranges from 60-90 cm, turbidity of water in winter season ranges from 80 -100 cm. In summer season the turbidity value ranges from 74 - 98 cm. A high range of transparency observed at (sight 1) Wai.

In Wagha (sight 2), turbidity range showed variations in all the seasons. A higher turbidity value was noticed about 100 cm at Wagha (sight 2) of monsoon season. The lower range was 60 cm. In winter season the turbidity of water ranges from 60-90 cm, turbidity of water in winter season ranges from 80 -100 cm. In summer season the turbidity value ranges from 74 - 98 cm.

4) **Hardness:** Hardness of the water samples in the summer season ranges from 67.5 to 132.5 mg/l. Highest range was observed at Wai (sight 1) (132.5 mg/l) and lowest range was shown in (sight 2) Wagha (67.5 mg/l).

   In winter season maximum hardness showed in Wai (site 1) (37.5 mg/l) and minimum hardness showed at Wagha (sight 2) (25mg/l). In monsoon season, hardness ranges from 15 to 25 mg/l.
5) **Salinity:** Salinity of water sample in the summer season ranges from 767.87 to 1471.73 mg/l. A highest range was obtained in Wagha (sight 2) (1471.73 mg/l) and lowest range was observed in (sight 1) Wai (767.87mg/l). Salinity of water sample in the winter season ranges from 671.89 to 1407.7 mg/l.

   In monsoon season salinity ranges from 48.006 to 64.017 mg/l. Maximum range was observed at Wagha (sight 2) (64.017 mg/l) and minimum range was shown in Wagha (sight 2) (48.006 mg/l).
6) **Ammonia:** Ammonia of water sample in the summer season ranges from25.5 to 42.5 mg/l. Maximum range was observed in site 2(42.5 mg/l) and minimum range was observed in (sight 1) Wai (25.5 mg/l).

   Ammonia of water sample in the winter season ranges from 17 to 42.5 mg/l. A highest range was observed at Wagha (sight 2) (42.5 mg/l) and lowest range was observed in (sight 1) Wai (17 mg/l). In monsoon season ammonia of water sample ranges from 5 to 25.5 mg/l. The maximum range was obtained in (sight 1) Wai (25.5 mg/l) and minimum range was observed at Wagha (sight 2) (5 mg/l).
7) **Carbon dioxide:** Carbon dioxide in water sample in summer season ranges from 26.4 to 35.2 mg/l. The maximum range was observed in (sight 1) Wai (35.2 mg/l) and minimum range was observed in (sight 2) Wagha (26.4 mg/l). Carbon dioxide of water sample winter season ranges from 15.84 to 22 mg/l. Maximum range was observed at Wagha (sight 2) (22 mg/l) In monsoon season, carbon dioxide of water samples ranges from 10.56 to 17.6 mg/l. The maximum range of carbon dioxide obtained in at Wagha (sight 2) (17.6 m g/l) and minimumrange was obtained in Wagha (sight 2) (10.56 mg/l).
8) **Dissolved Oxygen:** Dissolved oxygen of water sample in the summer season is ranges from 5.28 to 6.08 mg/l. The maximum range was obtained in site 2 (6.08 mg/l) and minimum range was obtained in (sight 1) Wai (5.28mg/l).

   Dissolved oxygen of water sample in monsoon season ranges from 5.76 to 6.72/l. Maximum range was observed in site 2 (6.72mg/l) and minimum range was observed in (sight 1) Wai (5.76mg/l). Dissolved oxygen of water samples in winter season is ranges from 5.76 to 6.72 mg/l. The maximum range was showed in site 2 (6.72 mg/l) and minimum range was showed in (sight 1) Wai (5.76 mg/l).

9) Biological Oxygen Demand: Biological Oxygen Demand of water sample in the summer season ranges from 0.32 to 0.64 mg/l. Highest range was observed in Wagha (sight 2) (0.64 mg/l) and minimum range was showed in (sight 1) Wai (0.32 mg/l).

Biological Oxygen Demandof water sample winter season ranges from 0.32 to 0.96 mg/l. A highest range was observed in Wagha (sight 2) (0.96 mg/l) and lowest range was observed in (sight 1) Wai (0.32mg/l). In monsoon season Biological Oxygen Demand ranges from 0.64to 0.96 mg/l. Maximum range was observed in (sight 1) Wai (0.96 mg/l) and minimum range was observed at Wagha (sight 2) (0.64mg/l).

10) Chemical Oxygen Demand: COD of water sample in summer ranges from 13.6-15.5mg/l. Maximum range was observedin site 2(15.5 mg/l) and minimum range was observed in (sight 1) Wai (13.6 mg/l).

In monsoon season COD ranges from 12.5 to 14.2 mg/l. The maximum range was observed at Wagha (sight 2) (14.2 mg/l) and minimum range was observed in (sight 1) Wai (12.5 mg/l). COD of water sample winter season ranges from 13 to 16.5 mg/l. The maximum range was observed in site 2 (16.5 mg/l) and minimum range was observed in (sight 1) Wai (13 mg/l).

TABLE 1- Seasonal variations of physico-chemical parameters in the study sites.

Parameters	Seasons	A (sight 1) Wai	B (sight 2) Wagha	MEAN ± SD
Temperature(^{0}C)	Summer	34.7	30.7	**30.87 ± 2**
	Winter	28	26	**27± 1**
	Monsoon	30.5	29	**29.75± 0.75**
pH	Summer	5	5	**5 ± 0**
	Winter	7	6	**6.5 ± 0.5**
	Monsoon	6	8	**7± 1**
Turbidity (cm)	Summer	88	72	**80± 8**
	Winter	82	74	**77.5± 4**
	Monsoon	98	82	**90± 8**
Hardness (mg/l)	Summer	132.5	67.5	**100± 32.25**
	Winter	122	37.5	**79.75± 42.25**
	Monsoon	120	37.5	**78.75± 41.25**
Salinity (mg/l)	Summer	67.87	64	**65.93± 1.93**
	Winter	57.618	48.618	**56.55± 4.5**
	Monsoon	671.89	658	**665.44± 6.9**
Ammonia (mg/l)	Summer	38	38	**38± 0**
	Winter	25.5	25.5	**25.5± 0**
	Monsoon	17	15	**16± 1**
CO_2 (mg/l)	Summer	35.2	22	**37.3± 6.75**
	Winter	10.56	10.56	**10.56± 0**
	Monsoon	17.6	11	**14.8± 3.3**
Dissolved oxygen (mg/l)	Summer	5.28	5.28	**5.28± 0**
	Winter	6.8	4.8	**5.8± 1**
	Monsoon	6.72	6.4	**6.56± 0.16**
BOD (mg/l)	Summer	0.64	0.32	**0.48± 0.16**
	Winter	0.96	0.32	**0.64± 0.32**
	Monsoon	0.96	0.64	**0.8± 0.16**
COD (mg/l)	Summer	14.6	13.6	**14.1± 0.5**
	Winter	15.5	12.5	**14.0± 1.5**
	Monsoon	**13**	**16.5**	**14.75±1.75**

Conclusion

The result of the studies shows that both the sites exhibited seasonal variations in the physico-chemical parameters. The study indicates that of (site 2) Wagha is safer and (site 1) Wai observed with marginal concern. Moderate to high rate of salinity and hardness was noticed in the study area.

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Nanoparticles Synthesis and Conjugation of Tetra-O- Benzoyl- β -D-Glucosyl Isothiocyanate with Flucytosine (Antifungal Drug)

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Abstract:

The diverse applications of Nanoparticles (NPs) across a range of biological, pharmacological, and medical fields have led to a high level of value in recent years. When seen structurally, they scarcely even approach 100 nm in size. Several drugs, including vaccines, tiny hydrophobic and hydrophilic chemicals, and biological molecules, can be controlled by these for tissue engineering, for targeted medication delivery, and for disease diagnosis, among other things. Chemical reactions based on nanoparticles are beginning to take the place of bulk material-based reactions. Owing to its many benefits, including the capacity to easily introduce multifunctionality, increase chemical activities, photochemical stability, and the conversion of partials into nano dimension, In this work we propose Tetra-o-benzoyl-B-D-glucosyl 3N(5-fluro)-cyatosine have been synthesized for the first time by the interaction of Tetra-O-benzoyl-B-D-glucosyl isothiocyanate and 5-Flurocyanosine All the synthesized compounds were characterized on the basis of elemental analysis and XRD studies. The polarimetric study of the title compounds has been carried out.

Keywords :- 5-Flurocyatosine , TBG isothiocyanate

Introduction :-

Carbohydrates are the most common form of biopolymers in the world, accounting for about 80% of biomass. Their main functions are support for structure and energy storage. It has lately become evident that carbohydrates control several biological functions. [1]. Despite these challenges, carbohydrates remain a fascinating substrate for biomaterial applications due to their biological relevance and tendency.

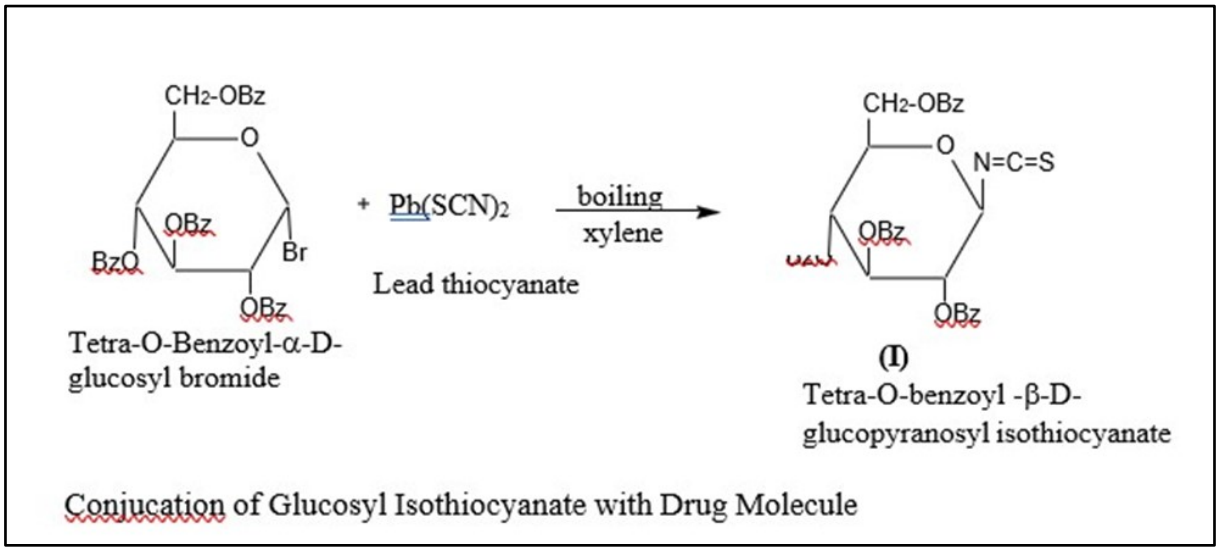
A variety of chemical and physical preparation processes, including photochemical, radiation, chemical precipitation, electrochemical, and Langmuir–Blodgett procedures, are available to create nanoparticles. However, these methods are often highly expensive and ecologically unfriendly since they employ dangerous, combustible, and poisonous substances that might endanger biological systems and the environment. In addition, low production rate, structural distortion of the particles, and inhibition of particle development are drawbacks of this kind of nanoparticle synthesis. Since noble nanoparticles are frequently utilised in areas where people come into touch with them, there is a growing need to develop sustainable techniques of producing nanoparticles without the usage of dangerous organic chemicals. To put the idea of the green chemical process into practice.

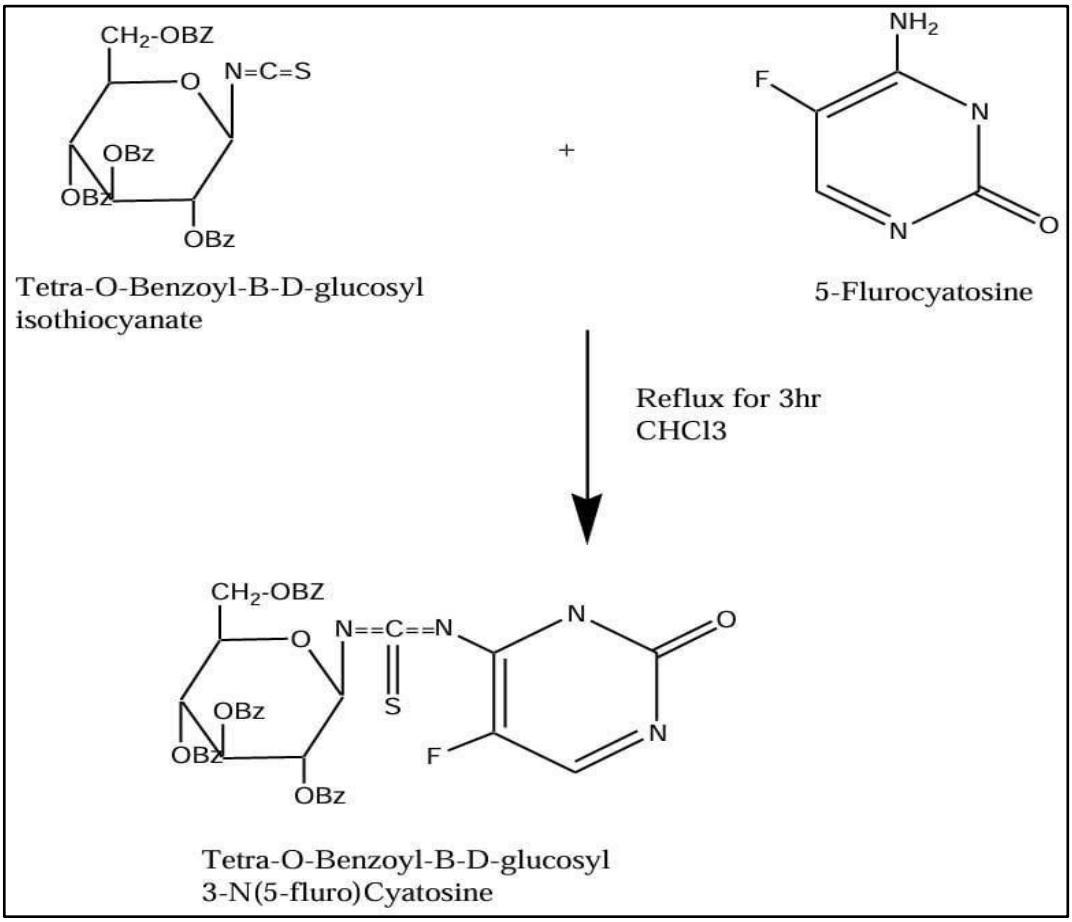
In recent years, nanotechnology is an escalating field of modern research [2] involving in synthesis design, characterization, production, and application of structures, devices, and systems by controlling shape and size at the nanometer scale [3]. Nanotechnology also involves synthesis of nanoparticles of size ranging from 1 to 100 nm [4]. Moreover, there is a new branch of nanotechnology existing, which is bio-nanotechnology that integrates principles of biology with physical and chemical procedures to generate nano-sized particles with specific functions [5]. The bio-based protocols for synthesis of nano-metals are both environmentally and economically green as they are based on green chemistry principles and are simple, relatively inexpensive, and easily scaled up for larger scale production[6]. However, the chemical methods available are often expensive, utilize lethal chemicals, and are comparatively complex. Hence, biosynthesis of nanoparticles using biological agents such as microbes or plant extracts has gained much attention in the area of nanotechnology in last few decades [7].

Each with its own advantages and disadvantages, these modern materials are employed as they are structurally designed to support the healing, absorb excess wound exudate while preventing dehydration of the

wounded area and they can be combined with pharmaceutical agents providing analgesia, and most importantly antibacterial agents preventing infections [8,9,10].

Reaction Scheme





Experimental :

I) Preparation of Tetra-O-Benzoyl-β-D-glucopyranosyl isothiocyanate :

This has been prepared by the interaction of tetra-O-benzoyl-α-D-glucopyranosyl bromide and lead thiocyanate, the former was prepared according to the procedure described earlier. Details of typical experimental are as follows :

a) Preparation of glucose Penta Benzoate :-

In bottle add 30ml Chloroform maintain the temperature up to 0-5^{0}C then slowly add 30ml Pyridine. In bottle no. 2 add 30ml Chloroform and slowly add 15ml Benzoyl Chloride. Shake both the bottles till mix. Maintain the temperature 0-5^{0}C in an ice bath. As temperature attend start addition of glucose. Add slowly i.e pinch wise and shake the bottle after each addition and simultaneously maintain the temperature 0-5^{0}C. Addition of glucose should take 2-3 hrs. After complete addition keep the reaction bottle to deep fridge for 24 hrs. To remove excess of chloroform & unreacted pyridine washing is necessary. Transfer the content of reaction to clean beaker or R. B. Finally separate the layer by separating funnel and keep the solution wrapped with filter paper over night. Triturate with petroleum ether to separate the product.

b) Synthesis of Tetra-O-benzoyl-α-D-glucopyranosyl bromide :

The finely powdered glucose pentabenzoate (21.0g) was added gradually to the brominating reagent. After the addition the flask was kept for 2 hr. at room temperature. The reaction mixture was mixed with chloroform (50 ml) then the mixture was shaken vigorously for about 15 min. The resultant mixture was pour in ice cold water.

The chloroform layer was then separated. It was washed several time with aqueous sodium bicarbonate to removed excess of acetic acid followed by the aqueous sodium meta-bisulphate to remove the excess of bromine and finely 2-3 times with water. To the chloroform layer addition of petroleum ether afforded a solid (15 g). This solid was expected tetra-O-benzoyl-ά-D-glucopyranosyl brominde, it was crystallized from ethanol, m.p. 90°C.

d) Preparation of lead thiocyanate :

Lead thiocyanate was prepared by mixing aqueous solution of lead nitrate and ammonium thiocyanate. The white granular lead cyanate was filtered washed with distilled water and dried at 50°C.

Preparation of Tetra-O-benzoyl-β-D-glucopyranosyl isothiocyanate :

To a suspension of tetra-O-benzoyl-α-D-glucosyl bromide , (21g,0.03M) in sodium dried xylene (80ml) was added lead thiocyanate (6g,0.03M). The reaction mixture was refluxed gently for 3 hrs with frequent shaking. This solution was then cooled and the liberated lead bromide was removed by filtration. The xylene filtrate was then treated with petroleum ether (60-80 c) and stirring, a white solid mass obtained (13g). This solid was expected Tetra-*O*-benzoyl-β-D-glucosyl isothiocyanate. It was purified by dissolving it in minimum quantity of chloroform and reprecipitating to with petroleum ether, m.p. 118- 120˚C.

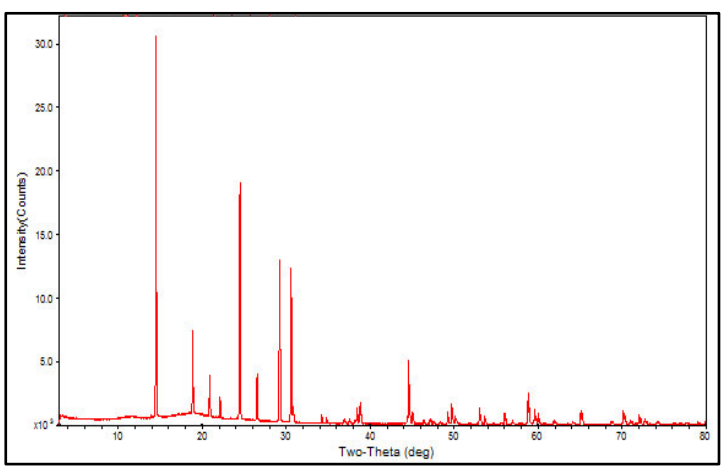
Preparation of Nanoparticles Tetra-O-benzoyl glucosyl -3N-(5-fluro) Cyatosine.

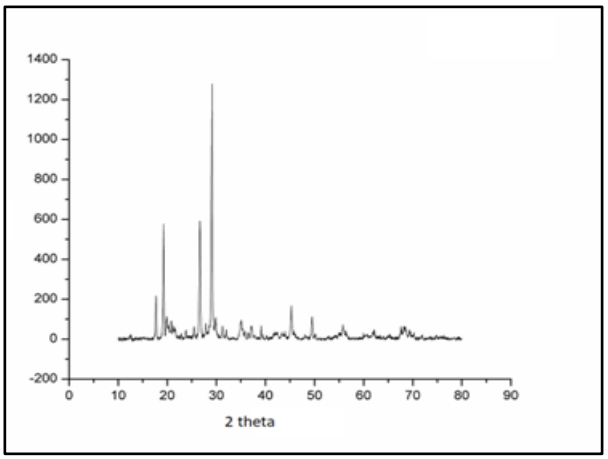
Take about 1 gm of Tetra-O-benzoyl glucosyl -3N-(5-fluro) Cyatosine and dissolve it completely in the 20ml of solvent in a 250 ml beaker and add poly vinyl alchole as a stibilizer 1.5ml . Now put this beaker in a sonicator. The highly penetrating acoustic waves are passed through the mixture, which creates high-pressure bubbles in the beaker due to which breakdown of the bulk material took place and desired sized nanoparticles are formed. Then stirred mixture about 6hr. in magnetic stirrer at room tempeture. The size determination of nanoparticlesis done by the partical size analysizer studies



Characterization of Nanoparticles:

1. Characterization using UV-Spectrophotometer: Single Beam UV-Spectrophotometer with software BI/CI/SP/SB-S-03 of Bio Era make. The UV-Visible Spectroscopy reveals the formation of Nanoparticles Characterization of Nanoparticles was done using a visible Spectrophotometer by using a model by showing different absorption those from bulk material.





XRD Graph of Sample for partial Size

XRD Sample Analysis

The result of X-ray diffraction plots the intensity of the signal for various angles of diffraction at their respective two theta positions. The two theta positions correspond to a certain spacing between the crystals or atoms in the samples, determined by the angle of diffraction from the incident x-ray beam sent into the sample. The intensity of the peaks is related to the number of molecules in that phase or with that spacing. The greater the intensity of the peak, the greater the amount of crystals or molecules with that distinct spacing. The width of the peaks is inversely proportional to the crystal size. A thinner peak corresponds to a bigger crystal. A broader peak means that there may be a smaller crystal, defect in the crystalline structure, or that the sample might be amorphous in nature, a solid lacking perfect crystallinity. For smaller samples, the patterns determined using XRD analysis can be used to determine a sample's composition. There is a large database of elements, compounds, and minerals that contain the diffraction patterns for elements, compounds, and minerals. The pattern for an unknown compound can be compared to the literature and experimentally determined values to verify the identity of an element, matching both the location, width, and relative heights of the diffraction patterns.

The Debye Scherrer equation, $D = K\lambda / \beta Cos\theta$, is used to calculate the crystalline size of the nanoparticles, and the partial size observed is **170nm**

Conclusion

Carbohydrate Nanochemistry is essential to many biological processes, and its N-linked sugar derivatives have a broad spectrum of medicinal uses. A physiologically active molecule's potency is usually enhanced when it is combined with another one. These findings gave rise to the idea that it would be beneficial to combine many N-linked sugar derivatives with different reagents and investigate their biological activity in the hopes of discovering a novel, powerful biomolecule with potential applications in industry and medicine.

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Review study: Cyclization and synthesis of α, β Unsaturated Ketones

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Abstract:

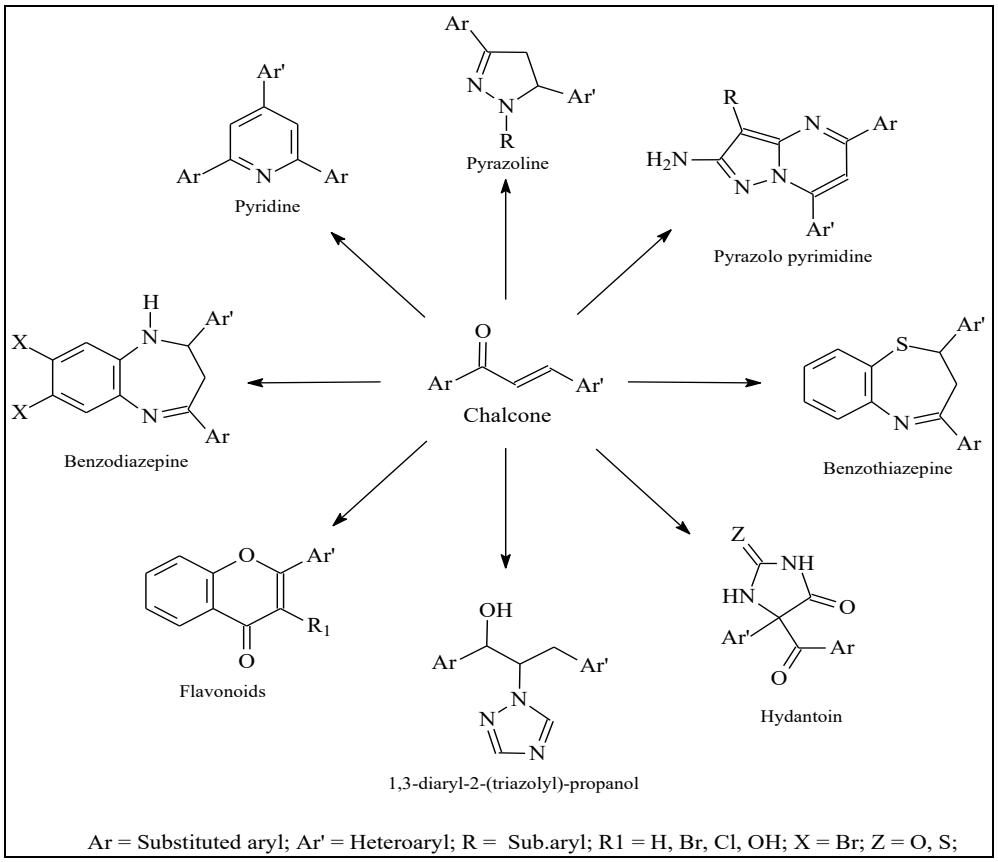
Several heterocyclic compounds bearing Nitrogen, Sulphur and Oxygen has attracted considerable attention from organic and medicinal chemists due to their considerable bioactivity. The heterocyclic compounds like, Chalcones, Pyrazolines, Pyridines, Pyrimidines, Pyrazolo pyrimidines and Benzodiazepines are shows broad spectrum of biological activities. The thiazole ring has been extensively studied and it forms a part of vitamin-B, Penicillin. The flavonoids have been reported to posses wide range of biological activities such antioxidant, anticancer, antihypertensive and enzyme inhibitory activities

Keywords: *Cyclization, Chalcones, Synthesis, Biological activity*

Introduction:

Chalcones constitute an important group of natural products and have been reported to possess varied biological and pharmacological activities. Chalcone represent branch point intermediates in the bio-synthesis of various classes of flavonoids. Chalcones are also used as starting materials in the synthesis of many heterocyclic compounds.These wide biological applications of heterocyclic compound have promoted us to work on synthesis of new heterocycles. In this proposed work, new series of substituted heterocyclic compounds will be prepared from the reaction chalcones with different nitrogen nucleophiles in environmentally benign reaction media to accomplish the desired chemical transformation.The most common synthetic approach towards the synthesis of heterocyclic compounds involves the ring-closure reaction of chalcones with various cyclizing reagents (Scheme-1). The starting chalcones were synthesized by the Claisen-Schmidt condensation method. Furthermore, these compounds are treated with different cyclizing reagents. In view of the current emphasis on green chemistry, our approach to reduces the use of solvents that are volatile organic compounds (VOCs) which are potentially toxic and hazardous. In recent years, polyethylene glycol (PEG-400) prompted reactions have attracted the attention of organic chemists due to their solvating ability and aptitude to act as a phase transfer catalyst, negligible vapor pressure, easy recyclability, ease of work-up, eco-friendly nature and economical cost. PEG is non-toxic, non-halogenated, inexpensive potentially recyclable and water soluble which facilitate its removal from reaction product. Many organic reactions have been carried out using PEGs as solvent or co-solvent. Prompted by the above mentioned biological properties of Nitrogen, Sulphur and Oxygen containing heterocyclic compounds, it was contemplated to investigate the biological activity of all the synthesized compounds. Pyrazolo pyrimidines are integral part of nucleic acid and will be evaluated for their DNA binding study. Finally all the synthesized compounds will be screened for their biological activities such as antibacterial, antifungal, antioxidant and enzyme inhibitory activity

General Reaction Scheme



A.Synthesis of Chalcones

A mixture of substituted acetophenone (1 mMol), substituted carbox- aldehyde (1 mMol) and KOH (2. mMol, with a minimum of H_2O) were added to the PEG-400 (10 –15 ml) and stirred at 50-60^0 C temperature until the reaction was complete. The reaction went to completion within 20-30 minutes determined by TLC. The precipitation of the product from PEG-400 can be facilitated by the addition of ice cold water (100 ml) to the reaction mixture.The products were isolated by acidification of the cool diluted acid solution and to furnish almost pure products or if required recrystallized from aq. acetic acid. All the starting materials were synthesized in laboratory except p-chloroacetophenone. P-Chloroacetophenone was commercially obtained (SD- fine). The various halogenoacetophenones used for synthesis of respective chalcones were synthesized by earlier reported method.[89]The purity of synthesized chalcones was checked by TLC on microscopic slide with silica gel-G layers. The spots were exposed in iodine chamber. Melting points were determined in open-glass capillaries.[1-5]

B. Synthesis of Pyrazolines

A mixture of substituted chalcone (1mMol), 2-hydrazino thiazole (1 mMol) and NaOH (2.5 mMol) in PEG-400 (15ml) was refluxed for 5 hours.After completion of the reaction (TLC), the reaction mixture was cooled and poured in ice cold water (100 ml). The separeted solid was filtered, washed with ice cold water and recrystallized from ethanol.The purity of synthesized thiazolyl-pyrazoline was checked by TLC. Their structures were assigned by elemental analysis and spectral studies (IR, ^{1}H NMR and MS). The M.Ps., yields and elemental analysis [6-10]

C.Synthesis of Pyrazolo-pyrimidine

A mixture of chalcone (1 mmol) and 4-(4'-chloro-phenylazo)-5-amino pyrazole (1 mmol) and NaOH (solid, 2 pallets) was stirred in PEG-400 (15 mL) at 80°C for 3h. The progress of the reaction was monitored by TLC. After completion of reaction the reaction mixture was cooled and poured in ice-cold water (25 mL). The obtained solid product was filtered and washed with 2x5 mL water the crude product was recrystallized from aqueous DMF to afford to the pure product .Melting points were determined by in open capillary method and are uncorrected. The purity of synthesized products was checked by TLC on microscopic slide with silica gel-G

layers. The spots were exposed in iodine chamber. The structures of these products were confirmed on the basis of spectral analysis.[10-15]

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E Synthesis of Flavoniods

To a solution of substituted 2'-hydroxychalcones (1 mMol) in polyethylene glycol (PEG-400) (15 mL), catalytic amount of iodine was added and refluxed under mild condition for 2 hours. After completion of the reaction (TLC), the reaction mixture was cooled at room temperature and poured into ice-cold water (100 mL). The separated solid was filtered, washed by dilute sodium thiosulphate solution (10%), followed by ice cold water. The isolated crude product was recrystallized from acetic acid (Table-5.1). The purity of synthesized products was checked by TLC.[16-19]

F. Synthesis of Benzodiazepines

A mixture of 3-(5-chloro-3-methyl-1-phenyl-1H-Pyrazol-4-yl) (3, 5-dichloro-2-hydroxy phenyl) - prop-2-en-1-one (1 mmol), *o*-phenylenediamine (1.5 mmol), and few drops of piperidine (2-3 mL) in polyethylene glycol (PEG-400) (15 mL) was heated at 80°C for 2 hours. After completion of reaction (TLC), the reaction mixture was cooled and poured in ice cold water (100 mL). The obtained solid product was filtered and washed with 2 x 5 mL water and recrystallized by aqueous acetic acid to give pure product.[20-23]

Conclusion

In this manuscript Review study Cyclization and synthesis of α, β Unsaturated Ketones explain in detail about method of preparation and its post workout method and characterization

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Comprehensive Assessment of Water Quality: Physical And Chemical Parameter Evaluation at Chikhali Tahasil

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Abstract:

This study aims to assess groundwater quality across various region of chikhali tahasil. Physio chemical characteristics of ground water of chikhali tahasil district Buldhana are taken from different location (Gajanan Nagar,Pundlik Nagar,Gandhi Nagar,Mali Pura) in present study. The study is carried out by collecting ground water sample at each sample site. Data is collected based upon the requirement and laboratory analysis of water sample is carried out. Comparison of water quality is done among each areas by certain physical and chemical parameters such as (hardness, pH, alkalinity, chloride content, TDS, residual chlorine, turbidity, etc.). The results obtained are thus compared with the standards for providing better quality of drinking water.

Keywords—Water Quality, Physical Parameters, Chemical Parameters, etc)

Introduction:

Water is essential for all forms of life, and its quality directly impacts public health, agriculture, and ecosystems. Groundwater, which constitutes a significant portion of the world's freshwater supply, serves as a primary source of drinking water for millions of people.[1-3] However, various factors, including industrial activities, agricultural practices, and urbanization, can significantly influence the physical and chemical characteristics of groundwater.[4-5]

This assessment focuses on evaluating the physical and chemical water quality parameters to identify potential contaminants and ensure that groundwater resources are safe for human consumption and ecological sustainability.[6] Physical parameters such as temperature, turbidity, and color can indicate changes in water quality and potential contamination sources. Chemical parameters, including pH, dissolved oxygen, heavy metals, and nutrients, provide critical insights into the water's health and suitability for various uses.[7-9]

Understanding these parameters is essential for developing effective management strategies, safeguarding public health, and protecting the environment.[10] This study aims to provide a comprehensive overview of groundwater quality across selected regions, identifying trends, potential risks, and areas needing intervention. Through rigorous analysis and community engagement, we hope to contribute valuable information to policymakers and stakeholders involved in water resource management.[11]

Objective:

1. **Evaluate Groundwater Quality**: To assess the physical and chemical characteristics of groundwater in various regions, determining its overall quality and suitability for human consumption and agricultural use.
2. **Identify Contaminants**: To identify and quantify specific contaminants, such as heavy metals, nitrates, and microbial pathogens, that may pose risks to public health and the environment.
3. **Analyze Variability**: To examine seasonal and spatial variations in water quality parameters, understanding how factors such as land use, climate, and geological features affect groundwater quality.
4. **Compare Against Standards**: To compare the obtained water quality data with established regulatory standards (e.g., EPA, WHO) to identify areas that require remediation or management interventions.
5. **Investigate Relationships**: To explore the relationships between physical parameters (e.g., turbidity, temperature) and chemical parameters (e.g., pH, dissolved oxygen) to better understand the dynamics affecting groundwater quality.

Test: **- pH**
Source of Water Supply:-Tube Well

Table 1: pH Value

Sr.No.	Location	pH Value
1	Gajanan Nagar	8.55
2	Pundlik Nagar	7.90
3	Gandhi Nagar	7.60
4	Mali Pura	8.35

Test: - **Turbidity**
Source of Water Supply:-Tube Well

Table 2: Turbidity Value

Sr. No.	Location	Turbidity (NTU)
1	Gajanan Nagar	3
2	Pundlik Nagar	2
3	Gandhi Nagar	4
4	Mali Pura	5

Test: - **Hardness (mg/l)**
Source of Water Supply:-**Tube Well**

Table 3: Hardness (mg/l)

Sr. No.	Location	Hardness (mg/l)
1	Gajanan Nagar	385
2	Pundlik Nagar	365
3	Gandhi Nagar	295
4	Mali Pura	410

Test**: - Residue Chlorine (mg/l)**
Source of Water Supply:-**Tube Well**

Table 4: Residual Chlorine value

Sr. No.	Location	Residue Chlorine (mg/L)
1	Gajanan Nagar	6.35
2	Pundlik Nagar	5.45
3	Gandhi Nagar	6.15
4	Mali Pura	4.5

Test: - **Total Dissolved solids (TDS) (mg/L)**
Source of Water Supply:-Tube Well

Table No. 5 Total Dissolved Solids Value (mg/L)

Sr. No.	Location	TDS
1	Gajanan Nagar	500
2	Pundlik Nagar	750
3	Gandhi Nagar	825
4	Mali Pura	950

Test: - **Alkalinity**
Source of Water Supply:-Tube Well

Table No.6 Alkanity value (mg/L)

Sr. No.	Location	Alkalinity
1	Gajanan Nagar	350
2	Pundlik Nagar	450
3	Gandhi Nagar	280
4	Mali Pura	410

Test: - **Fluoride**
Source of Water Supply:-Tube Well

Table No.7 **Fluoride value (mg/L)**

Sr. No.	Location	Fluoride
1	Gajanan Nagar	0.9
2	Pundlik Nagar	1.38
3	Gandhi Nagar	1.85
4	Mali Pura	1

Data Analysis

Comparative analysis of data which is obtained from the various areas has been done.

Table No.8 Combined data analysis,

Parameters	Gajanan Nagar	Pundlik Nagar	Gandhi Nagar	Mali Pura
pH	8.55	7.90	7.60	8.35
Turbidity	3	2	4	5
Hardness	385	365	295	410
Residual Chlorine	6.35	5.45	6.15	4.5
TDS	500	750	825	950
Alkalinity	350	450	280	410
Fluoride	0.9	1.38	1.85	1

Table No. 09 Standard Tabular Format

Sr. No.	Parameters	Desirable limits mg/l	Permissible limits mg/l
1	**pH**	6.5-8.5	No
2	**Turbidity**	5	10
3	**Hardness**	300	600
4	**Residual Chlorine**	0.2	-
5	**TDS**	500	2000
6	**Alkalinity**	200	600
7	**Fluoride**	0.6	1.2

Conclusion:

On the basis of above analysis, following suggestion & recommendations have been provided:

1. pH value was found to be in the range 6.5-8.5 in all the selected areas of work, hence it was suggested that the water can be directly used for drinking purpose.
2. The turbidity value was also much in the range as suggested by the BIS; hence the water was clear in all the areas.
3. Hardness value was found to be more in Malipura area as compared to the others, hence it is mostly seen that the areas are installed with the RO system in the houses.
4. Residual chlorine is higher in all areas as compare to standard tabular format.
5. It was also seen that no water treatment plant is installed in the nearby areas of chikhali tahasil, hence suggestion were given to installed the water treatment plant in the nearby areas.
6. Total dissolved solid indicate the salinity behavior of ground water. Water collected from Malipura show the more TDS.
7. Alkalinity and fluoride content is found to be moderate level.

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Isolation and Extraction of Platform Chemical as Syringic Acid from *Dichanthium Annulatum* (Forssk.) Plant and Synthesis of Ester and Amide Derivatives

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Abstract:

Syringic Acid has been shown to have biological activities such as antimicrobial, antioxidant, anti-inflammatory, antithrombogenic and anticancer properties. Moreover, it decreases liver and serum cholesterol, increases sperm viability, and all of these advantages are advantageous for coronary heart disease. Apart from this, it exhibits great commercial potential in the food, health and cosmetic industries. Because Syringic Acid is absorbed and metabolized by the human body, it has additional advantages. Thus, it is thought to devised a plan to extract and isolate syringic Acid from Dichanthium Annulatum (Forssk.) based on the aforementioned features. Based on the properties of this, strategies to isolate the syringic acid and synthesis of their analogues like ester and amide. Which were characterized by ^{1}HNMR and GCMS.

Keywords: *Syringic Acid, Dichanthium Annulatum, Isolation, Platform Chemical*

1. Introduction:

One of the most widespread grasses is *Dichanthium annulatum* (Forssk.), which is found in China, India, Southeast Asia, North Africa, Australia, Fiji, New Guinea, Cuba, Haiti, and Puerto Rico. This drought-tolerant grass is an excellent forage for mixed pastures. Its apomictic nature makes it more difficult to develop higher-quality variations that can withstand abiotic stresses. The most likely breeding techniques for producing novel cultivars seem to be germplasm collection, characterization, genetic diversity analysis, core subset formation, and selection for desired traits [1].

Chemical Compounds: This grass contains compounds such as 4-ketopinoresinol, *P*-coumaric acid, isoorientin, tricin, salcolin A and B, syringic acid and stigmasterol. A methodical categorization of *Dichanthium Annulatum* (Forssk.) [2].

A wide range of plants, shrubs, grasses and herbs can provide syringic acid. The chemical name of this naturally occurring phenolic organic molecule is 4-hydroxy-3,5-dimethoxybenzoic acid, also known as *o*-methylated trihydroxy benzoic acid, and it is denoted by the symbol SA. It has one benzene ring with one carboxyl (-COOH), one hydroxyl (-OH), and two methoxy (-OCH_3) groups [3].

A radical scavenger activity is subsequently influenced by hydroxyl groups. Syringic acid and other *m*-methoxysubstituted phenolic chemicals are examples of plant-derived aromatics that can be advantageous or disadvantageous to the biotechnology, fuel, and chemical industries . The phenylpropanoids guaiacyl (coniferyl alcohol) and syringyl (sinapyl alcohol) are the source of *m*-methoxylated aromatics, which polymerize into lignin during the formation of secondary cell walls. These smelly substances are frequently present in products derived from deconstructed biomass. These methoxylated aromatics can cause toxicity and stress responses in non-aromatic-degrading bacteria, which can inhibit microbial growth and the quantity of biofuel produced during fermentation, even though they are present in sugar-rich lignocellulosic hydrolysates at low concentrations [4].

Plant metabolites often contain syringic acid, a naturally occurring phenolic compound and dimethoxybenzene. Syringic acid is found in many plants, including *Ardisia elliptica* and *Schumananthus dichotomus*. Its biosynthesis occurs in plants through the shikimic acid pathway. Syringic acid is found in a number of fruits, including olives, dates, grapes, acai palms, honey, red wine and pumpkin. Its presence in the ancient Egyptian drink shade may attest to its grape-based composition, since the breakdown of the component malvidin [5].

Cereals with a high SA content include oats, maize, barley, rice, wheat, rye, and sorghum. SA is essential to the interaction between oil palm and *Ganoderma boninense*, the causative agent of oil palm basal stem root

disease. The phenolic content of infected plants was found to be lower than that of healthy plants, according to an analysis of phenolic content in oil palm roots from both infected and healthy *G. boninense* plants. It demonstrated that SA and other phenolic compounds affect oil palm resistance to *Ganoderma.* SA, a metabolite of *Tamarixaucheriana*, has shown several applications in human colon cancer cells, including anticancer and anti-mitogenic qualities [6].

2. Extraction and Isolation Protocol for Syringic Acid (SA)

The leaf flesh was ground to a fine powder (2 kg) and extracted in a Soxhlet extractor for 20 hours using 1000 ml of methanol. After the extract was dried at a Rotavapour under low pressure to produce a viscous mass (25 g), it was suspended in 500 ml of distilled water and extracted using 250 ml of hexane and 250 ml of ethyl acetate in a separatory funnel. The solvent was evaporated in a rotavapour at a lower pressure, yielding 15 milliliters of hexane and 15 milliliters of ethylacetate extracts [7].

The ethyl acetate extract (15 ml) shows chromatographed on a Sephadex LH-20 column eluting with methanol. Overall, five major fractions were together after monitoring by TLC for the presence of syringic acid (Rf 0.41) in solvent systems, toluene-ethylacetate-formic acid (5:5:1). The fraction F-4 (200 mg) covering syringic acid was further purified by preparatory thin layer chromatography in the solvent system toluene-ethylacetate-formic acid (10:10:1). An amount of 25 mg of sample F-4 was loaded on the home made preparative thin layer chromatographic plate (Silica gel GF254, 20 x 20 cm, 1 mm thickness). The band conforming to syringic acid was scratched off. Silica gel was washed with methanol and the solvent was evaporated to get white crystals of syringic acid (40 mg). It was finally purified and washed with hot water [8].

3. Synthesis of analogues

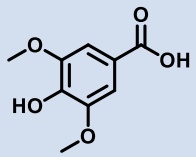
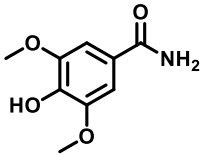
3.1 Amide analogue preparation:

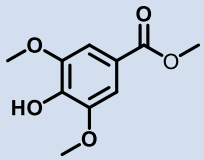
In a dry porcelain dish, syringic acid was reacted with $PC1_5$ (1:5) solid, and it was then ground in a fume hood using a Morton pestle until it liquefied. Crude acid chloride was the liquid that was thus produced. Conc. NH_4OH was then used to treat acid chloride. There appeared to be a strong response. After cooling, the product was filtered and given a water wash. This product underwent additional recrystallization using aqueous methanol, yielding the compound 4-hydroxy-3,5-dimethoxybenzamide (M.P. 221 °C) [9].

3.2 Ester analogue preparation:

For six to eight hours, syringic acid was refluxed with methanol (1:1) in the presence of H_2SO_4. The resulting mixture. the product methyl 4-hydroxy-3,5-methoxybenzoate B. P.305-307 °C, Yield: 74 %) was obtained by distilling the water-washed product [10].

Table No. 1

Sr. No	Structure of Compound	Confirmational analysis by ^{1}HNMR and GCMS
1	 Syringic acid	**^{1}HNMR (δ ppm):** carboxylic -OH proton at 12.72 ppm, 8.70 at phenolic -OH, Ar-H protons at 7.10 ppm and CH_3 protons at 3.80 ppm **GCMS (m/z):** 198.05 cal., Found 198.01
2	 4-hydroxy-3,5-dimethoxybenzamide	**^{1}HNMR (δ ppm):** phenolic -OH proton at 8.71 ppm, 8.46 ppm at amino -NH_2 and Ar-H protons at 7.00 ppm **GCMS (m/z):** 197.07 cal., Found 197.03

3	 methyl 4-hydroxy-3,5-dimethoxybenzoate	**^{1}HNMR (δ ppm):** phenolic -OH proton at 8.70 ppm, Ar-H protons at 6.94 ppm and CH_3 protons at 3.88 ppm **GCMS (m/z):** 212.07 cal., Found 212.05

4. Conclusion

Isolation and extraction of syringic acid from *Dichanthium Annulatum* (Forssk.) plant and synthesis of their analogues like ester and amide having broad spectrum in various fields. In addition, there are some challenges to overcome. These challenges include efficiency for good yields in synthesis of analogues, for this reason, we believe there is a need for the synthesis of medicinally active compounds, studying dissimilar properties and seeking new applications of novel analogues especially in synthesis field would be vast applications in various areas.

5. Acknowledgement

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Application of Carbon Nanotubes for Design of Active and Recyclable Heterogeneous Cu Metal Nanoparticle Catalysts

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Abstract:

The various techniques have been introduced to synthesized carbon nanotubes (CNTs) including arc discharge, laser ablation, high-pressure carbon monoxide disproportionate and chemical vapor deposition (CVD) methodology. These CNTs materials were exploited as heterogeneous catalyst support to fabricate active and recyclable Cu nanoparticles (NPs) catalysts. The structural and morphological attributes of as-synthesized Cu NPs catalysts and other materials was explored by adopting various physico-chemical techniques, XRD, FT-IR, N_2 sorption, Raman spectroscopy, TEM, HR-TEM, SEM, FE-SEM, CHNS analysis, XPS, ICP-OES, CO_2-TPD, H_2-TPR, TGA, UV-Visible spectroscopy, Zeta potential, etc. The effect of Cu NPs size, acidity-basicity, morphology, etc was scrutinized for understanding structure-activity association. The study evidently shows that material characteristics play imperative role in heterogeneous catalysis for obtaining desired product with excellent selectivity.

1. Introduction

Carbon nanotubes (CNTs) is a carbon allotrope that resembles a tube of carbon atoms. Carbon nanotubes are extremely robust and difficult to break, but they are still light.[1-5] Because of their exceptional mechanical, electrical, and thermal properties, carbon nanotubes are one of the most investigated Nanomaterials. Multiwall carbon nanotubes feature several concentric cylindrical lattices of carbon atoms, whereas single wall carbon nanotubes have only one cylinder of carbon atoms.[1-5] Buckytube is another name for carbon nanotubes. Two-dimensional graphite is folded or rolled into a cylindrical shape structure to create nanotubes. Inside, nanotubes are hollow. The nanotube has a diameter of 1-3 nanometers. CNTs are a type of carbon with a diameter of nanometers and a length of micrometres (where the length to diameter ratio exceeds 1000). CNT is made up of enrolled cylindrical graphitic sheets (named graphene) wrapped up into a seamless cylinder with a nanometer-sized diameter.

(a) **Electrical Conductivity –** CNTs are electrically and thermally conductive and have a high mechanical strength. Parallel arrays of multi-walled CNT can be drawn into electrically conductive continuous length webs.

(b) **Strength And Elasticity –** In terms of tensile strength and elastic modulus, carbon nanotubes are the strongest and stiffest materials yet found.

(c) **Thermal Conductivity and Expansion –**The carbon bond's rigidity aids in the transmission of vibrations throughout the nanotube, resulting in excellent heat conductivity. Because each carbon atom is connected to three other carbon atoms by strong covalent bonds, carbon nanotubes have an extremely high melting point. This also leaves a spare electron on each carbon atom, resulting in a sea of delocalized electrons within the tube, allowing nanotubes to conduct electricity.

(d) **Electron Emission –** Because each carbon atom is connected to three other carbon atoms by strong covalent bonds, carbon nanotubes have an extremely high melting point. This also means that each carbon atom has an extra electron, forming a sea of delocalized electrons within the tube, allowing nanotubes to conduct electricity.

2. Experimental Section

There are many techniques used to produce MWNTs or SWNTs. Methods such as electric arc discharge, laser vaporization and chemical vapour deposition techniques are well established to produce a wide variety of CNTs. [5-11] These methods are described in following sections. We have used the Chemical vapor deposition (CVD) method which is one of the most popular thin film deposition methods. CVD is very different from the other two common methods used for CNT production, namely electric arc discharge and laser vaporization. Arc discharge and laser vaporization can be classified as high temperature (> 3000 K) and short time reaction (μs-ms) techniques, whereas catalytic CVD is a medium temperature (700- 1473K) and long time reaction (typically minutes to hours) technique. The main technological drawbacks with arc discharge and laser vaporization are that the CNTs are produced as stand alone on their own. The CNTs do not grow on a conventional or patterned substrate. Earlier most CVD-grown CNTs were "spaghetti-like" and defective, but the potential of the technique to satisfy technological requirements was recognized. From 1998 onward, substantial and rapid progress has been made in the development of CVD to establish it as a highly controlled technology for the production of CNTs. Today, it is possible to fabricate high quality multi-walled carbon nantoubes (MWNTs) and single-walled carbon nantoubes (SWNTs) directly onto substrates or in bulk as a raw material. A major advantage of CVD is that the CNTs can be used directly without further purification unless the catalyst particle is required to be removed. In CVD method, CNTs are grown by decomposing an organic gas over a substrate covered with metal catalyst particles. Some CVD methods are reported, such as: thermal CVD, plasma enhanced CVD and catalytic pyrolysis of hydrocarbon. To get carbon precursor we have used very traditional and cost effective method means synthesis of carbon from Rice Husk (RHA). The following method have used for synthesis of carbon material. Weigh the 400 gm RHA as well as weigh the 480 gm NaOH and make a solution using 600 ml distilled water. Carefully add RHA in to the NaOH solution, it will start slowly bubbling. After that shake it properly by adding some porcelain pieces into it. Porcelain pieces control the bubbling and control the heating exposure. This assembly should be in round bottom flask (refluxing flask). Then kept RB flask in heating mantle & start refluxing at 70-80 °C for 3 hrs. After that cool the solution and kept some time for the decant process by adding distilled water into it. Start filtration by using whatmann filter paper. Collect the residue & filtrate separately. Dry the residue in hot oven at 60 °C for removing water droplets. Crush it using grinder. Will get black powder sample. This carbon precursor used for developing the catalytic support material for investigation the physiochemical effect between counter ion of catalyst.

3. Result and Discussion

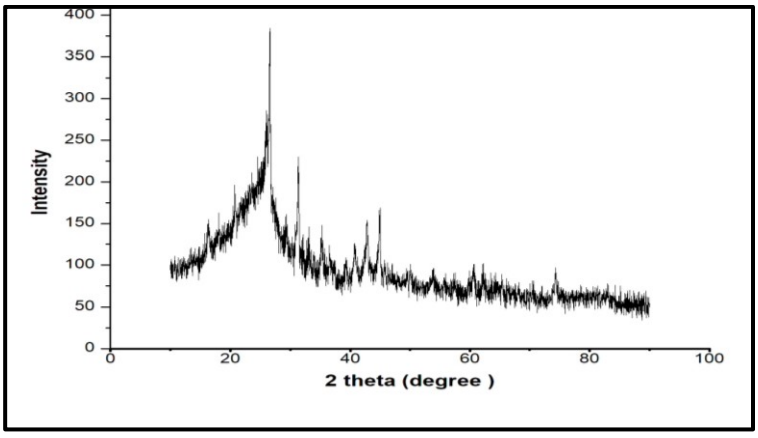


Figure.1 X-ray Diffraction pattern of carbon precursor.

For checking the activity of carbon precursor we analyze the material by using various techniques namely IR, XRD, etc. The data obtain from XRD techniques it is showing the amorphous nature of carbon precursor due to many small humph (Figure 1). We tested the three carbon sample among them one is synthesize in laboratory by using Rice Husk, another one is commercial carbon material and one is from taken from industry for comparative study. The results showing some small sharp peaks in the first graph due to presence of silica precursor in the carbon material, silica having crystalline nature.

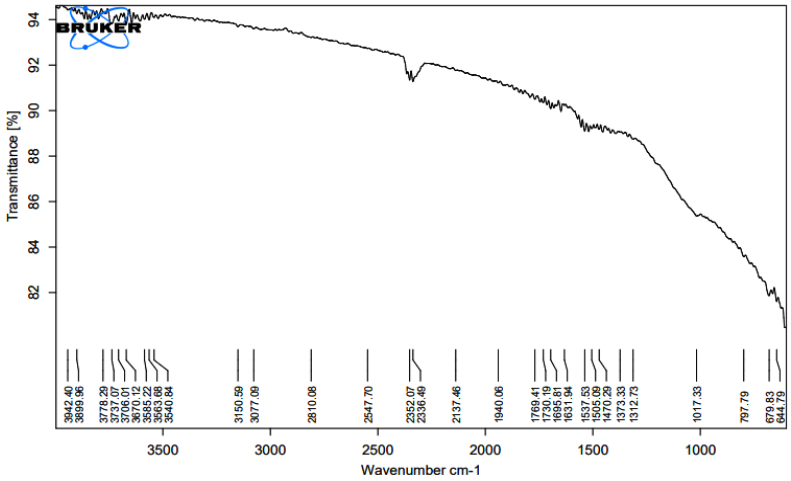


Figure 2. Infrared spectra of carbon precursor

The synthesize carbon material analyzed by using IR spectroscopy. Infrared spectroscopy is simple and reliable technique widely used in both organic and inorganic chemistry, in research and industry. In catalysis research it is a very useful tool to characterize the catalyst, as well as to detect intermediates and products during the catalytic reaction (Figure 2). The peak obtains at 1600 – 1650 and 3000 – 3700 cm^{-1} shows the OH vibration in the molecule. The peaks obtain at 2500 – 2334 cm^{-1} show the C-H aliphatic stretching. The peak obtains at 1426 cm^{-1} shows the Carbonyl stretching mode in the molecule. The graph obtains at 650 – 750 cm^{-1} shows there is indication of monosubstitution of CH group.

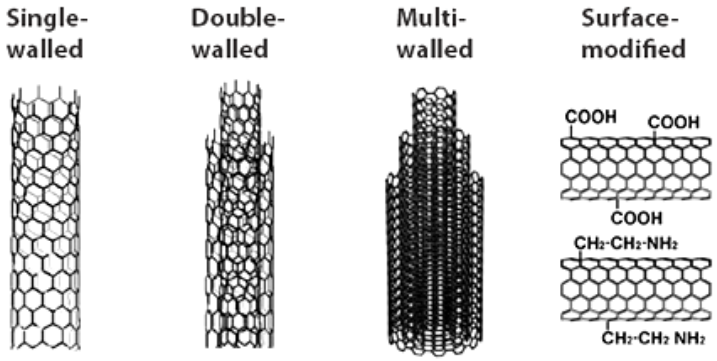


Figure 3. Carbon Nanotubes (SWCNTs, DWCNTs, MWCNTs).

4. Application of Carbon Nanotubes

The CNTs can be inert and can have a high aspect ratio, high tensile strength, low mass density, high heat conductivity, large surface area and versatile electronic behavior including high electron conductivity. [1-15] The combination of these properties makes them ideal candidates for a large number of applications provided their cost is sufficiently low. Electronically, CNTs are expected to behave as ideal one-dimensional 'Quantum Wires" with either semiconducting or metallic behavior, depending upon the diameter and orientation of tube axis (parallel or perpendicular to the C-C bond). Investigation reported an experimentally functioning carbon nanodevice (diode) based on nanotube having, a variety of structure cells. Room temperature transistor based on a single CNT has been reported which marks an important step towards molecular electronics [10-16]. Recent developments have focused considerable media attention on nanotube nanoelectronic application with crossed SWCNTs, three and four terminal electronic devices have been made, as well as a nonvolatile memory that functions like an electromechanical relay. Integrated CNT devices involving two CNT transistors have been reported, providing visions of large-scale integration. The small diameter of CNTs is very favorable for field

emission- the process by which a device emits electrons when an electric field or voltage is applied to it. Aligned CNTs are considered to be ideal for the purpose because of their high packing density and hence for use as high brightness field emitters.

5. Conclusions

CNTs are vital chemical supports, which can be suitably modified to achieve desirable physico-chemical properties. Present investigations evidently suggest that CNTs and its modified structures will be efficiently developed for fabrication of numerous heterogeneous catalysts.

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Anti-microbial and Phytochemical Investigation of Medicinal Plant *COLEUS AMBOINICUS*

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Abstract

In present work we have resented antimicrobial and Phytochemical Investigation of medicinal Plant Coleus Amboinicus.Coleus Amboinicus, commonly known as Indian borage or Mexican mint, has long been valued in traditional medicine for its healing properties. This study examines its anti-microbial efficacy and phytochemical composition. The extraction was done by soxlet and manually.The plant's extracts were found to contain key bioactive compounds, including alkaloids, flavonoids, terpenoids, tannins, and saponins, which are associated with medicinal benefits. Anti-microbial testing revealed significant activity against pathogens such as Staphylococcus aureus, Escherichia coli, and Candida albicans. These findings affirm the plant's potential as a natural remedy for infections, supporting its use in traditional medicine. Further exploration of its bioactive components could pave the way for developing plant-based antimicrobial treatments.

Keywords: *Phytochemicals, antimicrobial, extraction*

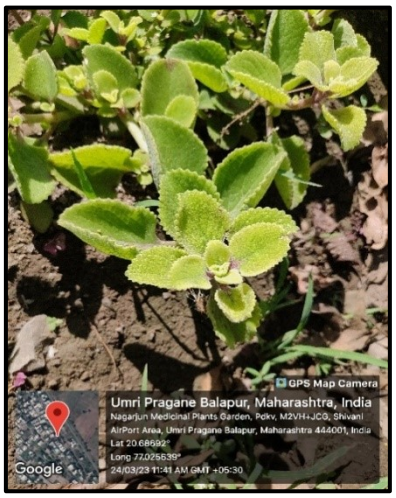
Introduction

India is home to a rich diversity of indigenous herbal resources, with over 20,000 plant species, around 2,500 of which are recognized for their medicinal value [1]. The therapeutic properties of these plants are attributed to phytochemicals—active compounds that produce specific physiological effects on the human body. Key phytochemicals include alkaloids, flavonoids, phenolic compounds, and tannins. The World Health Organization acknowledges medicinal plants as a valuable source for developing various drugs. Utilizing plant extracts and phytochemicals with established antimicrobial properties holds great potential for advancing therapeutic treatments[2].

Coleusamboinicus

Coleus amboinicus (Loureiro) Sprengel, also known as Indian borage, is a prominent member of the Lamiaceae family, notable for its aromatic, oregano-like scent and taste. It is among the most widely referenced species in this family, accounting for 68% of the medicinal uses reported for this genus[3]. Indigenous communities in tropical rainforests utilize this plant in both traditional medicine and cooking. Its essential oil is rich in bioactive compounds, including Carvacrol, Thymol, β-Caryophyllene, α-Humulene, γ-Terpinene, p-Cymene, α-Terpineol, and β-Selinene [4]. These compounds are known for their medicinal benefits and are traditionally used to treat conditions such as colds, asthma, constipation, headaches, coughs, fevers, and skin disorders.Coleus amboinicus (Loureiro) Sprengel, also known as Indian borage, is a prominent member of the Lamiaceae family, notable for its aromatic, oregano-like scent and taste. It is among the most widely referenced species in this family, accounting for 68% of the medicinal uses reported for this genus. Indigenous communities in tropical rainforests utilize this plant in both traditional medicine and cooking. Its essential oil is rich in bioactive compounds, including Carvacrol, Thymol, β-Caryophyllene, α-Humulene, γ-Terpinene, p-Cymene, α-Terpineol, and β-Selinene. These compounds are known for their medicinal benefits and are traditionally used to treat conditions such as colds, asthma, constipation, headaches, coughs, fevers, and skin disorders [5].

TAXONOMICAL HEIRARCHY



Division: Magnoliophyta

Kingdom: Plantae

Clade: Angiosperms

Class: Magnoliopsida

Order: Lamiales

Family: Lamiaceae

Genus: Coleus

Species: Coleus aromaticus

Synonyms: Coleus amboinicus Lour

Taxonomy and Morphological Features

C. amboinicus (Loureiro) Sprengel is a member of the Lamiaceae (mint) family and belongs to the oil-rich genus Coleus, part of the subfamily Nepetoideae. This genus includes around 300 species of annual and perennial herbs or subshrubs, many of which are succulents. Several Coleus species hold economic and medicinal significance, with C. amboinicus standing out as a key aromatic medicinal plant, known for its distinctively fragrant leaves with soft, erect hairs.[6]

C. amboinicus is a succulent shrub that can grow over 1 meter tall, often sprawling and aromatic. Its fleshy stems, 30–90 cm long, are either covered with rigid hairs or densely soft-haired. The leaves are thick, ovate, and pubescent with glandular hairs on the underside, giving them a frosted look. The plant produces pale purplish flowers in dense whorls, though it rarely flowers and its seeds are hard to gather. The leaves have a refreshing, aromatic taste and smell.[7]

Bioactivities of C. amboinicus

C. amboinicus exhibits potent antimicrobial properties due to its rich chemical diversity, with phytochemicals such as terpenes, alcohols, and phenols that are effective against bacteria, yeast, and mold. Additionally, it is widely used to treat respiratory disorders, digestive issues, and genitourinary diseases, and has been traditionally employed in managing asthma, bronchitis, urinary stones, and infections like cholera and meningitis.

Material Preparation

- **Collection of plant material**
  Mature leaves of *Coleus amboinicus* were collected in proper blooming period from Nagarjun Medicinal Plants Garden Dr.P.D.K.V, Akola.
- **Identification of plant material**
  As per the standard method the plant was identified and authenticated by the staff working at the Nagarjun Medicinal Plants Garden Dr. P.D.K.V, Akola.
- **Cleaning and drying of plant material**
  The fresh leaves collected bring to the laboratory plant washed with distilled water and to remove soil and unwanted dust particles. The leaves of *Coleus amboinicus* which were placed in shade dry at 28°C at room temp to remove water contain. Alternatively, the leaves can be dried in Hot Air Oven at 65°C for 3 hrs or until the leaves are completely dried.
- **Grinding of plant material**
  The dried plant is ground into a marble masher or using an electrical blender into a powder form. This material kept in air tight bottle for others extraction.

Extraction Methods

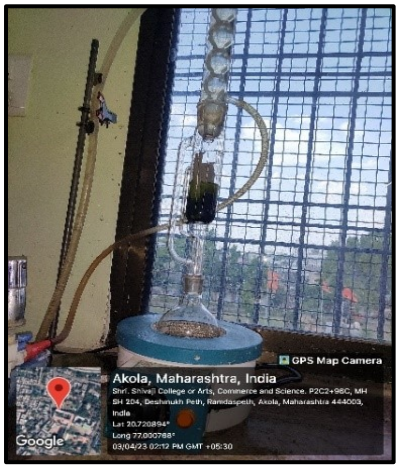
Two extraction methods were used to obtain plant extracts for phytochemical screening: manual extraction and Soxhlet extraction.

I) Manual Extraction



Preparation of Extract:Weigh 3 grams of powdered plant material and dissolve it in 30 ml of six different solvents (water, ethanol, 1:1 water + ethanol, chloroform, acetone, and petroleum ether) in separate reagent bottles. Allow the solutions to stand at room temperature (24-27°C) for 3 to 5 days, shaking the bottles once daily. Filter the mixtures using Whatman No. 1 filter paper to collect the filtrate. The obtained filtrate is then used for further phytochemical screening.

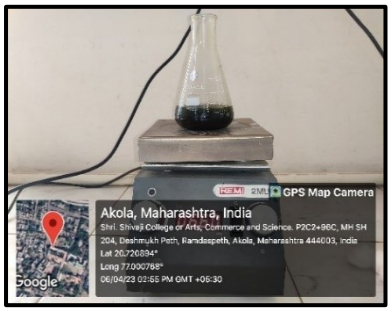
II) Soxhlet Extraction



- **Preparation of extract**

Weigh 10g of powdered plant sample. The powdered sample is extracted with Soxhlet apparatus using 100 ml of six different solvents (viz. water, ethanol, 1:1 water + ethanol, chloroform, acetone, pet ether)The extracted solvents were evaporated off, and then concentrated extracts were obtained as residues. These residues were further used for phytochemical screening

Stirring Of Extracts



Before the phytochemicals screening, we stir the extract on magnetic stirrer for 1 hr for the more solubility in solvent and get good result.

Prepation Of Reagents



Wagner's reagent: Dissolve 1.27g of iodine and 2g of potassium iodide in 100 ml water. **Ferric Chloride:**5 % aqueous ferric chloride and 100 ml distilled water.**Fehling's A Solution**: Take Copper Sulphate Penta hydra crystals and 7 gm. Of CuSo4 and 100 ml H2O. Add 2 drops of Sulphuric acid. **Fehling B solution:**35 gm. Potassium tartrate and add 12 gm. NaOH – sodium hydroxide. Add

100 ml water.**:20 % NaOH**20g NaOH add 80 ml water.**1 % NaOH:**1gm NaOH in 99 ml in water

Phytochemical Investigation

Phytochemical screening

Chemical tests were performed on extracts of the plant sample obtained from various solvents, including water, ethanol, 1:1 water-ethanol, and chloroform, acetone, and petroleum ether, from both manual and Soxhlet extraction methods. This qualitative analysis aimed to identify the presence of several phytoconstituents: alkaloids, flavonoids, tannins, phenols, steroids, terpenoids, saponins, carbohydrates, glycosides, and quinones, following standard procedures.

1) **Tests for Alkaloids**
   Each of the crude extracts was treated with dilute HCl and the tests were performed with the filtrate.
   Wagner's Test: Addition of Wagner's reagent to the filtrate results in formation of reddish-brown precipitate indicating the presence of alkaloids
2) **Test for Terpenoids**
   Salkowski's test: To 0.5ml of test solution, add equal quantity of chloroform and then add sulphuric acid along the sides of the test tube avoiding shaking.
   The appearance of reddish-brown colour in the chloroform layer signifies presence of phytosterols.
3) **Tests for Steroids**
   Salkowski's Test: 2 ml of extracts were treated with 2 ml chloroform and filtered. Filtrates were treated with few drops of concentrated H_2SO_4, shaken and allowed to stand. Appearance of golden yellow colour interface indicates the presence of steroid ring.
4) **Tests for Tannins**
   FeCl3 Test: 0.5 g of the powdered sample is boiled in 20 ml distilled water and then filtered using a filter paper. 5% (w/v) FeCl3 is added to the filtered samples and observed for the presence of brownish green or blue-black colour.
5) **Test for Saponins**
   Foam Test: 0.5 g of the extract was shaken well with 2 ml of water. The test is based on the production of persistent foam, indicating positive test for saponins.
6) **Tests for Flavonoids**
   Lead acetate Test:Extracts were treated with few drops of lead acetate solution. Formation of yellow coloured precipitate indicates the presence of flavonoids.
7) **Tests for Carbohydrates**
   Fehling test: 1ml of the filtrate is boiled in water bath with 1ml of Fehling's solution A and B. Red precipitate indicated the presence of sugar.
8) **Test for Cardiac Glycosides**
   Keller-Killiani test: To 2ml of test solutions, 1ml of glacial acetic acid and 1-2 drops of ferric chloride solution is added. Then 0.5ml of concentrated sulphuric acid is slowly added along the sides of the test tube avoiding shaking of test tube. A reddish-brown ring at the interface of two liquids indicates the presence of deoxy sugar.
9) **Test for Quinines**
   NaOH Test: To 1 ml of extract added 1 ml of 1% NaOH and mixed well. No Appearance of blue green or red indicates absence of quinines
10) **Test for Protein**
    Biuret test: An aliquot of 2 ml of filtrate was treated with one drop of 2% copper sulphate solution. To this 1 ml of ethanol was added, followed by excess of potassium hydroxide pellets. Pink colour in the ethanolic layer indicated the presence of proteins.

Results And Discussion

Phytochemical Screening Analysis

The use of plants as medicine dates back from many centuries or can be said from the time humans existed on earth. Then, Man did not require the modern methods of investigation to authenticate the use of plants for therapeutic purpose, which he often used in conjunction with the magical and other ritual practices. These folk

medicines differed with the plant available to the particular area, the practices and beliefs followed. The use of such medicine must have started with trial-and-error method over centuries and their continuing use now is not without any valid results. With increase interest in herbal medicine worldwide, a study authenticating the use of these for medicinal purpose is very helpful mainly because of their easy availability and affordability by many.

Traditional medicines invariably involve crude plant extracts containing multiple chemical constituents. Identification of these chemical constituents is necessary for further analysis of the plant material. Hence a preliminary phytochemical analysis of leaves extract of *Coleus amboinicus* was performed and compared. Phytochemical analysis of c. amboinicus was shown the presence of alkaloids, terpenoids, flavonoids, steroids, saponins, tannins, glycosides, carbohydrates, quinine.

Phytochemicals analysis of extracts obtained via manual extraction of dried leaves in aqueous solvent show the presence of alkaloids terpenoids flavonoids carbohydrate glycosides and queen in however saponin and steroids were absent. Ethanolic extracts showed the presence of terpenoidstannin saponin flavonoids glycosides and quinine however alkaloids carbohydrates cardiac glycosides and steroids were absent. 1:1 water- ethanol extract showed the presence of only alkaloids, flavonoids and steroids rest all phytochemicals were absent whereas chloroform extract showed only the presence of steroids. Acetone extract showed the presence of alkaloid, terpenoid, tannin, flavonoid, cardiac glycoside steroid and the absence of saponin and carbohydrates was observed. In pet ether extract terpenoids tannin and carbohydrate was present and remaining all the phytochemicals were absent.

Phytochemicals analysis of extracts obtained via Soxhlet extraction extraction of dried leaves in aqueous solvent show the presence of alkaloids, tannin, steroid, and quinine. Terpenoids, saponin, flavonoids, were absent. Ethanolic extracts showed the presence of only terpenoids, tannin, and cardiac glycosides and quinine. 1:1 water-ethanol extract showed the presence of alkaloids, tannin, carbohydrate, glycosides and quinine. Whereas chloroform extract showed only the presence of steroids. Acetone extract showed the presence of alkaloid, tannin, carbohydrate and steroid. In pet ether extract only saponin, flavonoid was present and alkaloids, terpenoids, tannin, carbohydrates, glycosides, and quinine were absent.

Results of Phytochemical Screening

Phytochemicals analysis of extracts obtained via manual extraction of dried leaves in aqueous solvent show the presence of alkaloids terpenoids flavonoids carbohydrate glycosides and queen in however saponin and steroids were absent. Ethanolic extracts showed the presence of terpenoidstannin saponin flavonoids glycosides and quinine however alkaloids carbohydrates cardiac glycosides and steroids were absent. 1:1 water- ethanol extract showed the presence of only alkaloids, flavonoids and steroids rest all phytochemicals were absent whereas chloroform extract showed only the presence of steroids. Acetone extract showed the presence of alkaloid, terpenoid, tannin, flavonoid, cardiac glycoside steroid and the absence of saponin and carbohydrates was observed. In pet ether extract terpenoids tannin and carbohydrate was present and remaining all the phytochemicals were absent.

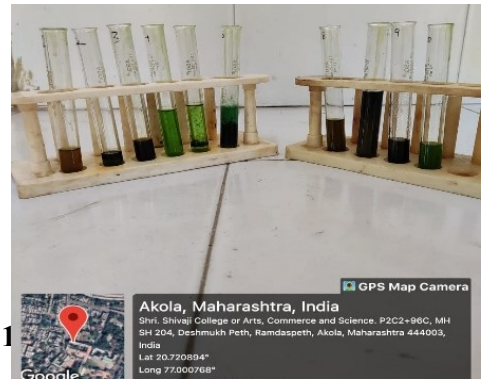
I) Manual Extraction

S.no.	Tests	Water extract	Ethanol extract	1:1 Water-Ethanol extract	Chloroform extract	Acetone extract	Pet ether extract
1	**ALKALOIDS** Wagner's test	Positive	Negative	Positive	Negative	Positive	Negative
2	**TERPENOIDS** Salkowski's Test	Positive	Positive	Negative	Negative	Positive	Positive
3	**STEROIDS** Salkowski's Test	Negative	Negative	Positive	Positive	Positive	Negative
4	**TANINS** FeCl3 Test	Positive	Positive	Negative	Negative	Positive	Positive
5	**SAPONINS** Foam Test	Negative	Positive	Negative	Negative	Negative	Negative
6	**FLAVONOIDS** Lead acetate Test	Positive	Positive	Positive	Negative	Positive	Negative
7	**CARBOHYDRATES** Fehling Test	Positive	Negative	Negative	Negative	Negative	Positive

8	**CARDIAC GLYCOSIDES** Keller-Killiani Test	Positive	Negative	Negative	Negative	Positive	Negative
9	**QUININES** NaOH Test	Positive	Positive	Negative	Negative	Negative	Negative
10	**PROTEIN** Biuret Test	Positive	Positive	Negative	Negative	Negative	Negative













S. no.	Tests	Water extract	Ethanol extract	1:1 Water-Ethanol extract	Chloroform extract	Acetone extract	Pet ether extract
1	**ALKALOIDS** Wagner's test	Positive	Negative	Positive	Negative	Positive	Negative
2	**TERPENOIDS** Salkowski's Test	Negative	Positive	Negative	Negative	Negative	Negative
3	**STEROIDS** Salkowski's Test	Positive	Negative	Negative	Negative	Negative	Negative
4	**TANINS** FeCl3 Test	Positive	Positive	Positive	Negative	Positive	Negative
5	**SAPONINS** Foam Test	Negative	Negative	Negative	Negative	Negative	Positive

6	**FLAVONOIDS** Lead acetate Test	Negative	Negative	Negative	Negative	Negative	Positive
7	**CARBOHYDRATES** Fehling Test	Positive	Negative	Positive	Negative	Positive	Negative
8	**CARDIAC GLYCOSIDES** Keller-Killiani Test	Negative	Positive	Negative	Negative	Negative	Negative
9	**QUININES** NaOH Test	Positive	Positive	Negative	Negative	Negative	Negative
10	**PROTEIN** Biuret Test	Negative	Negative	Positive	Negative	Positive	Negative

Anti-Microbial Activity Study

Plants are rich in alkaloids and other phytochemical contents and many of them are effectively used to cure a wide range of ailments. The alkaloids and phytochemical contents may be present in all organs of the plant including roots, stems, buds, leaves, flowers and fruits. All plant parts synthesize some chemicals which metabolite their physiological activities. These phytochemicals are used to cure the disease in herbal and homeopathic medicines. Now a day most of the peoples like to use the traditional methods to cure general diseases. This worldwide interest in medicinal plants reflects recognition of the validity of many traditional claims regarding the value of natural products in health care and the development of microbial resistance to the available antibiotics has led the authors to investigate the antimicrobial activity of medicinal plants.

Ethanolic extract of *Coleus amboinicus* was prepared using the Soxhlet apparatus during the current study to study its anti-microbial potential. Anti microbiological analysis of extract was carried out against two different organisms *S. aureus* and *E. coli* by Agar Well Diffusion Method.

Agar Well Diffusion Method:

The antibacterial activities were tested against ethanolic leaves extract of *Coleus amboinicus.* The inoculum of microorganism was prepared from pure cultures. About 15-20 ml of nutrient agar medium was poured in the sterilized Petri dish and allowed to solidify. One drop of bacterial strains was spread over the medium by swab creating a culture lawn. Wells of 6nm in diameter and about 2 cm apart punctured in the culture medium using sterile Cork borers. About 40 µl of plant extract was added to the wells. Plates were incubated in air at 37°C for 24 hours. Antibacterial activities were evaluated by measuring inhibition zone diameters.



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Nano Synthesis and Characterization of β-D-Maltosyl-3-substituted Benzothiazolyl Thiocarbamides

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Abstract:

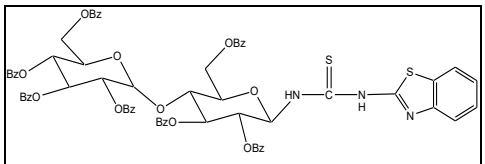
1-hepta-O-benzoyl-β-D-maltosyl-3-substituted benzothiazolyl thiocarbamides have been prepared by the interaction of hepta-O-benzoyl- β-D-maltosyl isothiocyanate and substituted benzothiazoles. The confirmation of new N-Maltosyl benzothiazolyl thiocarbamides has been established on the basis of usual chemical transformations i.e. IR, NMR and Mass spectral studies. Size determination of the nanoparticles was carried out by X-ray Diffraction and Field Emission Scanning Electron Microscopy.

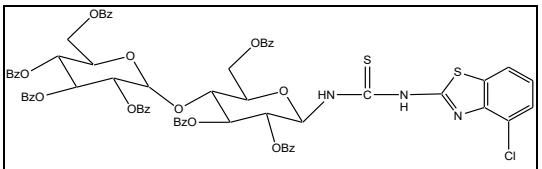
Benzothiazole is a representative class of Sulphur heterocycles which involves a benzene ring fused with a thiazole ring. This is a bicyclic system with multiple applications which is widely used as antioxidants, plant growth regulators, anti-inflammatory agents, enzyme inhibitors, imaging reagents etc. Especially benzothiazole plays an important role in the field of medicinal chemistry & renders an extensive range of biological activities including anticancer[1, 2], antibacterial[3, 4], antituberculosis[5, 6], anti-diabetic[7] etc. hence, the synthesis of benzothiazole is very important due to its significant biological activities and great pharmaceutical value. D. N. Belozerova et al.[8] have been synthesized the benzothiazoles, benzothiazines and benzothiazepines by the reaction between pyrrole diones and aminothiophenoles, O. M. Salih et al.[13] have been synthesized novel 2-aminobenzothiazole derivatives and estimated their anticancer activity and that's why Benzothiazole Thiocarbamide nanoparticle synthesis is an important task. In this paper we are dealing with the synthesis and characterization of nanoparticles different derivatives of N- Maltosylated benzothiazolyl thiocarbamide.

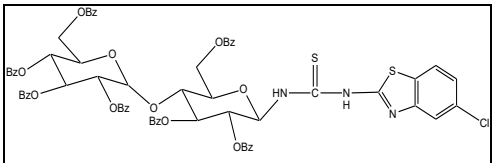
Result and Discussion:

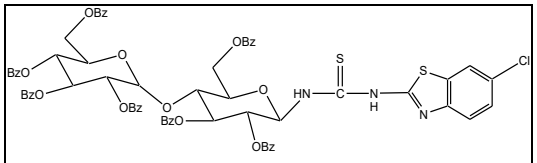
Table 1: Synthesis of 1- hepta-O-benzoyl-β-D-maltosyl-5-aryl Benzothiazolyl thiocarbamides (VIIA-VIIG)

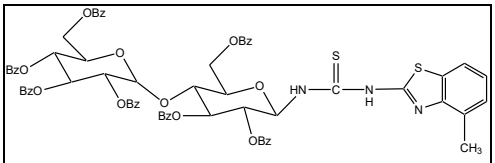
Sr. No.	(R)	1-hepta-O-benzoyl-β-D-Maltosyl-5-aryl benzothiazolyl thiocarbamides	Yield %	M. P. of Bulk (°C)	M. P. of NPs (°C)
1.	H	-5-phenyl benzothiazolyl thiocarbamide **(VIIA)**	72	143	139
2.	*o*-Cl	-5-*o*-chloro-phenyl benzothiazolyl thiocarbamide **(VIIB)**	61	166	158
3.	*m*-Cl	-5-*m*-chloro-phenylbenzothiazolyl thiocarbamide **(VIIC)**	63	164	159
4.	*p*-Cl	-5-*p*-chloro-phenyl benzothiazolyl thiocarbamide **(VIID)**	68	162	155
5.	*o*-CH_3	-5-*o*-tolyl benzothiazolyl thiocarbamide **(VIIE)**	79	158	150
6.	*m*-CH_3	-5-*m*-tolyl benzothiazolyl thiocarbamide **(VIIF)**	64	153	148
7.	*p*-CH_3	-5-*p*-tolyl benzothiazolyl thiocarbamide **(VIIG)**	70	156	149

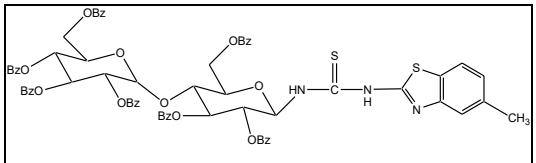

1-hepta-O-benzoyl-beta-D-maltosyl-5-phenyl benzothiazolyl thiocarbamide **(VIIA)**

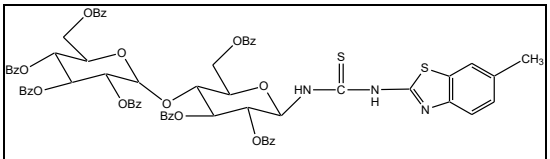

1-hepta-O-benzoyl-beta-D-maltosyl-5-O-Cl-phenyl benzothiazolyl thiocarbamide **(VIIB)**


1-hepta-O-benzoyl-beta-D-maltosyl-5-m-Cl-phenyl benzothiazolyl thiocarbamide **(VIIC)**


1-hepta-O-benzoyl-beta-D-maltosyl-5-p-Cl-phenyl benzothiazolyl thiocarbamide **(VIID)**

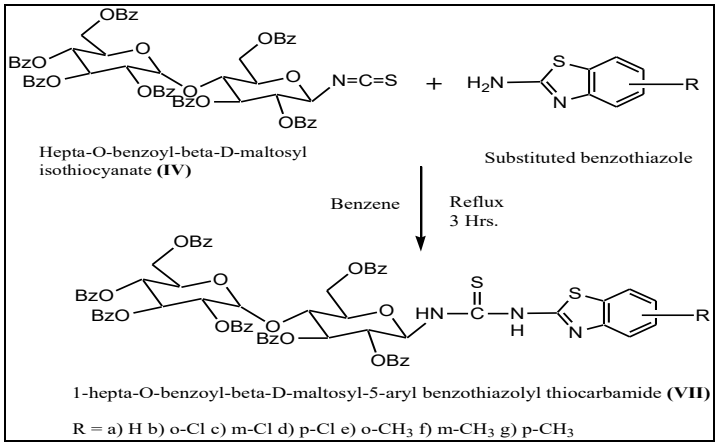

1-hepta-O-benzoyl-beta-D-maltosyl-5-O-tolyl benzothiazolyl thiocarbamide **(VIIE)**


1-hepta-O-benzoyl-beta-D-maltosyl-5-m-tolyl benzothiazolyl thiocarbamide **(VIIF)**


1-hepta-O-benzoyl-beta-D-maltosyl-5-p-tolyl-benzothiazolyl thiocarbamide **(VIIG)**

The characterizations of compounds have been confirmed by ^{1}H NMR which shows one singlet and one doublet due to two N-H protons in between 5.92 to 8.94 ppm, Maltosyl protons at 3.34 to 6.66 ppm and benzoyl protons at 6.00 to 8.20 ppm. In case of methyl derivatives methyl protons shows singlet peak towards shielded region. Graph 1 shows IR data of compound VIIE indicates –N-H stretching frequency (2° amine) at 3356 cm^{-1}, -C-N stretching frequency (Ar-amine) at 1265 cm^{-1} and -C-N stretching frequency (Aliphatic-amine) at 1026 cm^{-1}. Graph 2 shows EI mass spectrum of compound VIIE as HRMS (ESI$^+$, m/z): calculated for $(C_{70}H_{57}N_3O_{17}S_2)^+$ $(M+H)^+$: 1276.3436; found 1276.3074. The preparation of nanoparticles has been confirmed by UV visible spectroscopy which states that, as the size of nanoparticles decreases the band gap difference increases. The confirmation of nanoparticles has also done with the aid of lower in melting point of nanoparticles. Initially synthesis of NPs was ensured by comparing the melting point of NPs with bulk. Melting point of NPs found to be lower value than bulk material of respective compounds.

Scheme:



Graph 1 shows IR data of compound VIIE indicates –N-H stretching frequency (2° amine) at 3356 cm^{-1}, -C-N stretching frequency (Ar-amine) at 1265 cm^{-1} and -C-N stretching frequency (Aliphatic-amine) at 1026 cm^{-}

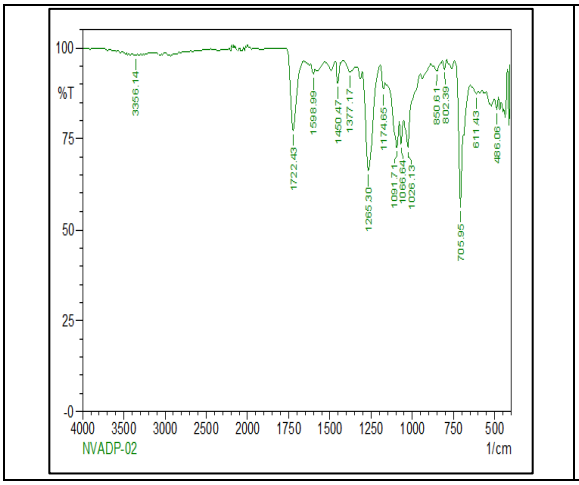
[1]. Graph 2 shows EI mass spectrum of compound VIIE as HRMS (ESI$^+$, m/z): calculated for $(C_{70}H_{57}N_3O_{17}S_2)^+$ $(M+H)^+$: 1276.3436; found 1276.3074. The calculated size of compound VIIE NPs was found to be 12.59 nm.

The size of NPs was calculated using Debye-Scherrer formula using peak (200) from XRD pattern. The Debye-Scherrer formula is given by $D = 0.9\lambda/\beta \cos\theta$.

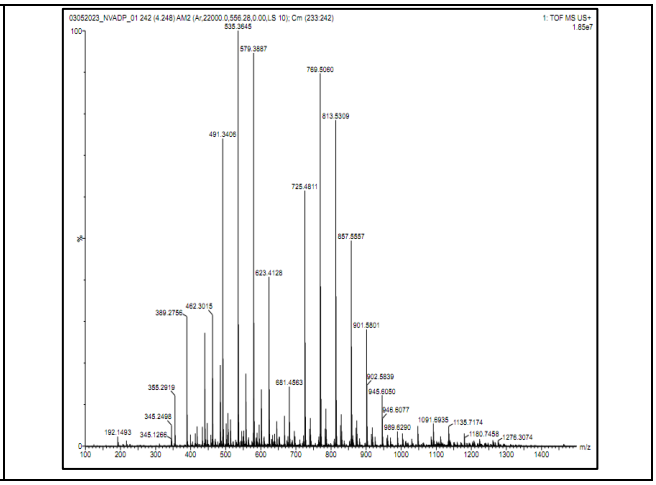
Where, λ – wavelength of x-ray, θ- angle of diffraction, D – Size of particle

The X-Ray Diffraction pattern shows the Cubic structure of synthesized Compound VIIE. The typical peaks show at 29.22, 48.64 and 57.76 in the XRD spectra corresponding to the plane (200), (220) and (111). The observed broadening of peaks confirms the scale of nanoparticle is small.

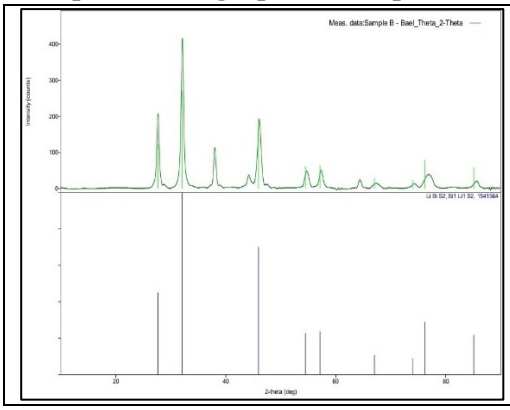
Graph 1: FTIR image of Compound VIIE



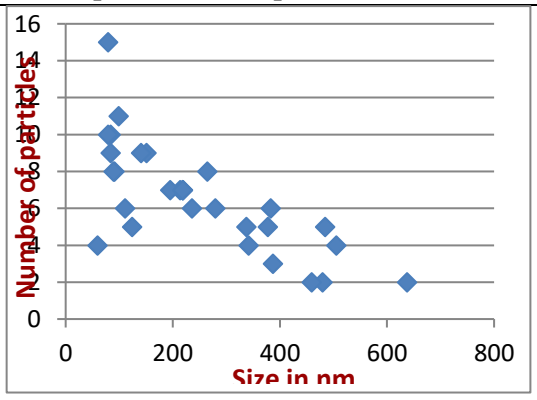
Graph 2: EI mass spectra of compound VIIE



Graph 3: XRD graphs of compound VIIE



Graph 4: FESEM particle size distribution



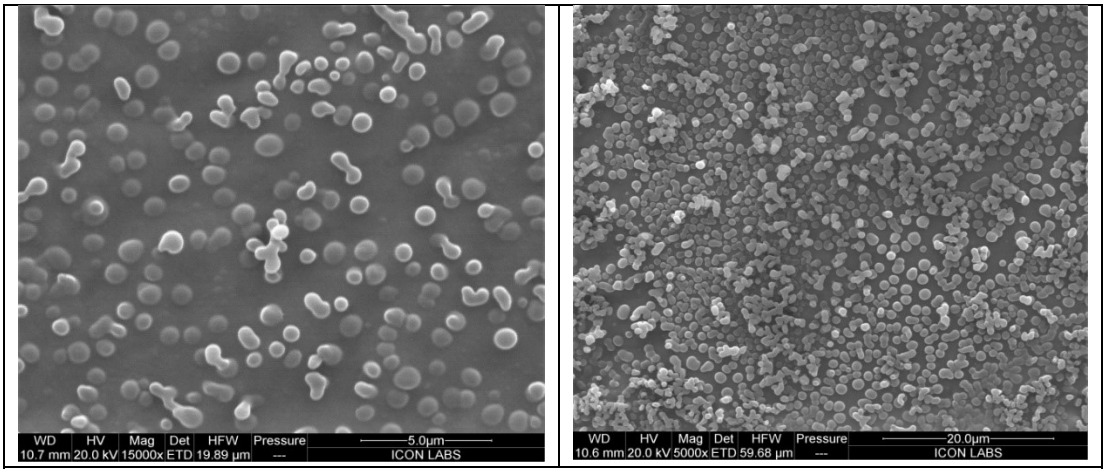


Fig.1 FESEM images of sample code VIIE: *Model- Quanta 200F, Magnification range: 30 x to 2 lac x, Resolution: 2.5 nm*

Fig.1 of FESEM reveals significant size of NPs is 59.524 nm whereas average size of NPs lies in the range of 79 nm to 180 nm.

Experimental Section:

Alpha –D- maltose undergoes benzoylation reaction after continuous shaking with benzoyl chloride and pyridine in chloroform solvent (1:1:2) for approx. 2 hrs. After 24 hrs at 0-5 ºC maltose octabenzoate (I) was obtained by several washings with sulphuric acid, sodium bicarbonate and water followed by trituration with petroleum ether. Maltose octabenzoate undergoes bromination reaction using brominating agent[*9] results maltose bromobenzoate which further refluxed with lead thiocyanate[*10] in boiling xylene medium for 3 hrs, obtained maltose isothiocyanate as the product followed by trituration with petroleum ether. Derivatives of 1-hepta-O-benzoyl-β-D-maltosyl-5-aryl benzothiazolyl thiocarbamides were prepared by the condensation reaction of 1-hepta-O-benzoyl-β-D-maltosyl isothiocyanate and substituted benzothiazol[*11] (1:1) in benzene solvent (30 ml). The reaction mixture was refluxed over water bath for 3 hrs. and solvent was distilled off, the sticky mass obtained as residue was triturated several times with petroleum ether. A white granular solid was obtained as a product.

Conclusion:

The work related to above scheme has started with Synthesis of intermediate Maltose isothiocyanate, which were transformed in to derivatives of benzothiazolyl thiocarbamides. Isothiocyanate acts as a good intermediate and provides good binding site for various nucleophilic substrates. Synthesized NPs were characterized by Field Emission Scanning Electron Microscopy and X-Ray Diffraction which confirms the size of NPs was found to promising. According to FESEM the average size of NPs was 59.52 nm which is very effective in case of biological activities.

Acknowledgements:

SCZ and NVA are thankful to BGE society and Shri. R. L. T. College of Science for providing research facilities.

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To Investigate of Insecticidal and Insect Repellent Phytochemical Property of Seed Extract of the Thevetia Peruviana

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Abstract:

The medicinal plant has been more beneficial and demanding properties for various applications due to traditional application and dements of people. In this study, we studied the insecticide and insect repellent Phytochemical of Thevetia Peruviana plant. Each plant there is some own properties are present that, in this plant the ins lot of property are present in that such as antifungal, toxically, antibacterial, antimicrobial, antimalerial etc, is quite evident from this review that Thevetia Peruviana contains a number of phytoconstituents which reveals its uses for various the rape tic purposes, looking upon wide prospects and potential of Peruvian for various purposes. The study can be tried on various fruit stores trict the action of fruit flies, bacteria or fungus and thereby enhancing their shelf-life. The commercial application of leaf extract Thevetia Peruviana, Plant of thevethia peruvinaaisea has their chemical consistuent, in this plant each and every part is poisonous but most powerful chemical is found in their seed.In this seed most poisonous chemical is present. In the research work we carried out the work on seed and prepared the chemical by nature source of the insecticide base is present in thevethia peruvinaa extract. The extract solution is present property, it is act as antibacterial, and antibiotics, antimicrobial. It is use in farming purpose, it is using the home-made paste control and it is present insecticide property so it will use in farm.
Keywords: Thevetia Peruviana, medicinal plant, antibacterial, insecticide and Phytochemical.

Introduction:

In our nation and all our surroundings there is lot of plants, there is some are useful and some are dangerous in nature. But we know that some plants are very useful to us. It is using act as medicine for cure the disease (1). In ancient time man is survived by eating fruits of plant food. They were dependent in nature. When plant is modified as a medical Purpose we also called as drugs or medicine. The plant is very playing important role in health system in any nation. Different type of plant is many uses, such as it is using act as medicine, it acts as drugs (2). Plant contained different type of property, such as anticipated, antibacterial, anti- inflammatory, anticancer, antioxidants, etc. In plants there is most of plants include in alkoniods, glucoside Terpenoid, tannis etc (3).

Thevethia peruvinaa is one of most important plant. It is mostly found in all countries are available. It is evergreen plant. It is mostly found in tropical and subtropical Region. It is most useful for the pharmacological and medicinal uses (4). The plants are beloning to apocynanesee is called yellow oleander. The plant is evergreen, the mostly length is found 3-8 m long and their length is15-18cm long. The flower of thevethia peruvinaa is found in yellow, it is attractive in nature. The peers have been found; it is contained oil. This oil is beneficial to health. Each of revery plant contains milky juices (5) Pharmacological properties.

Botanical name	**Thevetia Peruviana**
Family –	apocynanesee
Genus–	Thevethia
Kindom–	plants
Common name–	bitti,yellowkaner, yellowoleander
Synonyms–	Cascabela thevethia, thevethia nriifolia



The plant is mostly found in South America, Maxco, Brazil, West-Indies, also found in India (6). Thevethia peruvinaa is grown for ornamental purposes, and intemperate climates, it is typically planted as a large flowering shrub or small ornamental tree standard in Garden sand parks. For Many years, missionaries and explorers have grown as a decorative plant in temples, residences, Schools, gardens, churches and by the sides of roads. Though widely cultivated in tropical and Subtropical are as of the world (7).

Now recently, we will study the phytochemical and some insecticidal and insect repellent and pesticidal property. The milky juice of thevethia peruvinaa is most toxic in nature, in their Peers of thevethia peruvinaa theirs is oil it is dangerous in Nature. Some study the pest Control property and phytochemical property. We will find some what type of chemical present in the plant is found out.

2. Experimental work:

1. Collection of Thevetia peruvinaa seed:

The fresh, seed of Thevetia Peruviana were collected from rural areas of mana village,taluka-murtizapur Dis-akola. The plant materials of Thevetia Peruviana seed were washed with tap water, shade Dried at room temperature and powdered by an Electrical blender.



Fig 2.1 Collection of Thevetia peruvinaa seed:

2. Steam Distillation method-In this method, 20gm Thevethia peruvinaa seed powder dissolved in 200 ml solvent in benzene, chloroform, ethanol and continues heating for 3hr.After process is carried out get seed extract. All seed extract is filtered



Fig 2.2 Steam Distillation

3.**Filtration-** Filtration is a method to separate the components of a mixture of a liquid and an insoluble substance.

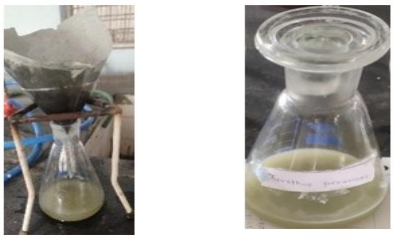


FIG 2.3 Filtration of Seed extract

4. Column chromatography technique–:In column chromatography Technique the mixture of molecule is separated based on their different partition coefficient between mobile and stationary phase . Initially the column is washed with distilled water, plug a Pasteur pipet with small amount of cotton used wood applicator to clamp the column to stand. Add dry silica gel into the column, when properly packed, the silica gel fills the column to just below the indent on the burrete, then add the cotton tightly. Then transfer it HCl solvent upto bottom and then remove it. Then add the sample mixture load to the column, process is carried out, the colored bands will travel down the column as the compound.





5. Ultrasonics machine –In this method the all the seed extract a dissolve the 2gm of arsenic metal, the arsenic metal is toxic in Nature to the toxicity of solution, then the beaker transfer to the machine and continue apply the vibrations and heating for1 hrs. After the process the metal is totally mixed in the sample.



Fig 2.5 Ultrasonication of Arsenic metal in plant Extract

6. TLC Chromatography: TLC used to help determine the number of components in a mixture, the identity of compounds, and the purity of a compound.,Weuse TLC 3.5cm and add the seed extract drop and seed extract and arsenic drop then TLC plate. Compose the mixture of ammonia,purified water and acetone. As solvent system on chromatogram applied the thevethia peruvinaa solution was applied the standard mixture of scopolamine hydobromide and atropine sulphate was used out of which 10 u is applied. Transfer to the solvent system and rest out,thes pot is formed, then TLC plate is transfer to the uv-cabinate and mark the spot, and calculate the RF value, after calculating the Rf value, the Rf value is 0.45 is find, ursolic acid is present cause the Rf value of ursolic acid is 0.45,so this chemical present in thevethiaperuvinaa plant.

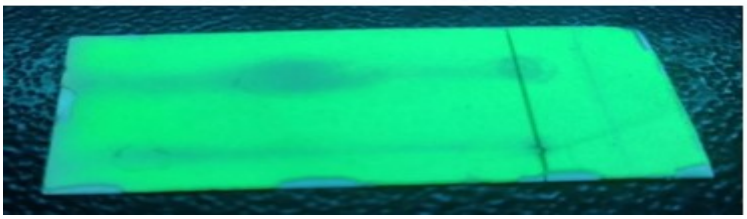


Fig 2.6 TLC Chromatography

3 Results and Discussion:

3.1. High-performance liquid chromatography (HPLC)

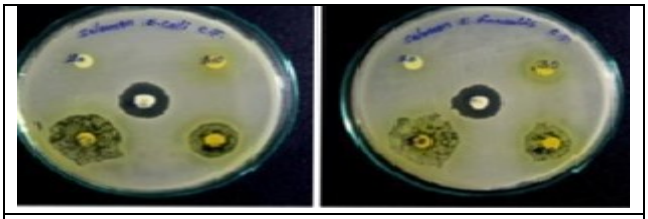
HPLC analysis was done (Kimetal.,2006) utilizing a liquid chromatography from the Agilent Technologies1100 series with a diode-array detector. The acetonitrile (A)Mobile phase contained 2% acetic acid in water (v/v)(B).The whole run time was70min, with a flow rate of 0.8ml/min. The gradient programme went from100% to85% in 30min, from 85% to 50% in 20 min, from 50% to 0% in 5 min, and from 0%to100% in 5 min. was the inject Hion volume. Peaks for the derivatives of benzoicacid and cinnamic acid were observed at 260,330, and 370 nm. Peaks were noted when UV Spectra and Retention durations were compared to standards.

3.2 Antibacterial susceptibility test. –Solomonet.al,

The disc diffusion method (Baueretal.,1966) was used to screen the antibacterial activity. In-vitroantibacterial activity was screened by using Muller HintonAgar(MHA)obtained from Himedia (Mumbai).The MH A plates were prepared by pouring 15ml of molten media into sterile petriplates. The plates were allowed to solidify for 5 minutes and0.1% inoculum suspension was swabbed uniformly and the inoculums were allowed to dry for 5minutes. The compound of concentration 20mg/ml, 30mg/ml,40mg/ml,50mg/ml were loaded on 6mm steriledisc. The loaded disc was placed on the surface of medium and the Compound was allowed to diffuse for 5minutes and the plates were kept for incubation at $37^{0C}$for 24hrs.At the end of incubation, inhibitionzones formed around the disc were measured with a transparent ruler in millimeter. Standard antibiotic chloramphenicol of concentration1mg/ml was used as positive control [9].

3.3 Antimicrobial activity

The antimicrobial activity of ethanol extract obtained from Thevetia peruviana was tested against bacterial species of Escherichia coli, Enterobacter Aerogenes, Proteus vulgar is and fungal species of Escherichia coli, and Penicillium spp. Better antimicrobial activity was observed with the extracts showed maximum activity against E.coli.(10).



1) Escherichia coli, 2) Penicillium spp

Fig 3.3 Antimicrobial Activity of Plant Extract

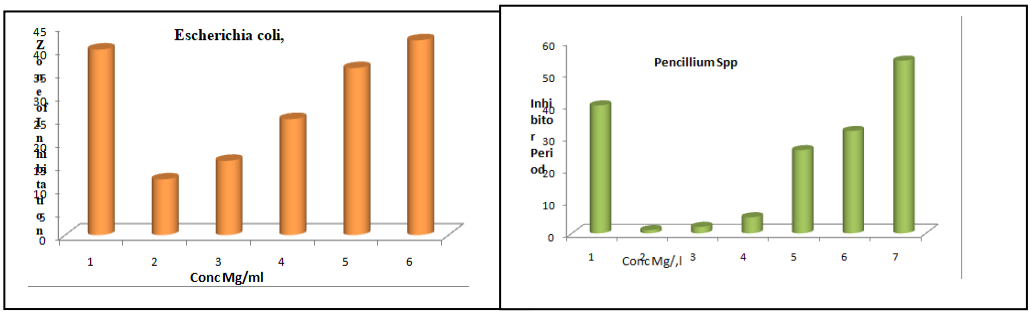


Fig 3.1. Graphical Presentation of Antimicrobial activity

3.4 Properties and constituents

As reported work in reference SinghKishanetal.IRJP2012,3(4). The plant Seeds Extract contain a toxic glucoside, thevetin, Seeds yield a fixed oil containing triolein 63%, tripalmitin and stearin,37%. Thevetin has been classified with the digitalin group so activity on the heart muscle, blood pressure lavation, heart-irregularities. It also causes increased intestinal peristalsis, increased salivation, and pupil contraction.

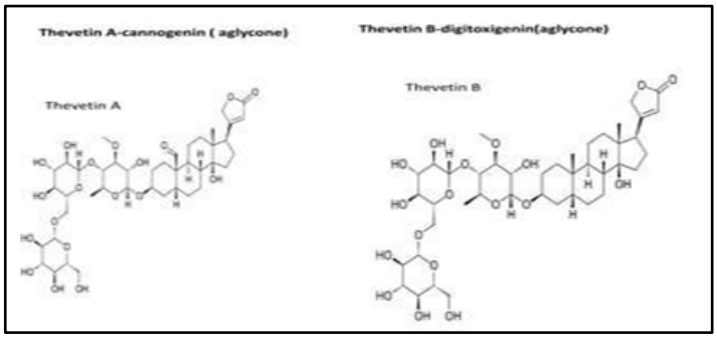


Fig 3.2. Chemical constituent present in Thevethia peruvinaa

Properties Barkismetic, febrifuge, and antiperiodic. Milky juice is poisonous and vesicant. Chemical constituent present in Thevethia peruvinaa plant seed extract is as reported in http://www.ijcmas.com,Pharmacognosy Communications, 2023.as follow as

3.5. Antimicrobial activity on fungus-

The prepared both the solutions pure with the metal are spread on the fungus Separately and then observed the change with the microscope study.

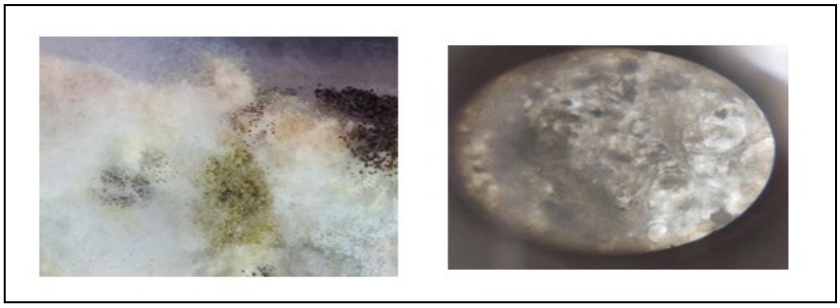


Fig 3.3. Result Action of pure thevethia peruvinaa extract on fungus and bringle plant.

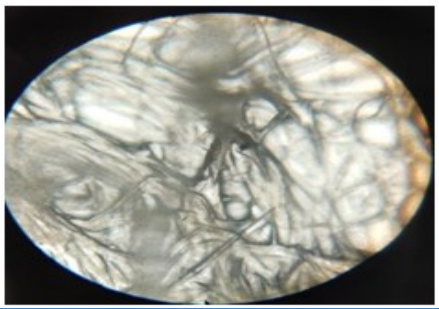
Case-1.Action on Thevethia peruvinaa extract- **While the thevethia peruvinaa extract spread on the fungus the black spot is observed on it. Firstly, the white colour are seen the microscope** **By applying thevethia peruvinaa extract the a10%growth of fungus we ripstop with in15min.**	
Case-2. Action of thevethia peruvinaa extract on bringle plant- **By applying pure extract on plant the12% results obtained in15min and dead the insect.**	

Fig 3.4 case study the spraying action on fungus and insects.

Day	Concentration	Percentage
Day1	1:10	No change
Day2	2:10	5%
Day3	3:10	10%
Day4	4:10	20%
Day5	5:10	30%
Day6	6:10	40%
Day7	7:10	54%
Day8	8:10	64%
Day9	9:10	70%
Day10	10:10	80%

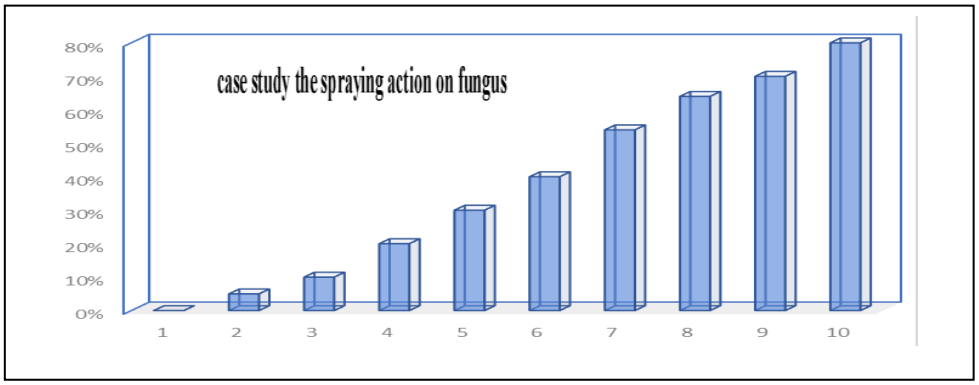


Fig 3.5. Graphical Presentation of plant extract Insecticide activity

Table1-Observation table for pure extract of thevethiaperuvinaa.

From the above observation table the experiment carried out upto10 day. In the day1obserd the10% results is obtained, then day2 we are observed 20% results is obtained, then up to procedure is carried out the day7 get 54% and lastly the day10 get 80% results and up to more insect death because the thevethia peruvinaa plant is toxic is nature. So toxically effects show in this bringle plant.

ResultsB-.Action of thevethiaperuvinaa extract+ Arsenic metal on fungus and Bringle plant

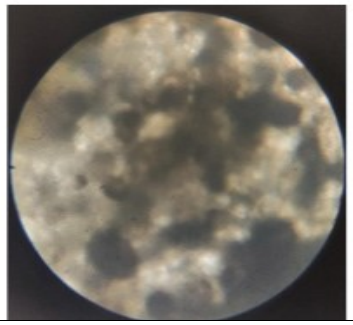
Case-1.Action on Thevethia peruvinaa extract- When the arsenic metal extract spread on the normal fungus then more blackspot are observed. Due to reason arsenic metal is more toxic in nature .and more toxicity of solution because Arsenic tri oxide to help the rate of growth of fungus destroy in10min. than thevethia Peruviana extract.	
Case-2. Action of thevethia peruvinaa extract on bringle plant- **Live experiments on bringle plant-** When the thevethia peruvinaa with arsenic metal spread on the crop insect then observed all insect few insects is slowly death and some insect Fastly death, this experiment is carried out10 day on plant. Lastly when increasing the toxicity of solution and give the 97% result due to the toxicity of solution because the arsenic metal to control the stop growth of bacteria and insects.	 

Fig 3.5. case study the spraying action Arsenic metal extract on fungus and insects.

Day	Concentration	Percentage
Day1	1:10	10%
Day2	2:10	17%
Day3	3:10	20%
Day4	4:10	30%

Day5	**5:10**	**50%**
Day6	**6:10**	**63%**
Day7	**7:10**	**70%**
Day8	**8:10**	**78%**
Day9	**9:10**	**84%**
Day10	**10:10**	**97%**

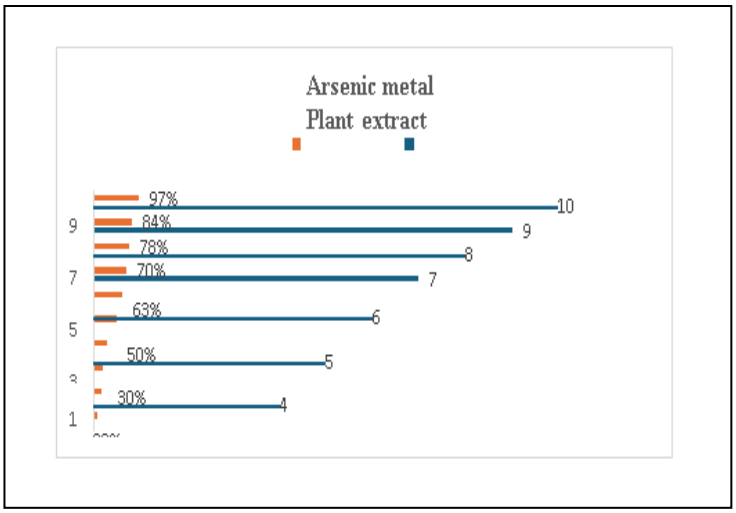


Fig 3.5. Graphical Presentation of Arsenic metal plant extract Insecticide activity

Conclusion –

We know that the thevethia peruvinaa is one most important plant it is observed is surrounding. this plant there is lots of medicinal uses, and also toxically Substances are also present in this plant, in the toxically property is human society and also use in farm. In the present study we focused on the investigation of Phytochemical and Insecticidal properties of Thevetia peruvinaa seed Extract. The sufficient availability of more time duration, Instrumentation and Research facility or funding we will definitely Modify the work into the advanced level and finalize product can be use In the form of a spray on crop to control the insect but firstly we willer form the experiment in field and then finalized.

In this seed most poisonous chemical is present, we carried out the work on seed and prepared the chemical by nature source of the insecticide base is present in thevethia peruvinaa extract. The extract solution is present property, it is act as antibacterial, and antibiotics, antimicrobial. It is use in farming purpose, it is using the home-made paste control and it is present insecticide property so it will use in farm. The arsenic metal plant extract is more powerful tool to develop the nano-spray in the field of farming and home-made insecticides controller. If the work geta Success in future then it can be market.

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Relative And Specific Viscosity Studies of Substituted Benzimidazole Phenyl Thiourea In 70% Dioxane -Water at Different Temperature 298, 300 And 305^{0}c

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Abstarct

Benzimidazole derivatives are important biologically active heterocyclic compounds and are among the ten most widely used five-membered nitrogen heterocycles in drugs approved by the U.S. Food and Drug Administration (FDA). Benzimidazole derivatives have acquired a unique identity in medicine and medical science over the past decades. As a result, viscosity studies were conducted at 70 % of the various ratio of solvents. The combination of components, which is the intermolecular -molecular gorgeous force between the dissolved permeability, and the dielectric permeability of the medium and the percentage of research, emphasizes the results.

Keywords : Substituted Benzimidazole ,dioxane water and viscometric measurements.

Introduction

Benzimidazole (also known as 1H-benzimidazole, 1,3-benzodiazole, benzoglyoxaline, iminazole and imidazole) is an aromatic organic compound containing a benzene ring fused at the 4,5-position to an imidazole ring to form a 2,3 bicyclic ring[1-3] .The electron-rich nitrogen heterocycles of benzimidazole can easily accept or donate protons and easily enable the formation of multiple weak interactions, offering the advantage of binding to a wide repertoire of therapeutic targets, thus exerting broad-spectrum pharmacological activity. Increasing evidence has reported the broad pharmacological profile of benzimidazole and its derivatives, in several classes of therapeutic agents with unique properties, including antimicrobial [4-5], antituberculosis [6-7], antiviral, ulcers [8-9], anti-inflammatory, diabetes medicine, anticonvulsant[10], blood pressure and malaria medicine [11-12]. We used viscosity measurements to obtain information about solute-solution interactions. Interaction of aqueous and non-aqueous solutions of binary mixtures with the β-viscosity coefficient using this measure by many colleagues [13-27]. Recently some workers have introduced measurement of viscosity and refractive index, so this study involves measuring the viscosity of Benzimidazole derivatives, the broadest spectrum antibiotic, at different temperatures.

Experimental Section

All chemicals are of analytical reagent grade (AR) and from Sd -Fine Chemicals (India) were used without further purification. Viscosities were measured using a cleaned and dried, Oswald viscometer kept in a thermostatic water bath (± 0.10 c) with sufficient time allowed between each measurement to allow for temperature changes. The density of the solutions was determined with a calibrated two-capillary pycnometer deionized with double-distilled water. This study deals with the measurement of the viscosity of the ligand Benzimidazole derivatives in a 70% dioxane-water mixture at different compositions and temperatures of 298°k, 300°k and 305°k. Viscometric values were taken from a literature review. The determined results were mentioned, the A- and β -coefficient values were calculated in the following table.

Table: Determination of Relative and Specific Viscosities at 70% Dioxane-Water

Temperature (^{0}k)	Concentration (M)	Time flow (Second)	Density (ρ) g.cm^{-3}	Relative Viscosity ηr	Specific Viscosity sp= ηr -1	ηr - 1/√C	A-Coefficient	B Coefficient

298°k	0.100	87.8	1.0240	1.3765	0.7864	1.48681	3.67	**-1.7490**
	0.075	85.8	1.0249	1.3813	0.6913	1.52390		
	0.050	84.2	1.0245	1.3124	0.6226	1.63053		
	0.040	82.0	1.0331	1.2403	0.5503	1.68471		
300°k	0.100	88.9	1.0337	1.4430	0.5532	1.74841	3.17	**-1.8850**
	0.075	86.9	1.0345	1.3883	0.4984	0.81992		
	0.050	84.4	1.0334	1.3202	0.4402	0.86017		
	0.040	82.9	1.0349	1.2887	0.3986	0.84496		
305°k	0.100	87.9	1.0335	1.3276	0.4176	0.52056	2.78	**-2.8851**
	0.075	86.9	1.0322	1.3064	0.4165	0.52083		
	0.050	85.4	1.0225	1.2794	0.3695	0.56056		
	0.040	**81.8**	**1.0319**	**1.2543**	**0.3443**	**0.68102**		

Result And Discussion

The Jones-Dole equation $(\eta r - 1) / \sqrt{C} = A + B\sqrt{C}$ where C is the molar concentration of the ligand solution, A is the viscosity coefficient that measures the solute-solute interaction, and B is the measured viscosity. coefficient and the relative viscosities are analyzed solute to substance-solvent interactions. Graph of $\sqrt{C}$ vs $(\eta r - 1) /\sqrt{C}$. Each system shows a linear straight line, which is the validity of the Jone-Dole equation. The slope of the linear graph gave the value of the β coefficient. Strong hydrogen bonding was observed, indicating weak solute-solvent interactions.

Conclusion

Based on the results, ligand concentration is directly proportional to ligand density and relative viscosity at 298°k, 300°k and 305°k for a 70% dioxane-water mixture. Due to the weak solvation effect, which indicates a weak molecular interaction, the values of A and β coefficients are negative, which represents a weak solvent-solvent interaction, which is good for drug-receptor interactions with considerable drug activity and pharmacokinetics. It has a weak molecular interaction due to the ligand density and relative viscosity, which is inversely proportional to the temperature of the solution. It specifies that when the temperature of dioxane-water increases, the weak solute-solvent interaction, that is, the interaction between the mediator (drugs) and dioxane, which can stabilize the drug activity, increases. It can be concluded that ligand-drug absorption, drug transfer and drug effect are more effective at higher dioxane-water temperature.

Acknowledgement

I would like to thanks to the Adv. Salimji Bappumiya Patel, President - Satpuda Shikshan Va Gramin Vikas Sanstha, Palshi Vaidya and Principal, Bapumiya Sirajoddin Patel Arts, Commerce and Science College, Pimpalgaon Kale, for providing necessary facilities.

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An analysis of the geochemical composition of groundwater in rural and urban area of Karanja Tehsil of Washim District (MH).

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The purpose of this study is to evaluate the quality of the groundwater in Karanja, Maharashtra. The present study aims to estimate groundwater excellence indices in order to assess the suitability of groundwater resources for agricultural and drinking purposes based on water quality. 25 samples of groundwater were gathered, and several geochemical parameters, such as pH, total dissolved solids (TDS), total hardness, cations, and anions, were examined. The study region's groundwater has a neutral to slightly alkaline pH. The bulk of the samples, according to Piper's schematic categorisation, belong to $CaMgHCO_3$ hydrochemical surface. The bulk of samples fall into the rock dominance, according to the Gibbs plot. The entire sample falls into the good water category, according to the water quality index. The studied area's groundwater is suitable for agricultural use based on several water quality indicators.

Introduction

In India's rural and urban areas, groundwater is the primary source of drinking water. Because to the massive use of chemical fertilisers, industrial development, urbanisation, and other human activities, contaminating the groundwater. As stated the world health organisation estimates that 80% of human illness arises from the declining standard of drinking water. Because of the scarcity of surface water, which is made worse by pollution, urbanisation, and industrialisation, as well as the misconception that groundwater is uncontaminated, most people in India rely on groundwater resources for domestic, industrial, and agricultural purposes [1]. The vast majority of people living in rural India are reliant on groundwater. Around 65% of all agricultural land is irrigated by groundwater, making it the greatest abstractor and primary user of groundwater resources worldwide [2-3]. Although surface water was once thought to be safer than groundwater, groundwater contamination has increased recently as a result of poor waste management [4]. The properties of the soil and rock media that groundwater flows through to reach the saturation zone of the groundwater determine its chemical quality [5]. It also depends on how long the water is kept underground (called residence time) [6]. Numerous investigators investigated the hydrochemical properties of groundwater and its quality in various basins, including metropolitan regions [7]. Therefore, understanding the hydrochemistry of freshwater is crucial to evaluating the groundwater quality, particularly in rural regions where it affects the groundwater's appropriateness for industrial, household, and irrigation purposes. Groundwater is therefore an extremely valuable natural resource. The degree of groundwater-related environmental issues varies from location to location based on influencing geological, hydrologic, climatic, and geochemical elements. Nonetheless, research on groundwater quality has been done in several locations with regard to irrigation and drinking in India. The goal of the current study is to determine the effects of both natural and man-made processes on groundwater chemistry, as well as to establish groundwater quality indices for the suitability of groundwater resources for agricultural and drinking purposes.

Research domain

Location

The samples were gathered in Karanja Taluka, Washim District, Maharashtra, from both rural and urban regions. The research region's sampling location map is displayed in Figure 1. The primary rationale for selecting this specific research location is the region's reliance on groundwater. In this area, groundwater is utilised for commercial, household, and agricultural uses.

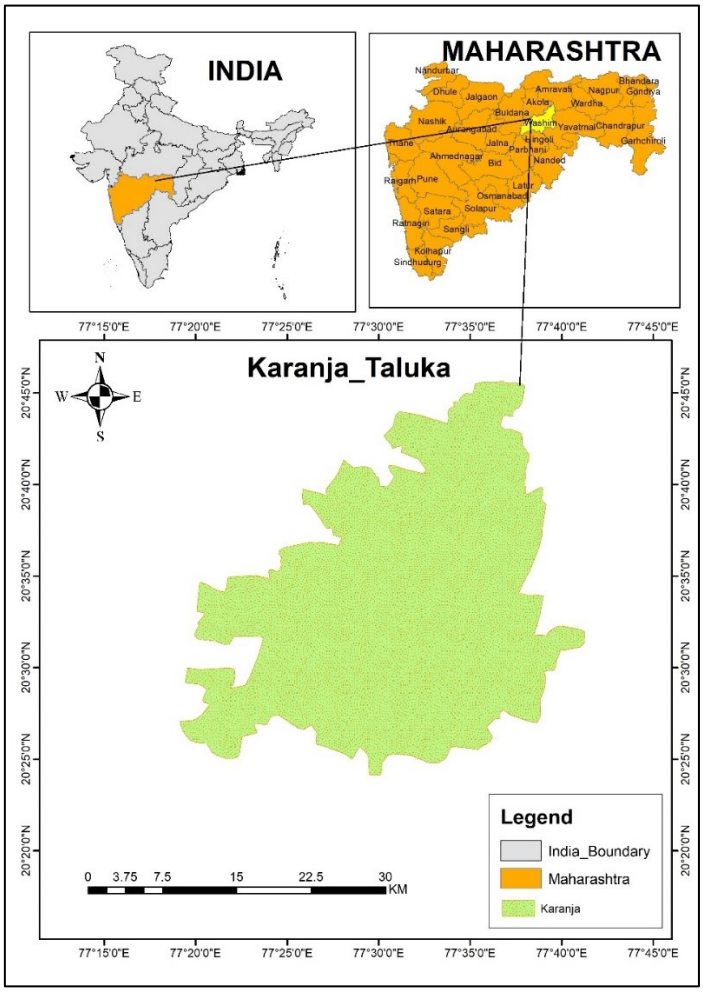


Figure. 1 Research region Karanja Taluka Map

Geology and hydrogeology

Field Experience

To assess the chemistry of groundwater, twenty samples of groundwater were gathered. In the current study, a selection measure was constructed before data assortment to help identify appropriate sample locations for the groundwater quality assessment. These hand pumps, bore well and wells were selected for sample collection because they were active, functioning, and continuously used for human consumption and other everyday tasks. The samples were collected, preserved, and examined using the standard procedures outlined in APHA and BIS. Samples were gathered in polyethylene containers that had been properly labelled and cleaned with groundwater sample before to filling. To neutralise the electrical conductivity (EC) and eliminate the influence of the stagnant water in the metal shell, groundwater tests were taken five to ten minutes after the water was flushed.

Geochemical parameters analysis

Using a portable ion selective electrode based multi-parameter water analysis kit (HANNA Portable Multiparameter), geochemical parameters such as dissolved oxygen (DO), temperature, pH, total dissolved solids (TDSs), oxidation reduction potential (ORP), electrical conductivity, chloride, fluoride (ORP), salinity, and nitrate were analysed at the sampling location. Throughout the investigation, verified standard solutions were used to calibrate every equipment. The inventory of instruments utilised with a minimal degree of detection is shown in Table 1. The obtained samples underwent hardness and alkalinity utilising the BIS procedure in less than 24 hours. The H_2SO_4 titration method employed methyl orange and phenolphthalein as indicators to assess total alkalinity, whereas the ethylenediaminetetraacetic acid complexometric titration method measured total hardness. Analytical grade (AR) chemicals and reagents were used in the chemical process.

Spatial distribution mapping

When interpreting spatial data properties across a geographic region, the spatial distribution approach might be helpful. Evaluations of spatial patterns, distribution trends, pattern flow, area relationship, proximity, distance, placement, and spatial relationship are also beneficial [8]. The GIS is an effective tool for evaluating and analysing monitored data because this specific tool monitored water quality data set, which has time and location properties [9]. The geographical data of water quality based on distance weighting is interpolated in the current study using the inverse distance weighting (IDW) interpolation method. Spatial distribution analysis of water quality parameters was performed using ArcGIS software, 10.8 version.

Results and discussion

Hydrogeochemical facies

The dominant ions in the water facies are determined by the Piper trilinear diagram (Piper, 1944), where major ions are plotted in two base triangles as major cations and major anions [10]. The analysis of the Piper diagram indicates that the dominant ions in the study area are bicarbonate and alkaline earth (Figure 2), and the major water type of the study area is the $CaMgHCO_3$ type.

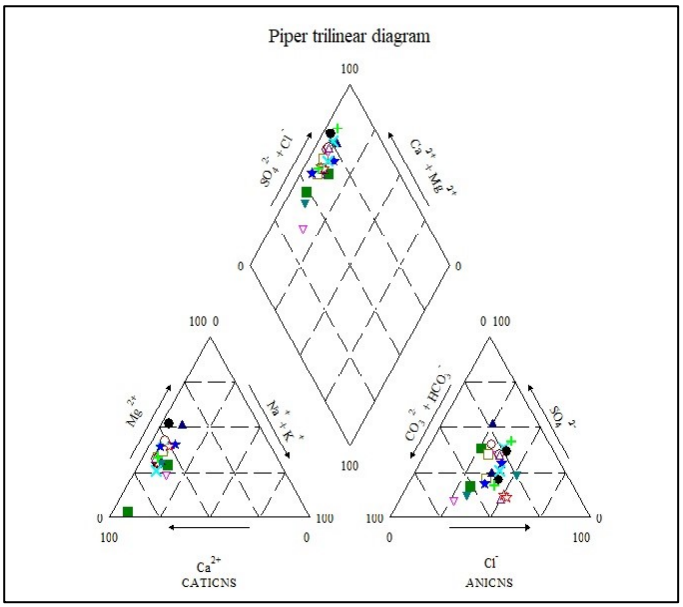


Fig. 2 Trilinear diagram showing the relative cation and anion composition of groundwater samples**.**

Gibbs plot

In order to better understand the hydrogeochemical processes with respect to rock-water interaction, atmospheric precipitation, and evaporation over the management of groundwater geochemistry, Gibbs (1970) developed two diagrams [11]. The graph of the ratio of anions [Cl/(Cl + HCO3)] and cations [(Na + K) / (Na + K + Ca)] against TDS is known as a Gibbs plot. According to the Gibbs plot (Figures 3a and 3b), every sample in the research area comes from rock dominance. The primary mechanism regulating groundwater chemistry in alluvial plains is the rock-water contact [12].

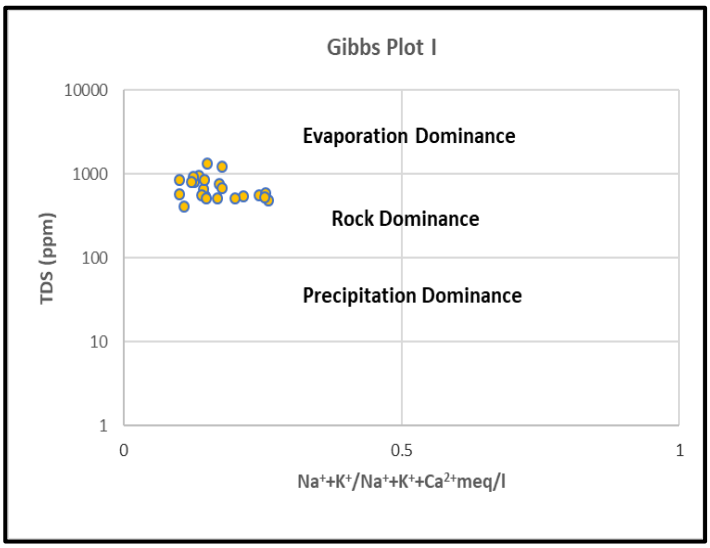


Fig.3a Mechanism controlling groundwater chemistry (Gibbs I).

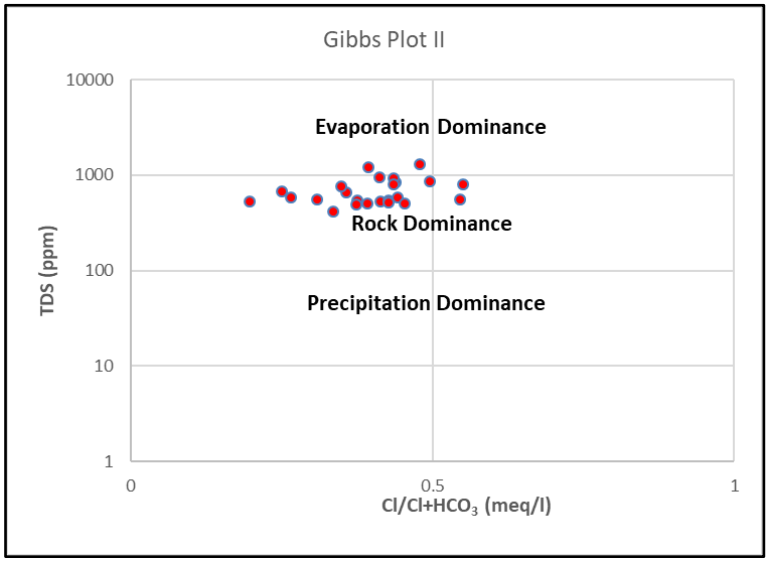


Fig.3b Mechanism controlling groundwater chemistry (Gibbs II).

Wilcox Diagram

Wilcox (1948) assessed the appropriateness of groundwater for irrigation using specific conductance and salt percentage. The ratio of sodium to all cations sodium, potassium, calcium, and magnesium is determined by the sodium percentage. The units of expression for all concentration values are equivalents per million (epm). According to Table 1 findings, groundwater close to the upstream is suitable for irrigation, but large levels of pollution are discovered close to the downstream (Fig. 4). This may be the result of both home sewages dumped into the river and industrial effluents.

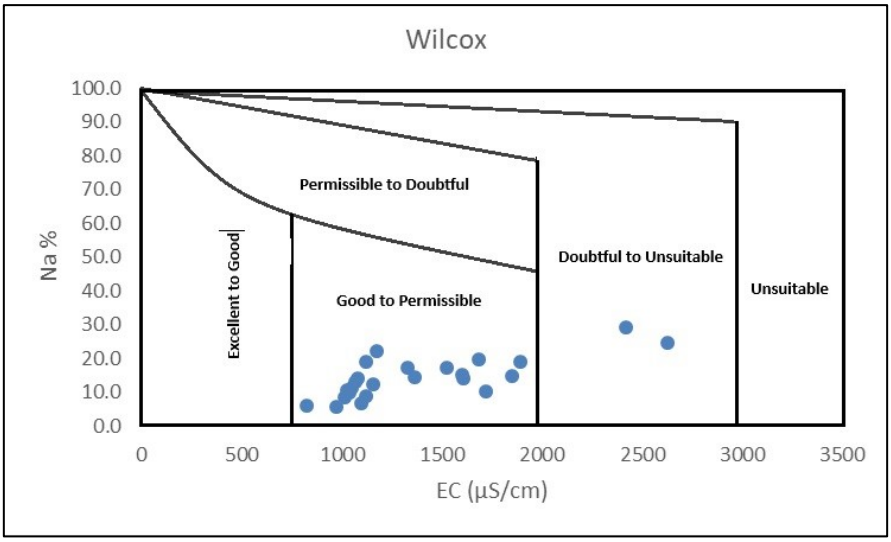


Fig.3 classification of groundwater samples on the basis of electric conductivity and percent sodium (Wilcox, 1948).

Geochemical parameters analysis

The water geochemical parameters in the samples that were obtained were subjected to a statistical analysis, with the findings presented in Table 1. The differences were found to be between 6.85-7.86, 824-2628 μScm^{-1}, 199.5-301.8 mV, 412-1314 ppm, 2.98-5.20 ppm, 50.4-148 ppm, 0.33-0.87, ppm, 9.72-45.8 ppm, 105-743ppm, and 89-298 ppm for pH, electrical conductivity, ORP, TDS, DO, chloride, fluoride, nitrate, hardness, and alkalinity, respectively. The lowest, median, and maximum concentrations of many geochemical parameters from water, such as TDS, alkalinity, nitrate hardness, and chloride, are graphically depicted in Figure 2. Total dissolved solids (TDS) were found to have an average value of 695 mg/L and to vary in value from 412 to 1314 mg/L. The percentage of samples with results over the permissible limit of 1000 mg/L is just 8 %.

Table 1. Ranges of chemical parameters and their comparison with World Health organization (2011) standard for drinking water.

Paraneters	Min	Max	Average	Median	SD	WHO (2011) Permissible limit
pH	6.85	7.86	7.36	7.29	0.28	9.2
TDS (ppm)	412	1314	695	583	230	1000
EC (µS/cm)	824	2628	1390	1166	461	--
ORP (mV)	199.5	301.8	258.2	266	29.31	--
DO (ppm)	2.98	5.2	3.99	3.93	0.55	--
Floride (ppm)	0.33	0.87	0.51	0.45	0.16	1.5
Chloride(ppm)	50.4	148	92.7	90.5	23.1	250
Nitrate(mg/l)	9.72	45.8	17.3	14.6	7.8	50
Sulphate (mg/L)	21.3	274	94	70.3	62.2	500
Phosphate (mg/l)	1.9	16.4	7.2	6.7	3.8	--
Total hardness(mg/l)	105	743	367	331	162	500
Ca^{2+} (mg/l)	18	173	92	85	40.5	200
Mg^{2+} (mg/l)	2.1	76.9	33.4	29	18.3	150
K^{+}	0.6	5.9	2.7	2.5	1.4	12
Na^{+}	5.7	29.1	14.3	14.1	5.9	200

Spatial distribution mapping

The interpolation approach (inverse distance weighted) is used in the current study to forecast the link between the geographical distribution patterns and the water quality measures. The primary reason for using the inverse distance weighted (IDW) interpolation method is because it is a deterministic estimating technique in which values at adjacent known locations are linearly combined to determine values at unknown places. This technique is useful for visualising the parameters over the research region. The generated maps, which display the geographical distribution of water, are displayed in Fig. 5a–c. quality standards across the whole research region.

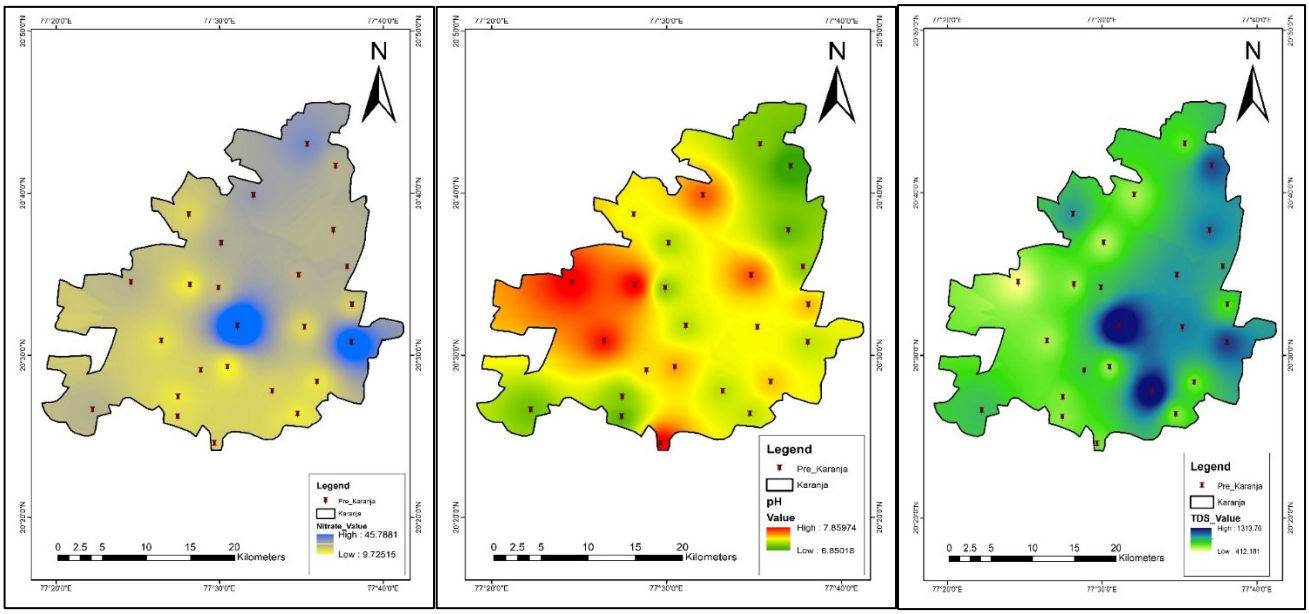


Fig.5a-c Spatial distribution map (Nitrate, pH and TDS)

Water quality index (WQI)

A key factor in determining groundwater quality and suitability for human consumption is WQI [13,14]. According to WQI, ranking is a technique that provides the coordinated management of the main water quality

parameters on the overall superiority of water for human consumption [15]. The weighted arithmetic index method, developed by Brown et al. in 1972, is a technique to calculate the water quality index (WQI). The WQI is a rating that assesses the overall water quality by taking into account the impact of each water quality parameter. The method is based on the most commonly measured water quality parameters.

WQI is calculated from the following equation

$$WQI=\Sigma QnWn/\Sigma Wn$$

Table 2 shows the classification of water quality status based on Water Quality index [16-17].

Class	WQI value	Water Quality Status
I	<50	Excellent
II	50-100	Good Water
III	100-200	Poor water
V	>300	Water unsuitable for drinking

The research region's WQI value falls between 22.16 to 56.6 Based on WQI, all of the water samples are excellent water types except 2 samples shown in figure 6.

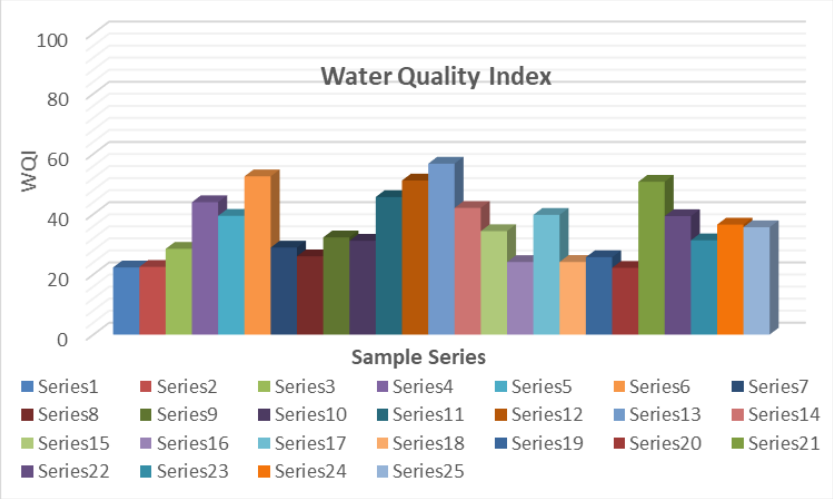


Fig. 6 Type of water based on WQI in the study region.

Conclusion

To determine the condition of groundwater quality for use in agriculture and drinking, traditional hydrogeochemical methods and quality indices are employed. We may infer that both natural and man-made causes influence the geochemistry of the studied area. Because of the inflow of HCO_3 ions in the groundwater aquifer, which is created by the interaction of the CO_2 existing in soil space and rains, the groundwater of the study region is neutral to slightly alkaline in nature. 90% of the samples are classified as $CaMgHCO_3$ water types, with the remaining samples being mixed types, according to the piper trilinear diagram. According to hydrogeochemistry, cation abundance is arranged as follows: Ca > Na > Mg > K. Almost all of the samples are safe for use in agriculture after calculating several indices and ratios that are frequently used in research to determine the fitness of groundwater for agricultural use.

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Synthesis of 1,3-disubstituted Thiobarbituric Acids by Eco-friendly Alternative

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Abstract:

The simple and efficient method developed for the synthesis of functionalized 1,3-disubstituted thiobarbituric acids by the reaction of symmetrical and unsymmetrical 1,3-disubstituted thiocarbamides and dicarboxylic acid (malonic acid) with in organic acid medium. This method provides easy access to liquid chromatography purification and simple stirring reaction at room temperature with remarkable features includes the wide range of functionalized target molecules. The present protocol has equal quantity of acetic acid used and reduces the use of acetyl chloride with excellent yields. Thus rendering the methodology is highly eco-friendly alternative to existing methods. All synthesized molecules were characterizes by by 1H, 13C NMR, and MS spectra.

Keywords: *Thiocarbamides, thiobarbituric acid, acetic acid, unsymmetric barbituric acid.*

1.Introduction

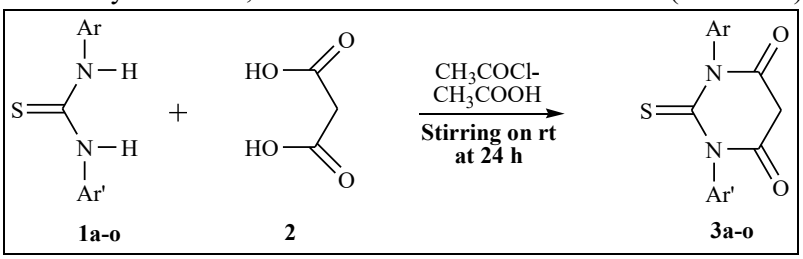
Inorganic, organic solvents are utilized in synthesis, which poses potential risk to environment and significantly contribute to the generation of hazardous squander, constituting an important wellspring of volatile organic compounds (VOCs) emission [1]. In this regard, the utilization of unsafe solvents in synthesis can represent an issue of environmental, health and safety concern. The search for safer solvents is distinguished as a reasonable need toward sustainable chemical processes. In fact, several principles of green chemistry [2–5] refer to this problematic issue. Thus, the 5th principle of green chemistry specifically refers to the use of safe synthetic methods whenever possible or their replacement by more secure choices. The term 'green solvent' has been referred to those solvents that enable minimizing the environmental impact that result from their use in chemical processes [6]. Apart from their direct impact on the environment, some other aspects are assessed to consider a solvent as green, namely, health and safety issues, but also indirect impacts derived from their production, use and disposal including, for instance, depletion of nonrenewable sources, potential solvent recycling and energy consumption in their synthesis, recycling and waste treatment [7].

Green approach in recent time is constantly challenged by expanding environmental concern [8]. In such manner, the utilization of harmful solvents in synthetic strategies can represent an issue of environmental, health and safety concern. Environmentally benign natural fruits and vegetables juice also attracting to research groups [9]. Fruit, vegetable juice and other organic solvents like acetic acid effectively behaves catalyst and solvents, these are non toxic, non hazardous, non polluting easily available and inexpensive. Such materials are examples of biocatalyst and carried out organic reactions like preparation of amides [10], triazole [11], Knoevenagel [12] condensation, Biginelli [13] reaction etc.

TBAs have gained considerable attention and their biological scaffold such as antimicrobial, antitubercular [14-15], antifungal [16], antitumor [17], antidiabetic and antibacterial [18] activities. TBA are good building block to use in varied organic transformations as precursor [19-22]. Hence, large number of efforts is being made to find out new routes and methodologies for the synthesis of TBA [23-24].

The goal of this perspective is to address the problematic of harmful organic solvent use in synthetic laboratory provide a framework for its replacement by their safer alternative solvent. The synthesis of Thiobarbituric acids (TBA) involves condensation of malonic ester with N-H/substituted urea in sodium alkoxide as catalyst, for 7h at 110° C to afford 72-78% of the products [25]. In addition there are few reports on the synthesis of N-H/substituted TBAs by reaction of malonic acid with N-H/substituted ureas in acetic anhydride and acetic acid [26-27], malonic chloride in Amberlyst-15 [28], malonic acid in acetyl chloride [29-33], malonates in DMSO and potassium *tert*-butoxide [34] and *N*-acyl thiourea with methyl malonyl chloride in dry 1,2-dichloroethane

[35]. Therefore, high temperature, long reaction time and excessive utilization of organic solvent has major drawback of the reactions protocol. We wish to report herein very simple, highly expedient, modified and efficient technique for the synthesis of unsymmetric 1,3-disubstituted thiobarbituric acids (Scheme 1).



Scheme- 1

1 Experimental

Melting points were taken in open capillary tubes and are uncorrected. Purity of all newly synthesized compounds checked by HPLC of Dionex Ultimate 3000 with PDA detection using reverse phase column Phenyl 5 µm, 150 X 4.6 mm, at 254 nm. ^{1}H (400 MHz) and 13C (100MHz) NMR spectra were recorded on a Bruker Advance-II 400 spectrometer from $CDCl_3$ solution with TMS as an internal reference. Chemical shift are recorded as ppm on the δ scale and multiplicities are described as s (singlet), d (doublet), dd (doublet of doublet), ddd (doublet of doublet of doublet), t (triplet), td (triplet of doublet) and q (quartet). The MS (ESI) spectra were recorded using mass spectrometer of Agilent technologies GC 7890A coupled with MS 5975C EI with Triple-Axis detection. Thin layer chromatography (TLC) was performed with E. Merck pre-coated TLC aluminium silica Gel 60 $F_{254,}$ and visualization was accomplished with ultraviolet (UV) light and by charring with suitable charring agent.

3. Results and Discussion

We planned to synthesize C–N coupling reaction by utilizing the corresponding thiocarbmides as the starting material. We examined the reaction of 1,3-diphenyl thiocabamide **1a** and malonic acid **2**, in molar proportion of acetyl chloride on room temperature stirring (Table 1). Thus, in situ malonyl chloride as an intermediate had occurred. The structure of **3a** was unambiguously allocated by chromatographic technique and further confirmed by spectral and analytical data. It is significant that the C-N cyclization reaction selectively occurred by possible pathways depicted in Scheme 2.

In order to investigate the role of acetyl chloride in presence or absence of solvent on C-N coupling reaction was executed. First we have carried out the reaction without acetyl chloride and solvent, no reaction in progress (Table 1, entry 1) however same reaction using 10 mmol of acetyl chloride in solvent free condition, reaction just towards improvement (Table 1, entry 2). At that point we optimized same reaction using 20 mmol of acetyl chloride with solvent free condition which offered 32% of product (Table 1, entry 3). Hence we have found that, the dominating role of acetyl chloride in C-N coupling pathways.

To improve the yield of **3a**, we optimized the reaction conditions by utilizing 20 mmol of acetyl chloride with 20 mmol of unlike solvents such as C_6H_6, $CHCl_3$, C_2H_5OH, DMF, DMSO and CH_3COOH, 42-75% yields were obtained but prolonged for completion of reactions (Table 1, entry 4-9). Upon screening for the appropriate solvent, we found to give relatively good outcome in acetic acid medium. Acetic acid as solvent and in presence of acetyl chloride, supposed to play significant role on the C-N coupling reaction. Hence, solvent impact was taken into account on the optimization of reaction condition.

Ultimately, acetic acid was found to be a good choice of solvent for this cyclization reaction. After ascertained the reaction with gradually increasing the proportion of acetic acid, we found the remarkable outcomes (Table 1, entry 10-12) and acetic acid was very good initiator in this reaction. Therefore we have chosen the proportion of CH_3COCl-CH_3COOH (20-40 mmol) for rest of the reactions and finally synthesized various TBAs without affecting any functional group.

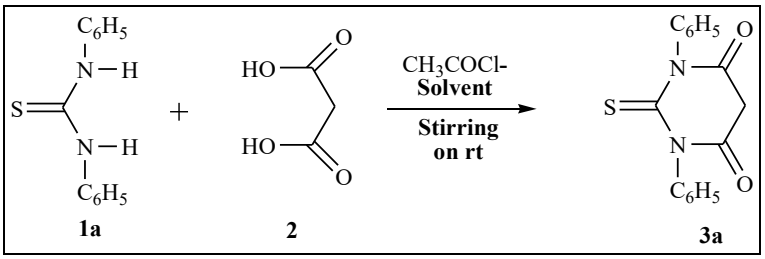


Table 1. Screening of ratio of Acetyl chloride-solvents for the 1,3-diphenyl thiocarbamide and malonic acid[b]

Entry	CH_3COCl (mmol)	Solvent (mmol)	Time (h)	Yield[c] (%)
1	Neat	Neat	10.0	0
2	10	Neat	8.0	20
3	20	Neat	9.0	32
4	20	C_6H_6 (20)	5.0	42
5	20	$CHCl_3$ (20)	5.5	45
6	20	C_2H_5OH (20)	5.0	50
7	20	DMF (20)	4.0	62
8	20	DMSO (20)	4.0	67
9	20	CH_3COOH (20)	3.5	75
10	20	CH_3COOH (25)	3.5	81
11	20	CH_3COOH (35)	3.0	87
12	**20**	**CH_3COOH (40)**	**2.5**	**99**

b-General reaction conditions: 1,3-diphenyl thiocarbamide (10 mmol), malonic acid (10 mmol), rt.
c-present yield

The progress of reaction was monitored by TLC using appropriate eluent. All synthesized products (**3a-o**) were further purified by reverse phase High Performance Liquid Chromatography with PDA detection at 254 nm (Table 2). HPLC method developed by using various proportions of solvents and finally acetonitrile and water with ratio of 80:20 performed skillfully.

Table 2. Formation of different functionalized products

S N	Ar	Ar'	3	Time (h)	Yield[c] (%)
1	C_6H_5	2-CH_3-C_6H_4	**a**	3.0	96
2	C_6H_5	3-CH_3-C_6H_4	**b**	2.5	97
3	C_6H_5	2-Cl-C_6H_4	**c**	2.0	**99**
4	C_6H_5	3-Cl-C_6H_4	**b**	2.5	95
5	4-CH_3-C_6H_4	2-CH_3-C_6H_4	**e**	3.0	91
6	4-CH_3-C_6H_4	3-CH_3-C_6H_4	**f**	3.0	90
7	4-CH_3-C_6H_4	2-Cl-C_6H_4	**g**	2.0	93
8	4-CH_3-C_6H_4	3-Cl-C_6H_4	**h**	2.5	94
9	4-CH_3O-C_6H_4	2-CH_3-C_6H_4	**i**	3.0	94
10	4-CH_3O-C_6H_4	3-CH_3O-C_6H_4	**j**	3.0	98
11	4-CH_3O-C_6H_4	3-CH_3-C_6H_4	**k**	2.5	90

12	4-CH_3O-C_6H_4	2-CH_3O-C_6H_4	**l**	3.0	95
13	4-CH_3O-C_6H_4	2-Cl-C_6H_4	**m**	2.0	96
14	4-CH_3O-C_6H_4	3-Cl-C_6H_4	**n**	3.5	92
15	4-Cl-C_6H_4	CH_3-CH_2	**o**	2.5	97

c-present yield

4.Conclusion

This is the a simple, chief and environment friendly synthesis of symmetric and unsymmetric TBA by the interaction of symmetric and unsymmetrical 1,3-disubstituted thiocarbamides, malonic acid and acetic acid medium at room temperature. The present protocol provides the greener, simple, high yielding, advantageous and commercially available for synthesis of variety of thiobarbituric acids.

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