VIJAYA COLLEGE

R.V.Road, Basavanagudi, Bangalore-560004

RESEARCH

"BULLETIN-VIJAYAANVESHANE"

VOL-6

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(FOR PRIVATE CERCULATION ONLY)

Vijaya College

R.V.Road, Basavanagudi, Bangalore-04

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MESSAGE FROM DEAN

I am happy ***"Vijayaanveshane"*** is bringing out magazine every year highlighting the developments in the areas of science and technology. I am impressed by the previous publications.

This is an opportunity for both teachers and students of Vijaya College to showcase their published findings, this stimulates their motivation to take up research.I am happy to congratulate the magazine committee for their steady and fast approach in this regard.

Dr.K.S.Sameera Simha
Joint Secretary & Dean,
Vijaya College

MESSAGE FROM PRINCIPAL

Vijaya College encourages research as it expands one's knowledge base, provides latest information, gives solid foundation on which one can build ideas and opinions, helps in problem solving and encourages curiosity.

Additionally, research plays a vital role in promoting scientific progress, innovation, and the sharing of knowledge with society.

I am happy that Vijaya college Research Bulletin ***"Vijayaanveshane"*** is published each year successfully since 2017. This bulletin has a wide range of publications and bears testimony to the research culture prevailing in our college.

Some of our students, under the guidance of our faculty members have also actively participated in this research endeavour. This clearly indicates a unique team-work of our faculty members and students.

I strongly believe that this research culture will continue and there will be many more contributions from all the Departments of the College in the years to come.
I would like to thank the contributors and the reviewers and congratulate the editorial board for the successful publication of the bulletin.

Thank you

Dr.K.S.Suresh
Principal
Vijaya College

MESSAGE FROM VICE-PRINCIPAL (ACADEMIC)

The college research bulletin ***"Vijayaanveshane"*** arouses inspiration in the dedicated faculty and students. It showcases the depth of ongoing research across disciplines. Congratulations to the entire research committee for bringing out the innovations in research.

Zaiba Nishath Bano
Vice-Principal (Academic)
Vijaya College

MESSAGE FROM VICE PRINCIPAL (ADMINISTRATION)

Research is the cornerstone of progress, and I am delighted to see how our academic community continues to push the boundaries of knowledge across diverse disciplines. The contributions in this year's bulletin reflect the depth and breadth of research being undertaken at our institution, from theoretical explorations to practical applications, all aimed at addressing current and future challenges.

It is with great pride and joy that I present the 6th edition of "***Vijayaanveshane***" our college's annual research bulletin. This publication is a testament to the unwavering commitment of our faculty and students toward the pursuit of academic excellence and innovation. At Vijaya College, we strive not only to impart knowledge but also to nurture curiosity, critical thinking, and a spirit of inquiry.

I extend my heartfelt congratulations to all the contributors for their dedication and efforts. Your work exemplifies the ethos of Vijaya College, where knowledge is not only gained but also created and shared for the betterment of society. I also want to express my sincere gratitude to the editorial team for their hard work in bringingthis publication to life. May "***Vijayaanveshane"*** continue to inspire and foster a culture of research, curiosity, and lifelong learning in our academic community.

Dr.M Subramanya Bhat
Vice Principal (Admin),
Vijaya College

MESSAGE FROM CONVENOR

"Research is a systematic enquiry to describe, explain, predict, and control the observed phenomenon. Research is performed to identify existingproblems and to solve, Set pragmatic goals, and develop productive marketing strategies.The characteristics of good researchfollows a systematic approach to capture accurate data. Researchers need to practice ethics and a code of conduct while making observations or drawing conclusions.

I am expressing my happiness to release the 6th edition of research bulletin "***Vijayaanveshane".***It's was a great opportunity to serve as chief editor and convenor to bring this bulletin to the public. I congratulate all the contributors for contributing the research papers and also forthe committee members in collating the research papers to printable forms in this new edition.

Dr.Jalajakshi.S
Convenor, Research Committee
Vijaya College

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Influence of Massive Stars on Star Formation and Stellar Evolution

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B.Sc. VI Semester Physics student, Vijaya College

1. Introduction

The Big Bang and the Beginning of the Universe

The universe began approximately 13.8 billion years ago with the Big Bang, an event that marked the rapid expansion of an extremely hot and dense point. This expansion led to the cooling of the universe, which allowed for the formation of subatomic particles and simple atoms. Over time, these particles coalesced under the force of gravity to form galaxies, stars, and planets.

Formation of the First Stars

The first stars, known as Population III stars, formed about 100 to 200 million years after the Big Bang. Composed primarily of hydrogen and helium, these stars were massive and short-lived. Their deaths in supernova explosions enriched the interstellar medium with heavier elements, paving the way for the formation of later generations of stars and planetary systems.

Stellar Evolution

Stars form from the gravitational collapse of gas and dust in molecular clouds. As these clouds collapse, they fragment into clumps that form protostars. Over millions of years, these protostars evolve into main-sequence stars, where they spend the majority of their lives fusing hydrogen into helium.

- Low-Mass Stars: These stars expand into red giants and eventually shed their outer layers to form planetary nebulae, leaving behind white dwarfs.

- High-Mass Stars: These stars undergo more complex fusion processes and end their lives in supernova explosions, leaving behind neutron stars or black holes.

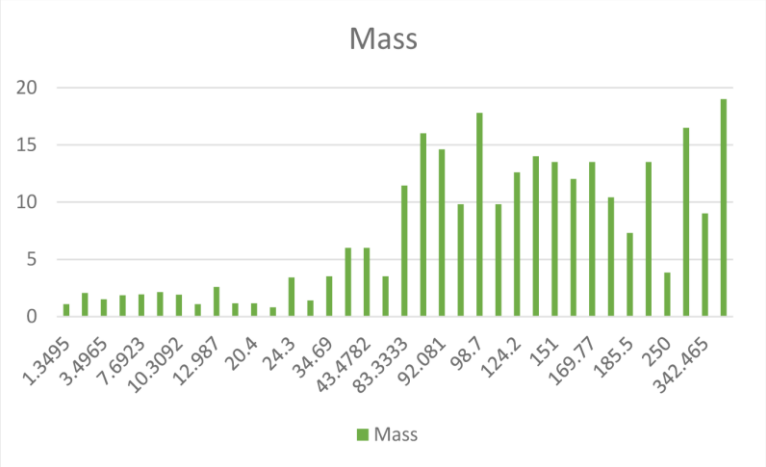
2. Data Overview

The dataset contains information about various stars, including their mass, age, distance from Sun, surface temperature, spectral type, absolute magnitude, bolometric correction, and color index (B-V). Here is a preview of the dataset:

3. Analysis

Mass vs. Distance

The scatter plot below shows the relationship between the mass of stars and their distance from Sun.

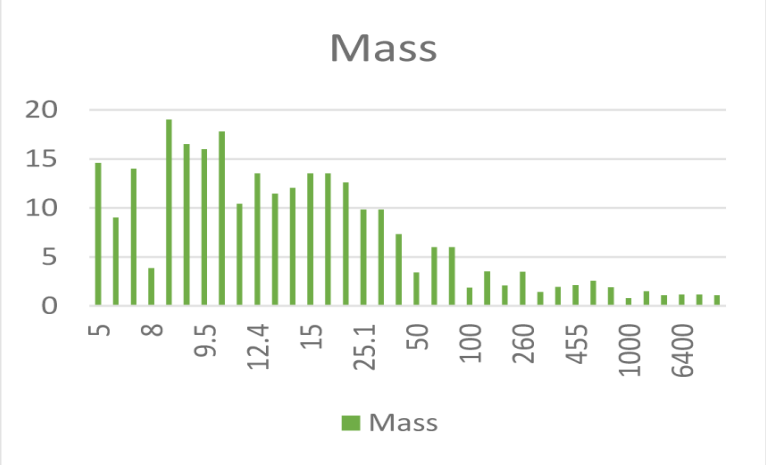


Explanation:

This graph shows how the mass of stars varies with their distance from Sun. Generally, more massive stars are not found at great distances compared to less massive stars, which might indicate that massive stars have a more significant influence on their surroundings, affecting the formation of nearby stars.

Mass vs. Age

The scatter plot below shows how the mass of stars correlates with their age

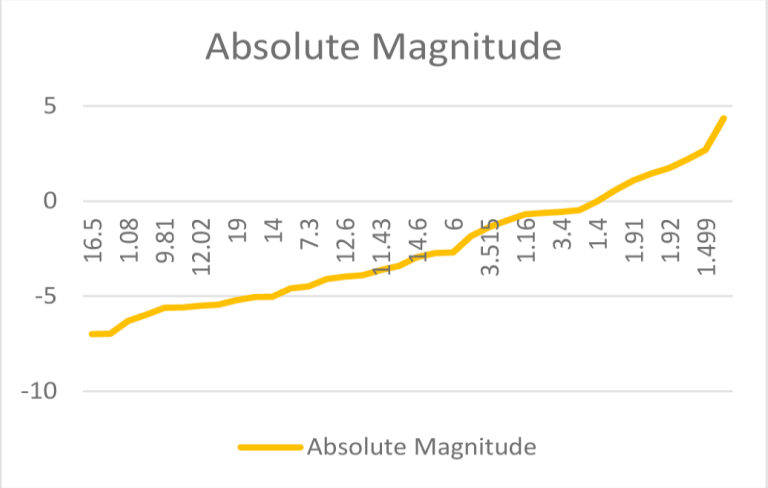


Explanation:

This graph illustrates the relationship between a star's mass and its age. Younger stars tend to have a wider range of masses, while older stars tend to be less massive. This might be due to the fact that massive stars have shorter lifespans compared to less massive stars.

Luminosity (Absolute Magnitude) vs. Mass

The scatter plot below shows the relationship between the absolute magnitude of stars and their mass.

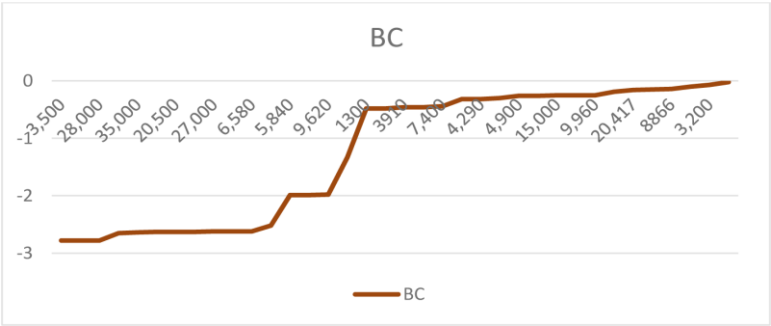


Explanation:

This graph shows how the absolute magnitude (luminosity) of stars varies with their mass. More massive stars tend to be more luminous, as indicated by their lower absolute magnitudes. The inverse relationship between luminosity and magnitude is evident here.

Bolometric Correction (BC) vs. Temperature

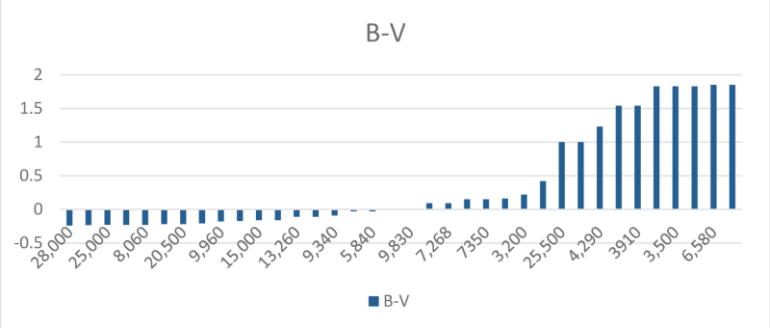
The scatter plot below shows how the bolometric correction varies with the surface temperature ofstars.



Explanation:

This graph shows the relationship between bolometric correction (BC) and surface temperature. Bolometric correction adjusts the visual magnitude of a star to account for radiation at all wavelengths. The trend shows that hotter stars have smaller BC values, indicating a lower adjustment needed for their luminosity.

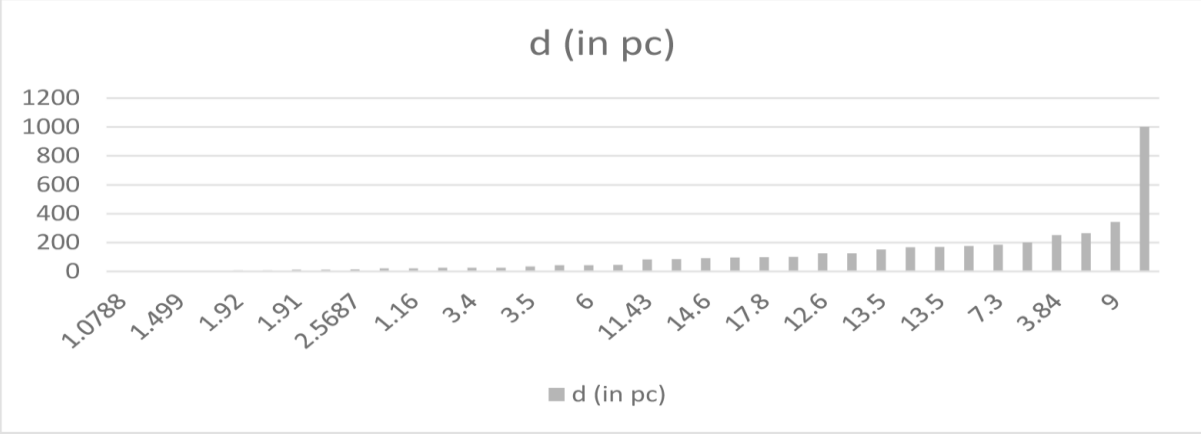
Color Index (B-V) vs. Temperature
The scatter plot below shows the relationship between the color index (B-V) and the surface temperature of stars.



Explanation:

This graph shows how the color index (B-V) varies with surface temperature. The color index is a measure of a star's color, which correlates with temperature. Hotter stars (with higher temperatures) have lower B-V values (appear bluer), while cooler stars have higher B-V values (appear redder).

Cluster Analysis
Grouping stars by distance to identify clusters and analyzing the mass distribution withineach cluster:



Explanation:

This analysis groups stars by their distance to identify clusters. The histogram shows the mass distribution within each cluster. This helps to understand the mass distribution in regions where stars are relatively close to each other, indicating possible star formation regions or gravitational interactions.

1. Conclusion

Summary of Findings: The analysis reveals a correlation between the mass of stars and their surrounding environment. More massive stars tend to have less massive stars around them.

Implications for Astrophysics: This observation aligns with the theoretical understanding of star formation and evolution, where massive stars can influence their surroundings, potentially impacting the formation and mass of nearby stars

Spectroscopic, theoretical and computational investigations of novel benzo[b]thiophene based ligand and its M(II) complexes: As high portentous antimicrobial and antioxidant agents

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[d]Department of PG Studies and Research Centre in Physics, Govt. First Grade College, Hosakote, Bangalore Rural, Karnataka, India

Abstract

The reaction of 3-chlorobenzo[*b*]thiophene-2-carbohydrazide with 4-(diethylamino) salicylaldehyde gave the new ligand; 3-chloro-N'-(4-(diethylamino)-2-hydroxybenzylidene)-benzo[*b*]thiophene-2-carbohydrazide. The Cu(II), Co(II), Ni(II), and Zn(II) complexes have been successfully prepared. The ligand and the complexes were characterized by analytical, FT-IR, ^{1}H NMR, mass, UV–visible spectroscopy, molar conductivity, and magnetic susceptibility measurements. The FT-IR spectral data showed that the ligand adopted a tridentate fashion when binding with the metal ions *via* the nitrogen atoms of the imine (C = N), carboxyl (C = O), and phenolic oxygen (O–H) donor atoms. Density Functional Theory (DFT) estimations for the ligand at the DFT/B3LYP level *via* 6-31G^{++} (d, p) replicate the structure and geometry. Finally, HOMO and LUMO analyses were used for the charge transfer interface of the structure. Furthermore, molecular docking and ADME calculations were also performed to correlate and interpret the experimental results. The antimicrobial activity study illustrated enhancement in the activity of the free ligand upon complex formation, and the Cu(II) complex (MIC 25 μg mL^{-1}) may be considered a promising antibacterial agent, and the Ni(II) and Zn(II) complexes (MIC 25 μg mL^{-1}) as promising antifungal agents. Also, synthesized Cu(II) and Zn(II) metal complexes (MIC 3.125 μg mL^{-1}) showed promising anti-TB activity against *M. tuberculosis.* Further, benzo[*b*]thiophene-based ligand and its metal complexes were evaluated for *in vitro* antioxidant activity, and in silico docking studies were carried out against *Cytochrome c Peroxidase* (PDB ID: 2X08).

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Review on Contemporary Synthetic Recipes to Access Versatile Coumarin Heterocycles

Basavarajaiah, S. M., Gunavanthrao Yernale, N., Punith Kumar, M., & Rakesh, B. M.
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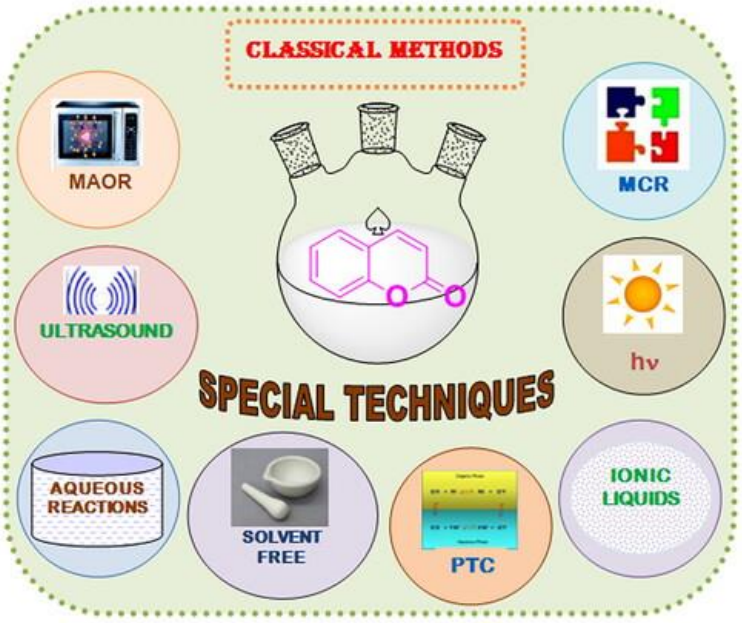
Abstract

Coumarin and its derivatives are extensively used as scaffolds in the synthesis of novel heterocyclic motifs. In the literature, several approaches especially involving metal and metal-free catalysts have been developed to get novel biological potential coumarin analogs. This review spotlights recent advancements in the synthesis of heterocyclic coumarin and its associated molecules recounting the literature articles from 2015 to the middle of 2022. Further, in this review, we have focused on the contents based on classical and non-classical methods for coumarin synthesis.



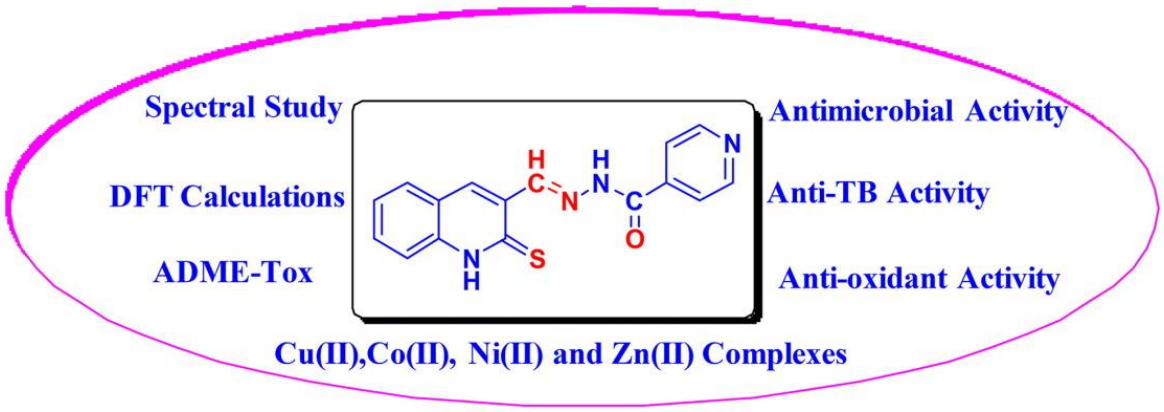
Published in: Polycyclic Aromatic Compounds, 44(5), 2023, 3576–3600.
https://doi.org/10.1080/10406638.2023.2235874

Synthesis, Spectral Analysis, DFT Calculations, in Vitro Screening, and Molecular Docking of New Metal Complexes with Quinoline and Isoniazid Schiff Base as Antimicrobial and Antioxidant Agents

S. M. Basavarajaiah
PG Department of Chemistry, Vijaya College, RV Road Bangalore-560004

Abstract

We herein report the synthesis, spectral analysis, DFT calculations, in vitro and in silico biological activities of novel N'-((2-thioxo-1,2-dihydroquinolin-3 yl)methylene)isonicotinohydr-azide with its Cu(II), Co(II), Ni(II), and Zn(II) complexes have been successfully prepared. The ligand and the complexes were characterized by analytical, FT-IR, 1H NMR, mass, UV–visible spectroscopy, molar conductivity, and magnetic susceptibility measurements. Density Functional Theory (DFT) estimations for the ligand at the DFT/B3LYP level via 6-31 G++ (d, p) replicate the structure and geometry. Furthermore, molecular docking and ADME calculations were also performed to correlate and interpret the experimental results. The antimicrobial activity study illustrated enhancement in the activity of the free ligand upon complex formation, and the Cu(II) complex (MIC 25 µg mL−1) may be considered a promising antibacterial agent, and Ni(II) and Zn(II) complexes (MIC 25 µg mL−1) as promising antifungal agent. Also, synthesized Ni(II) and Zn(II) metal complexes (MIC 3.125 µg mL−1) showed promising anti-TB activity against Mycobacterium tuberculosis. In the antioxidant activity, the Cu(II) complex showed excellent activity as compared to standard drugs and in silico docking studies were carried out against Cytochrome c Peroxidase (PDB ID: 2X08).



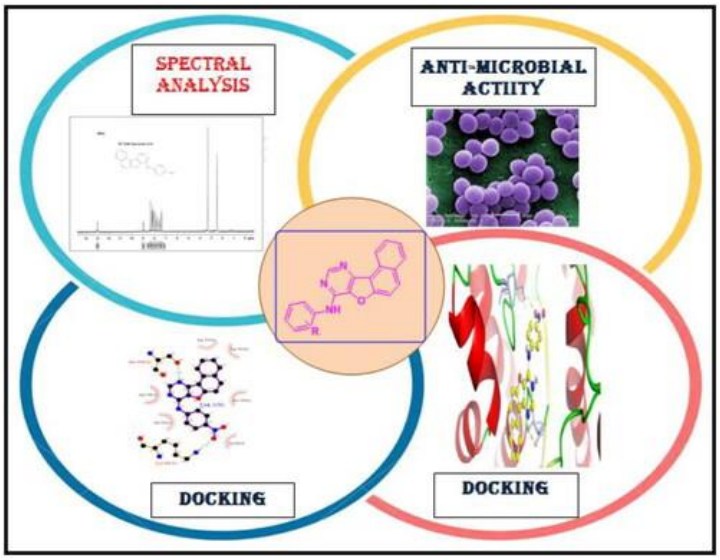
Published in: Polycyclic Aromatic Compounds, Volume 44, Issue 8, 2024, Pages 5439-5459, https://doi.org/10.1080/10406638.2023.2265024

Design, Synthesis, Spectral Analysis, Drug Likeness Prediction, and Molecular Docking Investigations of New Naphtho[2,1-*b*]Furan Encompassing Pyrimidines as Potential Antimicrobial Agents

S. M. Basavarajaiah
PG Department of Chemistry, Vijaya College, RV Road Bangalore-560004

Abstract

In view of the extremely important biological and medicinal properties of napthofurans, the synthesis of these heterocycles has fascinated the interest of medicinal and organic chemists. Keeping this in mind, we herein report the synthesis and antimicrobial evaluation of 4-*N*-aryl-naphtho[2,1-*b*]furo[3,2-*d*] pyrimidines **5 (a–l)**. Structures of these synthesized compounds were confirmed by spectral analysis like IR, NMR, and Mass spectrometry. The *in vitro* antimicrobial activities were reported for all the compounds **5 (a–l)**. The compounds **5e** and **5f** exhibited excellent antibacterial, antifungal, and antidermatophytic activities against tested pathogens at MIC 3.125, and 3.125 µg/mL, respectively. Furthermore, molecular docking studies of these compounds against *S. aureus* tyrosyl-tRNA synthetase (**PDB ID: 1JIJ**), *S. aureus Gyrase* (**PDB ID: 2XCT**), and SARS-CoV-2 Omicron (**PDB ID: 7TOB**), revealed the potential binding mode of the ligands to the site of the appropriate targets. Finally, drug-likeness and structure-activity relationship studies were also disclosed.



Note: Polycyclic Aromatic Compounds,2023,1.
https://doi.org/10.1080/10406638.2023.2272012

A comprehensive overview of coumarinyl-triazole hybrids as anticancer agents

S. M. Basavarajaiah

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Abstract

There are over 100 commercially available drugs for the handling of cancer, but only a handful of them have high specificity, leading to a variety of side effects. The past few decades have seen the scientific community concentrate on drug discovery. Candidates that are pharmaceutically active are isolated from natural resources and then synthesized. More than 60 % of medications in the market are synthesized with natural components. Additionally, necessity for pharmaceutical therapies is critical due to the prevalence of chemoresistance and relapse. Coumarin is a highly privileged pharmacophore for the creation of drugs for the medications of cancer because coumarin-derived compounds are widely distributed in wildlife and can easily interplay with a variety of enzymes and targets on the receptors site in cancer affected cells through interactions with weak bond. Conversely, triazole also known as pyrrodiazole is part of numerous clinically and medically used drugs for the treatment of several diseases, for instance, diabetes, cancer, etc., and a number of 1,2,3-triazole by-products are currently being tested in clinical trials to treat various types of cancers. Consequently, the goal of this review is to highlight significant coumarin analogues with triazole moiety as anticancer properties wrapping the articles published from 2012 to 2022.

Published in: Journal of Molecular Structure Volume 1302, 15 April 2024, 137478

https://doi.org/10.1016/j.molstruc.2024.137478

A comprehensive investigation of green solutions for sustainable wastewater remediation: A review

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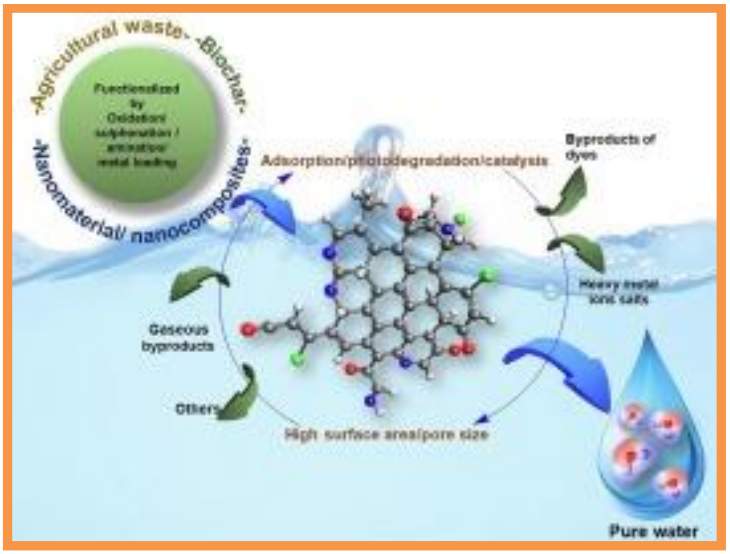
Abstract

There is a growing emphasis on harnessing the potential of agricultural waste, biochar, and nanomaterial (NM). This review explores their utilization, highlighting their role in mitigating environmental contamination. Methodology encompasses a comprehensive comparative analysis focusing on patterns discerned within key parameters such as pollutant types, temperature, specific surface, contact times, and pH levels in the study of wastewater treatment. This analysis employs advanced visualization tools like radar, contour, and Q-Q plots to unravel insights into heavy metals and other elements' removal efficiency. This study reveals the effectiveness of agricultural waste, particularly in pyrolysis processes, for removing various pollutants like sulfamethoxazole, phenol, and acid orange 7 along with microstructural analysis. The pH range of 5–8 demonstrates its significance in these removal processes. Furthermore, nanomaterials (NM) exhibit a wide spectrum of removal efficiencies of heavy metal ions and other pollutants, ranging from 0 % to 95 %, over extended treatment durations of up to 2500 min, underlining their potential in diverse wastewater treatment scenarios. The utilization of agricultural waste, biochar, and nanomaterials for environmental remediation strongly corresponds with key UN Sustainable Development Goals, spanning clean water, responsible consumption, climate action, biodiversity preservation, and innovation, showcasing a holistic strategy for sustainable development.



Published in: Journal of Molecular Liquids, 400, 2024, 124532.

https://doi.org/10.1016/j.molliq.2024.124532

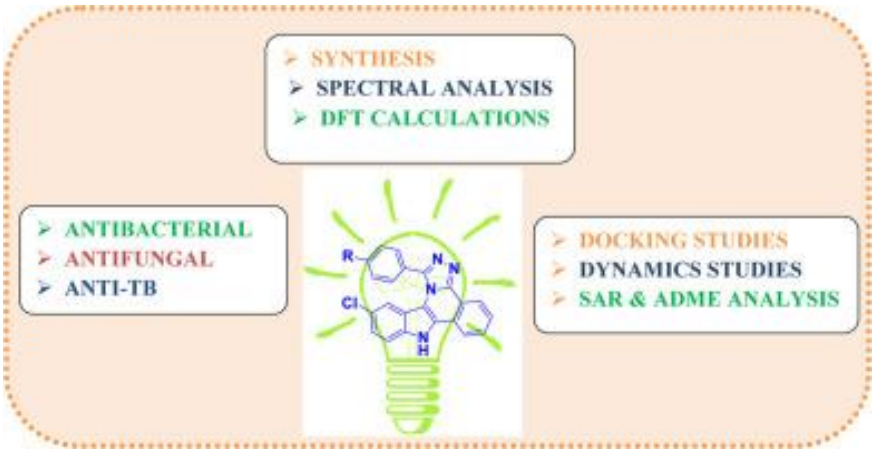
Investigating the molecular interactions of 11-substituted-1-(4-chlorophenyl)-8H-indolo[3,2-c][1,2,4]triazolo[3,4-a]isoquinolines for Antimicrobial Potential: Synthesis, Spectral, In vitro and In silico study interpretations

S. M. Basavarajaiah

PG Department of Chemistry, Vijaya College, RV Road Bangalore-560004

Abstract

Indole molecules are one of the important scaffolds in the discovery and development of new drugs. We herein described a synthesis of new 11-substituted-1-(4-chlorophenyl)-8*H*-indolo[3,2-c][1,2,4]triazolo[3,4-a]isoquinoline **6 (a-h)**. Structures of the newly synthesized compounds were confirmed by making use of spectroscopic techniques like IR, NMR and mass. The DFT calculations were taken for the selected molecules using CAM-B3LYP hybrid functional with a 6–31+*g*(d) all-electron basis set using the Gaussian 09 package. The drug-likeness calculations were explained for the synthesized derivatives. The compounds **6b, 6c** and 6 g exhibited excellent antibacterial, antifungal and anti-TB activities against tested pathogens at MIC 3.125 μg/ml. Furthermore, molecular docking studies of these compounds against *S. aureus* Gyrase (**PDB ID: 2XCT**), *Staphylococcus aureus* tyrosyl-tRNA synthetase (**PDB ID: 1JIJ**), and *Mycobacterium tuberculosis* enoyl reductase (INHA) (**PDB ID: 4TZK**), revealed the potential binding mode of the ligands to the site of the appropriate targets. Finally, drug likeness and SAR studies were disclosed. Lastly, the protein stability, fluctuations of APO-Protein, and protein-ligand complexes were investigated through molecular dynamics simulations studies using Desmond Maestro 11.3 and potential lead molecules were identified.



Published in: Journal of Molecular Structure Volume 1312, Part 1, 15 September 2024, 138617

https://doi.org/10.1016/j.molstruc.2024.138617

A Concise Review On Recent Development Of Indole Derivatives For Anticancer Activities

S. M. Basavarajaiah
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Abstract

Indole heterocycles have been considered as noteworthy associated hybrids because of their diverse applications in organic synthesis, and coordination chemistry, as well as in the field of medicinal chemistry. Hence, numerous researchers around the globe have produced indole and its derivatives as objective motifs and exploited their biological activities. This review article intended to represent information about the synthesis, potential of the anticancer property, cytotoxicity, and level of clinical treatments, which could lay out the investigation to extend more effective indole-derived anticancer medicines. This insight also presents advanced synthetic analogs of indole derivatives and their anti-cancer activity. The literature report represented for the anticancer agents herein covers largely for the year 2014–2023.

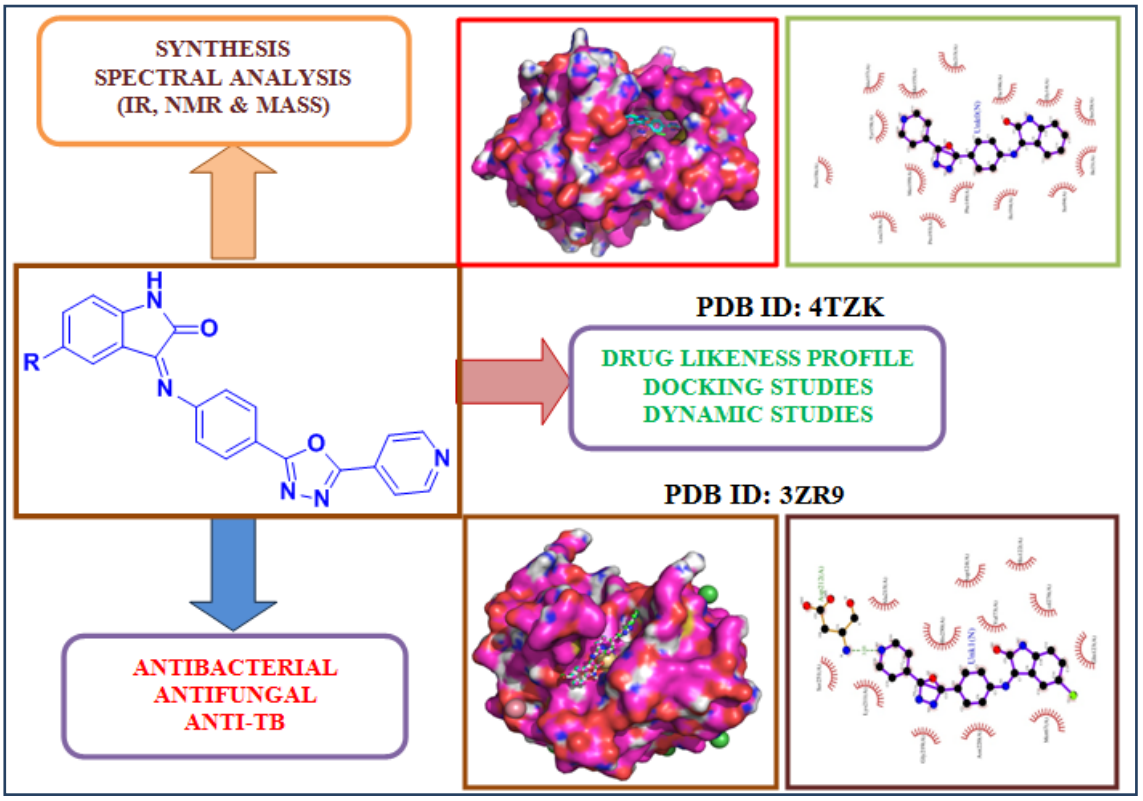
Published in: Journal of the Indian Chemical Society Volume 101, Issue 10, October 2024, 101282. https://doi.org/10.1016/j.jics.2024.101282

Discovery of novel isatin encompassing oxadiazoles as potential inhibitors against New Delhi metallo-β-lactamase-1: Synthesis, spectral analysis, antimicrobial and molecular modeling studies

Yamuna M., Sanjay S., Srinath K. R., Ranjinikanth K., and Basavarajaiah S. M.

PG Department of Chemistry, Vijaya College, RV Road Bangalore-560004

Graphical Abstract



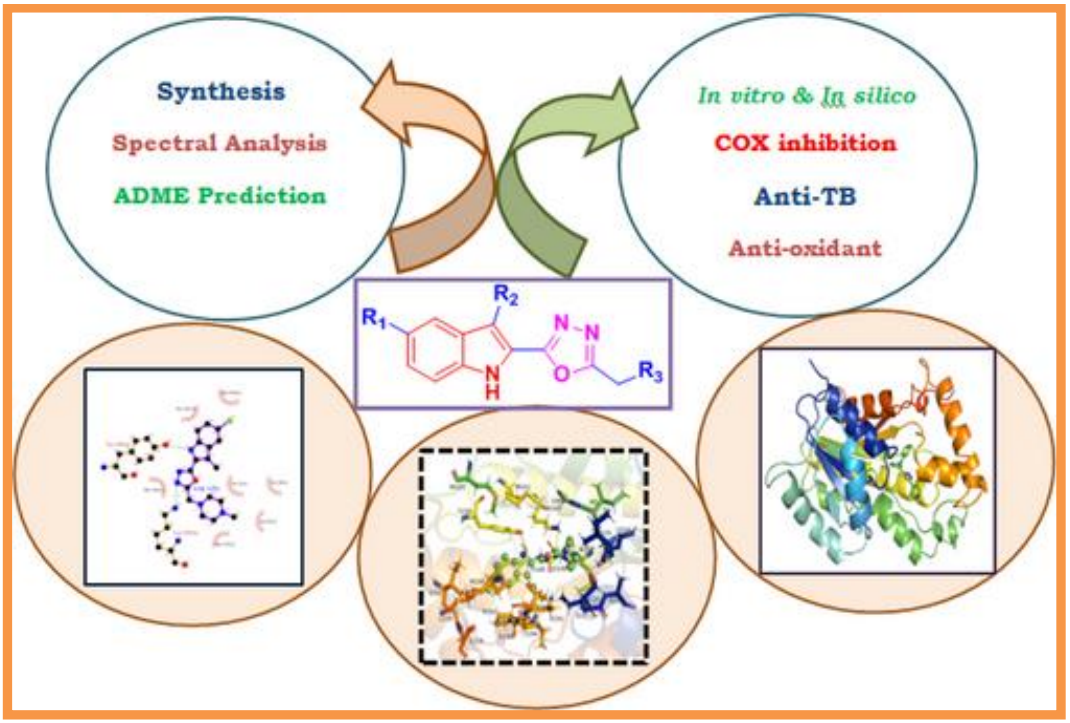
Russ J Bioorg Chem 50, 1376–1389 (2024). https://doi.org/10.1134/S106816202404023X

Investigation of Novel 2-(Chloromethyl)-5-(3, 5-Disubstituted-1H-Indol-2-yl)-1,3,4-Oxadiazole Derivatives as In Vitro, and In Silico Bioactivity Potential: Anti-inflammatory, Anti-TB and Antioxidant Activities Study

S. M. Basavarajaiah
PG Department of Chemistry, Vijaya College, RV Road Bangalore-560004

Abstract

A series of novel 2-(chloromethyl)-5-(3, 5-disubstituted-1*H*-indol-2-yl)-1,3,4-oxadiazole (**3 a**–h) derivatives have been synthesized as potential COX inhibitors, anti-TB, and anti-oxidant activities. The structures were confirmed by IR, NMR and mass spectral techniques. The physicochemical properties, ADME, and drug-likeness profile for the synthesized compounds were evaluated by SwissADME. Finally, these compounds were taken for their molecular modelling studies.



ChemeistrySelect, Volume9, Issue33, September 4, 2024, e202401756.

https://doi.org/10.1002/slct.202401756

Plasmonic photocatalytic materials for pollutants removal

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Abstract: The upsurge in industrialization has imposed a serious threat on the contamination of the aqueous streams making it extremely difficult for the survival of aquatic organisms. To this end, advanced oxidation processes (AOPs) have been rigorously explored to treat the waste water and appearto be promising from the prospect of a cost-effective approach and environmental sustainability. Among the various AOPs, semiconductor photo catalysis utilizing various semiconductors has dominated the area owing totheir ability to generate free radicals that can directly lead to the completemineralization of organic pollutants. The titania has received greater attentiondue to its admirable properties such as biocompatibility, photostability,chemical stability at a wider pH range, suitable band edge potentials, facilepreparation, and easy availability of the precursors. Despite their unique functionalities, the large bandgap and lower photonic efficiency make them incompatible with solar light_induced applications. The massiveresearch from four decades concludes that the modifications of titania through impurity doping, noble metal deposition, and coupling with narrowgap semiconductors were reported to overcome the aforementioned drawbacks. However, impurity doping beyond the threshold level mightalso favor charge carrier recombination pathways. On the other hand, theformation of impure phases and poor interfaces prevails during the fabricationof composite structures making them incompatible with photocatalyticreactions. Thus noble metal deposition over the titania surface wouldbe beneficial to improve the optical response and lifetime of the chargecarriers. Compared to the sensitizers such as dye molecules, metalcomplexes, quantum dots, and metal organic frameworks, Au seems to bean appropriate candidate due to their strong adherence over the TiO_2 surfaceand also for their role as catalytic materials. In this context, we intend to focus onthe recent advances in the design and fabrication of Au-TiO_2 from variousmethods and their photocatalytic activity for the degradation of pollutants.In addition, progress achieved in the ternary hetero junctions associated with Au-TiO_2 toward the wastewater purifications is brieflydiscussed.

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Review and Perspective on Rational Design and Interface Engineering of g-C3N4/ZnO: From Type-II to Step-Scheme Heterojunctions for Photocatalytic Applications

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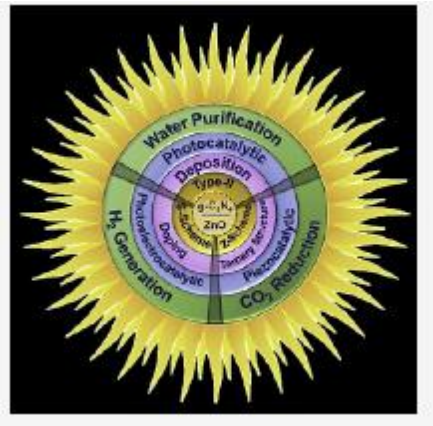
ABSTRACT:



Heterostructuring the g-C3N4 (GCN) with wide gap oxide photocatalysts is ofprominent interest as they can harvest photons spanning the UV−visible region. In this regard,GCN/ZnOhave garnered remarkable attention due to their admirable structure, optical,dimensional anisotropy, and electronic properties. The 2D sheet-like structure of GCN canserve as a suitable substrate for the growth of distinct ZnO nanostructures under the multitudeof reaction conditions. This review focuses on the progress in the rational design and interface engineering of GCN/ZnO to from Type-II and Z/S-scheme hetero junctions, followed by their relevant photocatalytic applications toward H2 evolution, CO2 reduction, pollutantdegradation, and bacteria inactivation. The mechanism underlying the crystallization of GCN and ZnO together with their intimate contact in the composite are emphasized under thelight of diverse preparation methods. The modification of GCN/ZnO with co-catalysts such as metals, alloy, semiconductors, and carbon materials to form ternary systems to highlight their advancements. The gap analysis and future prospectus of this intricate hetero structure concerning the challenges in synthetic approaches and the charge carrier dynamics are discussed. This review envisages the development of efficient GCN/ZnO-based heterostructures for multiscale applications.

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Advances in MXene Ti_3C_2 and its composites for the adsorption process and photocatalytic applications

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Abstract

Due to the 2D anisotropy and unique functionalities associated with its structure,MXenes are spotlighted expansively in energy and environmental applications. In thisspecific contribution, the recent advancements in the fabrication of composite structures based on MXene Ti_3C_2 and their application towards the adsorption processes andphotocatalytic reactions are highlighted. The photocatalytic materials such as metaloxides/sulphides, g-C_3N_4 and Ag/Bi-based semiconductors are integrated with $Ti_3C_2$and theirpreparation methods are elegantly discussed. The impact of several reaction parameters overthe composite performance together with the optimized reaction conditions to achieve the maximum activity are discussed. The adsorption isotherms, charge carrier transfer pathwaysand participation of free radicals in the pollutant degradation mechanisms are emphasized.The gap analysis and the current challenges associated with these composite materials arepresented to broaden their visibility for various applications.

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Intellectual Property Management of Millets

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ABSTRACT

Millets are a group of cereal grains that belong to the Poaceae family, also known as the grass family. They are widely consumed in developing countries throughout Africa and Asia. They have gained global attention due to their nutritional value, adaptability to diverse environments for growth, potential to combat food scarcity and climate change. As these grains hold immense cultural, nutritional, and economic significance, application of effective Intellectual Property Management strategies are crucial to protect their traditional knowledge, preserve biodiversity, foster innovation, and ensure sustainable development. This paper explores the significance of millets and discusses Intellectual Property issues surrounding them. It also proposes strategies for managing Intellectual Property Rights (IPR) to promote millet cultivation and conservation, popularise consumption and equitable distribution of benefits to thesociety.

Keywords: Millets, Exploitation, Intellectual property rights, Intellectual property management, Challenges, Strategies, Future directions.

HISTORICAL RELEVANCE AND SIGNIFICANCE OF MILLETS

Millets (Kodo Millet, Ragi/Finger Millet, Pearl Millet, Foxtail Millet, Barnyard Mille, Little Millet, and Sorghum) hold significant historical relevance as staple crops cultivated across various regions worldwide for thousands of years (1). They were among the earliest domesticated plants in the ancient human agriculture for providing healthy living. They were cultivated in Asia, Africa, and parts of Europe around 7000 years ago. They were essential grains in ancient civilizations like China, India, Africa (especially in the Sahel region), and even parts of Europe (2).

Millets are adaptable to diverse climatic conditions, which led to their cultivation in different regions and among various communities (3). They were particularly favoured in regions with less fertile soil or erratic rainfall. They were and are prized for their nutritional value. They are gluten-free and rich in nutrients like protein, fibre, vitamins, and minerals, providing sustenance to populations in different parts of the world (4). They often played a crucial role in cultural practices, religious ceremonies, and traditional cuisines of various societies (5). They were used not just for food but also for brewing beverages (6).

With the introduction of other high-yielding crops and changing dietary habits, the cultivation and consumption of millets declined in some regions. However, due to their nutritional benefits and resilience to climate change, there has been a recent resurgence of interest in millets globally.Millets are at present recognized for their potential to address food security challenges, improve soil fertility, and contribute to sustainable agriculture (1). They are also gaining popularity due to their suitability for modern dietary preferences like gluten-free and healthy intake.

In short, millets have a rich historical significance as a staple food that sustained civilizations for millennia and continue to offer nutritional and agricultural benefits today.

INTELLECTUAL PROPERT RIGHT (IPR) - DEFINED

Intellectual property rights are the rights given to persons over the creations of their minds. They usually give the creator an exclusive right over the use of his/her creation for a certain period of time. Therefore, one can state that Intellectual property rights (IPR) are a set of legal right granted to the owners to protect creations of the human intellect, such as inventions, artistic works, designs, symbols, names and images used in commerce (7). The main purpose of IPR is to provide incentives for innovation and creativity by granting exclusive rights to the creators or owners allowing them to control and profit from their intellectual creations. These rights may enable monopoly in the market, which in turn defeats public rights for a liberalised free market. This is duly maintained in the IP laws by extending such rights for limited time only.

SIGNIFICANCEOF INTELLECTUAL PROPERTY IN MILLETS

Intellectual property issues related to millets revolve principally around Traditional Knowledge (TK), genetic resources, and modern agricultural methods. Some of the key aspects are listed below:

- **Traditional Knowledge:** Many indigenous communities possess extensive Traditional Knowledge about age-old cultivation techniques of millets, its uses as a healthy diet, and many medicinal properties associated with these grains (8). Protecting this knowledge from exploitation or misappropriation by unauthorized entities is one of the major concerns. There have been discussions on safeguarding traditional knowledge through intellectual property mechanisms like patents or Sui generis systems.

- **Biodiversity and Genetic Resources** (9): Millets represent diverse genetic resources. Preserving this biodiversity is crucial for ensuring future food security and crop improvement. Issues arise when genetic resources of millets are used for breeding or research without proper consent or benefit-sharing agreements with the communities or countries where these resources originate.International agreements such as the Nagoya Protocol (10) under the Convention on Biological Diversity and national laws

(Bio diversity Act…) play a significant role in addressing these issues. They aim to provide guidance on accessing genetic resources, benefit sharing, and protecting traditional knowledge. Issues related to access to genetic resources and benefit-sharing agreements are critical. There's a need to establish fair and transparent mechanisms for accessing millet genetic resources while ensuring that the benefits derived from their use are shared equitably with the communities or countries of origin.

- **Modern Agricultural Innovations** (11): Some modern agricultural innovations related to millets, such as improved varieties, pest-resistant strains, or processing techniques, might be subject to intellectual property protection through patents or plant variety protection. Balancing the need for innovation and commercial development with equitable benefit sharing and access to these innovations can pose challenges.

- If the millets owe their quality / uniqueness owing to geographical environment and soil conditions where they are grown, then the Geographical Indications as an exclusive IP right for the whole community could also be considered.

INTELLECTUAL PROPERTY RIGHTS AS APPLIED TO MILLETS

Intellectual property rights, including patents, geographical indications (GIs), trademarks, and copyrights, can be applied for protection of communities from exploitation by fraudsters. The application of such mandates for various aspects related to millets are deliberated in the following part:

1. Patents(12)**:** Patents can be applied to specific innovations or inventions associated with millets. This might include novel breeding techniques, specific genetic modifications, or unique processing methods. Patents grant exclusive rights to the inventor or assignee for a limited time, enabling them to prevent others from using, making, or selling the patented invention without permission.

2. Geographical Indication (GI) (13): GIs can be used to protect the identity and reputation of millet varieties originating from specific geographic regions. For instance, certain types of millets might have unique qualities or characteristics linked to their geographical origin, and GIs help protect these qualities. It prevents others from using the geographical name on products that don't originate from that specific region. This leads to positive outcomes for local economies and rural development.

3. Trademarks (14): Trademarks can be applied to brand names, logos, or symbols associated with millet-based products. They help distinguish these products from others in the market and build recognition among consumers. Trademark protection ensures that the use of similar marks by other entities might lead to confusion or misleading consumers about the origin or quality of the product.

4. Copyrights (15): Copyright protection may apply to literary or artistic works related to millets, such as books, articles, artistic representations, or specific software developed for millet-related activities. This protection grants exclusive rights to the creator or owner to reproduce, distribute, or display the copyrighted work.

5. Plant Breeder's Rights (16):In agricultural research, plant breeders may seek protection for new plant varieties they have developed through Plant Breeders' Rights (PBR) systems the Protection of Plant Variety and Farmers Right Act(PPVFR). PBR PPVFR grants exclusive rights to produce, sell, and distribute the new plant variety for a specified period.

For instance:

- Patents could be used for a unique millet processing machine or a genetically modified millet variety.

- Geographical Indications might protect the name of a specific millet variety originating from a particular region known for its quality.

- Trademarks could safeguard the logo or name of a millet-based food product, distinguishing it from competitors.

- Copyrights could protect educational materials, books, or digital resources related to millet cultivation or recipes.

INTELLECTUAL PROPERTY MANAGEMENT STRATEGIES FOR MILLETS

1. Legal Framework Development: Establishing specific laws or regulations tailored to the unique aspects of millets (Sui generis system- an independent legal classification) (17). This might involve enacting newer legislation that addresses issues related to traditional knowledge, biodiversity conservation, access and benefit-sharing, and commercialization of millets.

2. Protection of Traditional Knowledge (8): Recognizing and safeguarding the traditional knowledge associated with millets held by indigenous communities or local farmers could also be considered. This involves setting up mechanisms to prevent unauthorized use or exploitation of this knowledge while ensuring that the holders benefit from its commercialization.In India we do not have such a law and it is time to consider this as an option for protecting TK in general and millets in particular.

3. Conservation of Genetic Diversity(18)**:** Implementing measures to conserve the genetic diversity of millets is essential. This includes establishing gene banks, promoting in-situ conservation practices, and encouraging the cultivation of diverse millet varieties to maintain their resilience to changing environmental conditions.

4. Benefit Sharing: Defining clear guidelines for equitable benefit-sharing between different stakeholders involved in the production, research, and commercialization of millets needs to

be prioritised. This ensures that communities contributing to the conservation or development of millets receive fair compensation or benefits.

5. Promotion and Market Recognition: Creating awareness campaigns to promote millets, their cultural significance, nutritional value, and environmental benefits. This could involve labelling schemes, certifications, or marketing strategies to enhance consumer awareness and recognition of millet products.

6. Stakeholder Participation and Collaboration: Involving diverse stakeholders such as farmers, researchers, policymakers, lawyers and indigenous communities in the development and implementation of the sui generis system. Collaboration and consultation ensure that the system addresses the needs and concerns of all involved parties.

7. Capacity Building and Research: Investing in research, development, and capacity-building initiatives focused on millets. This includes supporting scientific studies, innovation in cultivation techniques, processing methods, and value addition to enhance the economic viability of millet-based products.

CHALLENGES RELATED TO INTELLECTUAL PROPERTY MANAGEMENT OF MILLETS

1. Lack of Recognition: Traditional knowledge associated with millets often lacks formal recognition under existing intellectual property systems (22), leading to its vulnerability to misappropriation without appropriate benefit-sharing.

2. Complexity in Traditional Knowledge Protection(23): Traditional knowledge related to millets is often collective and dynamic, making it challenging to define ownership and establish legal protection mechanisms without infringing on communal rights.

3. Resource Disparities: Limited resources and capacities among smallholder farmers, indigenous communities, or less-developed regions hinder their ability to engage effectively in intellectual property protection and commercialization of millets.

4. Bio piracy and Unauthorized Use (24): The risk of bio piracy, where genetic resources or traditional knowledge are exploited without consent, remains a concern due to inadequate legal frameworks and monitoring mechanisms.

5. Limited Research and Innovation (1): Insufficient investment in research and innovation in millet cultivation, processing, and product development impedes the creation of intellectual property assets in this domain.

FUTURE DIRECTIONS

1. Sui Generis Systems: Developing specialized legal frameworks or sui generis systems tailored to the specific needs of millets and traditional knowledge protection, considering the collective nature of this knowledge.

2. Capacity Building: Empowering smallholder farmers and indigenous communities with knowledge, resources, and legal support to engage effectively in intellectual property management and benefit-sharing arrangements.

3. Innovation and Research Support: Encouraging research and innovation in millets, providing incentives such as grants, funding, or tax incentives for developing new millet varieties, processing methods, or value-added products.

4. International Collaboration: Fostering international collaboration and dialogue to establish harmonized standards for the protection of traditional knowledge associated with millets and ensuring equitable benefit-sharing globally.

5. Policy Reform: Advocating for policy reforms at national and international levels to strengthen intellectual property protection mechanisms for traditional knowledge, genetic resources, research and development and innovative millet-based products.

6. Awareness and Education: Enhancing awareness among stakeholders, policymakers, and researchers about the significance of IPR and fair benefit-sharing. Educating consumers about the nutritional value and ecological benefits of millets will increase demand.

Addressing these challenges and moving towards these future directions would significantly contribute to the effective management of intellectual property related to millets, ensuring their conservation, sustainable use, and equitable benefits for all stakeholders involved.

CONCLUSION

IPRs are pivotal in fostering innovation and fuelling economic growth. By effective management of IPR to millets, countries can leverage on the vast advantages millets have to offer to mitigate food scarcity, enhance economic progress for farmers, attract investment and nurture innovation. All these efforts ultimately lead to increased prosperity of nations.

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Intellectual Property Rights Vs Science: Prospects and Challenges

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Abstract:

Intellectual Property Rights (IPR) play a crucial role in promoting scientific innovation and encouraging the development of new discoveries. However, application of IPR to science also presents several challenges. This review paper explores the prospects and challenges associated with IPR in the context of scientific advancements. It examines the positive impact of IPR on scientific research, innovation, and knowledge dissemination, while also addressing concerns related to access to knowledge, collaborative research, and the balance between public and private interests. By analyzing these aspects, this paper aims to suggest strategies & solutions to create an environment that values knowledge sharing, which ultimately accelerates scientific progress & maximises the societal impact of scientific research.

Introduction

1. Brief overview of IPR and its significance in scientific research

IPR stands for Intellectual Property Rights. IPR a set of legal rights that protect creations of the human intellect, such as inventions, artistic works, designs, symbols, names, and images used in commerce(1). The main purpose of IPR is to provide incentives for innovation and creativity by granting exclusive rights to the creators or owners, allowing them to control and profit from their intellectual creations. Since Research and Development (R&D) in Science involves huge cost and investment of time, it is right that the researcher reaps the benefit of the findings.At the same time, R&D should also benefit the society as a whole. IPR should ensure that it strikes the right balance in benefits to researchers and to society.

Prospects of IPR in Science

1. Protection of scientific discoveries and inventions

It involves granting legal rights to researchers, scientists, and inventors to safeguard their intellectual assets, providing them with exclusive control over the use, commercialization, and dissemination of their innovations. Several mechanisms are commonly used to protect scientific discoveries and inventions:

Patents: Patents are the most common form of protection for scientific inventions. They provide exclusive rights to the inventor for a limited period, during which others are prohibited from making, using, selling, or importing the patented invention without the inventor's permission.(2)

Copyrights: Copyright protection applies to original creative works, such as scientific publications, research papers, software code, and artistic expressions. It grants the creator exclusive rights to reproduce, distribute, and display their work for a specific period, usually the lifetime of the creator plus 50 to 70 years. (2)

Trade Secrets: Some scientific discoveries, particularly in industry or technology sectors, may be protected as trade secrets. This involves keeping valuable information confidential and not disclosing it to the public. Trade secrets are protected indefinitely as long as they remain secret and provide a competitive advantage. (2)

Trademarks: Although less common in scientific discoveries, trademarks can be used to protect brand names, logos, and symbols associated with scientific products or services. (2)

Plant Breeders' Rights: In agricultural research, plant breeders may seek protection for new plant varieties they have developed through the Protection of Plant Variety and Farmers Right Act(PPVFR). PPVFR grants exclusive rights to produce, sell, and distribute the new plant variety for a specified period. (3)

2. Encouragement of research and development

The prospects of Intellectual Property Rights (IPR) in science present several opportunities to encourage research and development (R&D) and drive scientific progress. Here are some key prospects of IPR in science that can promote R&D:

Commercialization and Technology Transfer: IPR protection facilitates the commercialization of scientific discoveries and technologies. It provides a means for researchers and institutions to secure licensing agreements and collaborations with industry partners, leading to the translation of research findings into real-world applications. (4)

Investment and Funding Opportunities: Strong IPR protection can attract investment in R&D. Investors are more likely to support research projects and start-ups when they can have confidence in the protection of intellectual property, which in turn stimulates R&D activities and accelerates scientific advancements.

Academic-Industry Partnerships: IPR can facilitate collaborations between academia and industry. It provides a framework for joint research projects, technology development, and knowledge exchange, allowing for the transfer of scientific advancements from academia to industry for commercialization and societal impact.

Global Collaboration and Licensing Opportunities: IPR protection enables researchers and inventors to engage in global collaborations and licensing agreements. It allows for the exchange of scientific knowledge, expertise, and technologies across borders, fostering international cooperation and advancements in R&D. (5)

Reputation and Recognition: IPR protection enhances the reputation and recognition of researchers and institutions. It provides tangible evidence of scientific achievements, leading to increased visibility, collaborations, and opportunities for further R&D.

Challenges of IPR in Science

1. **Access to knowledge and information**

Access to knowledge and information is a significant challenge associated with Intellectual Property Rights (IPR) in the realm of science. While IPR aims to protect and incentivize innovation, it can inadvertently restrict the availability and accessibility of scientific knowledge. The challenges related to access to knowledge in the context of IPR in science include:

Limited Availability: Strict IPR enforcement can result in limited availability of scientific knowledge, particularly when patents or copyrights protect it. This restriction may impede researchers, students, and the broader public from accessing and building upon existing knowledge.

High Costs: Accessing scientific literature and patented technologies often involves high costs, such as subscription fees for academic journals or licensing fees for patented technologies. These costs can be prohibitive, especially for researchers and institutions with limited financial resources, hindering their ability to access the latest research findings and technologies. (6)

Inequitable Access: IPR can create disparities in access to knowledge, particularly between developed and developing countries. Patented technologies or research findings may be accessible only to those who can afford the associated costs, widening the knowledge gap and hindering progress in areas that require global collaboration.

Time Delays: The time required to grant patents or negotiate licensing agreements can cause delays in accessing knowledge. This delay may slow down research and development processes, impeding scientific progress and hindering the timely translation of discoveries into practical applications. (7)

Legal Complexity: The complex nature of IPR laws and regulations can make it challenging for researchers, particularly in interdisciplinary fields, to navigate the legal landscape and access the necessary knowledge and technologies. This complexity can deter collaboration and limit the potential for interdisciplinary advancements. (8)

2. **Balancing public interest and private incentives**

Balancing public interest and private incentives is a critical challenge when it comes to Intellectual Property Rights (IPR) in the field of science. While IPR aims to incentivize innovation and reward inventors, it must also consider the broader societal benefits and

ensure access to knowledge. The challenge lies in finding the right equilibrium between public interest and private incentives.

Access to Knowledge: Ensuring that scientific knowledge remains accessible to the public is crucial for societal progress. While IPR provides inventors with exclusive rights, mechanisms should be in place to facilitate knowledge dissemination and equitable access.

Affordable Healthcare and Essential Technologies: In fields like healthcare, access to affordable medicines, treatments, and essential technologies is of paramount importance. Striking a balance between IPR protection and the public's access to affordable healthcare is a challenge.

Case Studies and Examples

1. **Patenting and licensing in the pharmaceutical industry**

The pharmaceutical industry provides several case studies and examples that highlight the role of patenting and licensing in driving innovation and facilitating access to medicines. (9) Here are a few notable examples:

The Case of Gleevec (Imatinib) and Novartis: (10)

Gleevec, developed by Novartis, revolutionized the treatment of chronic myeloid leukaemia (CML). Novartis obtained patents to protect the drug's invention, providing exclusivity for a period.

The case raised debates around access to affordable medicines, as the high cost of Gleevec posed challenges for patients in some countries. This led to pressure for compulsory licensing and negotiations to enable more affordable access.

The Patent Pool Initiative: (11)

The Medicines Patent Pool (MPP) is an example of an innovative licensing mechanism established by the international community. It aims to facilitate access to HIV, hepatitis C, and tuberculosis medications in low- and middle-income countries.

The MPP negotiates licenses with patent holders and sublicenses the rights to generic manufacturers, allowing them to produce and distribute affordable versions of patented medicines.

Vaccine Development and Licensing: (12)

The COVID-19 pandemic highlighted the importance of patenting and licensing in vaccine development. Companies such as Pfizer, Moderna, and AstraZeneca secured patents for their COVID-19 vaccines, providing exclusivity for their innovations.

Licensing agreements, such as those between AstraZeneca and the Serum Institute of India, facilitated the production of vaccines at a larger scale, ensuring wider access to vaccines globally.

Strategies and Solutions

Promoting open access and knowledge sharing in the context of Intellectual Property Rights (IPR) and science is crucial for fostering innovation, collaboration, and the broader dissemination of scientific advancements. Here are some strategies and solutions that can be employed to encourage open access and knowledge sharing:

Creative Commons Licensing: Encouraging the use of Creative Commons licenses can provide a legal framework for sharing and reusing scientific content. Researchers can choose licenses that allow for different levels of reuse, modification, and commercial use, depending on their preferences and objectives. (13)

Collaborative Research Platforms: Platforms and networks that promote collaborative research, such as open research communities and citizen science initiatives, provide opportunities for researchers to work together, share resources, and collectively address scientific challenges. (14)

Encouraging collaborative research and open innovation in the context of Intellectual Property Rights (IPR) and science can foster cross-pollination of ideas, accelerate scientific advancements, and promote collective problem solving.

Reforming patent systems to address challenges: Reforming patent systems can address challenges associated with Intellectual Property Rights (IPR) in science and promote a more balanced and effective approach. Here are some strategies and solutions for patent system reforms: (15)

- Clearer Patentability Criteria
- Timely and Rigorous Examination
- Patent Quality Assessment
- Balanced Patent Duration

Role of governments and international organizations: Governments & international organizations play a key role in establishing policy frameworks and legislation related to IPR and science. They can enact laws and regulations that strike a balance that promotes innovation and protects public interest. They can Fund and Support research activities, oversee patent systems, facilitate technology transfer from academia to industry by establishing right mechanisms, such as technology transfer offices.

The Government can include the scientific community in planning of development funding, which increases science based solution to development.

References:

1. Singh R. Vol. 1. New Delhi: Universal Law Publishing Co. Pvt. Ltd; 2004. Law relating to intellectual property (A complete comprehensive material on intellectual property covering acts, rules, conventions, treaties, agreements, case-Law and much more)

2. Patent Copyright and TradeMark, by Richard Slim

3. IPR and Plant Breeders Rights, by Phundan Singh

4. Watal J. London: Kluwer Law International; 2001. Intellectual property rights in the WTO and developing countries.

5. Gutterman AS, Anderson BJ. London: Kluwer Law International; 1997. Intellectual property in global markets: A guide for foreign lawyers and managers.

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A Review Of Comparative Studies Of Specific Clinical Features Of Jwaras(Fever) In Charaka Samhita With Modern Medical Parameters

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INTRODUCTION

Charaka Samhita is considered as one of the oldest and most reliable texts in ayurveda, traditional system of medicine in India. Sage Charaka wrote Charaka Samhita around 2nd century BCE. Charaka Samhita consists of sections which are called 'sthanas'. The first section deals with basic principles (**Sutra sthana**) which includes the concept of doshas (**Vata, Pitta, Kapha**), dhatus (tissues), malas (waste products). The other sections include diagnosis (**Nidana sthana**), measurement (**Vimana sthana),** Pediatrics and Gynecology (**Sarira sthana**). Charaka samhita considers physical and mental aspects of individual. Fever is referred as 'jwara' in Charaka samhita. Jwara is associated with imbalance in doshas. Fever is related to 'god of death'. Charaka samhita mentions fever as chief among diseases because it affects body, senses and mind. Jwara is oldest of all diseases and is also very severe. Fevers are categorized based on predominance of doshas involved. The cause of fever includes infections which can be viral or bacterial. Lifestyle, diet and environmental factors also cause imbalance in doshas which lead to jwara. The Indian System of Ayurveda mainly focuses on maintaining balance in doshas. According to modern medicine fever is an increase in temperature of body above 38.5 degree Celsius. Measurement of temperature is carried out by oral, rectal or temporal route. The most common route is the oral route. Acute fever stays for a small span of time while chronic fever may persist for longer duration which might require further diagnosis.

JWARA IN CHARAKA SAMHITA

Jwara is mentioned as vikara, roga, atanka and vyadhi. In Indian system of Ayurveda, fever or pyrexia is considered as one of the attributes of jwara. Jwara can include different clinical features that can be with or without rise in body temperature. Jwara is given importance because its presence is common in most of the diseases. Classification is done on the basis of imbalances in the three doshas Vata, Pitta, Kapha.

CLASSIFICATION

The samhita speaks of two major types of fevers that is body and mind. The ancient text gives classification in the context of diagnosis. The definition considers excessive heat of body and mind. [31 chsa]. This indicates the equal importance given during diagnosis and treatment for both sthulasharira(physical body) and sukshmasharira(subtle body). It regards fever as excessive heat in both the bodies due to internal and external factors. The major classification is two types somatic and psychic which is attributed by two major sources that

is soma and agni which can attributed to body chemical change and consequently the agni related to temperature change. Even though Charaka Samhita classifies the fevers more scientifically as internal and external, it also classifies the fever into natural and unnatural origin. The unnatural origin is not mentioned as supernatural, but the fevers not categorized in the ancient time. The Samhita further classifies fever into curable and incurable types. It is accurate about its available technique and medicine for certain fevers which was classified as incurable. The curable fevers are five types, classified based on strength and weakness timings of dosha. They are remittent, rising twice a day, quotidian, tertian and quarter. There are seven types based on location of dhatus and eight types based on etiology (study of causes of disease). The Charaka Samhita mentions somatic fever with respect to body and modern medical science fails to explain certain fevers due to psychosomatic cause which is mentioned in Samhita as mental detraction and restlessness. Based on combined symptoms Vata and pitta with Vayu creates heat while Vata Kapha forms cold related fevers. The fever caused naturally due to seasons and doshas is explained elaborately as follows:

प्राकृतःसुखसाध्यस्तुवसन्तशरदुद्भवः| उष्णमुष्णेनसंवृद्धंपित्तंशरदिकुप्यति||४२||
चितःशीतेकफश्चैवंवसन्तेसमुदीर्यते| वर्षास्वम्लविपाकाभिरद्भिरोषधिभिस्तथा||४३||
सञ्चितंपित्तमुद्रिक्तंशरद्यादित्यतेजसा| ज्वरंसञ्जनयत्याशुतस्यचानुबलःकफः||४४||
प्रकृत्यैवविसर्गस्यतत्रनानशनाद्भयम्| अद्भिरोषधिभिश्चैवमधुराभिश्चितःकफः||४५||
हेमन्ते, सूर्यसन्तप्तःसवसन्तेप्रकुप्यति| वसन्तेश्लेष्मणातस्माज्ज्वरःसमुपजायते||४६||
आदानमध्येतस्यापिवातपित्तंभवेदनु ||४७||

Charaka samhita - chikitsasthana - jwaras 3rd chapter 42- 46

Natural fever which is seen in autumn is easily curable. Pitta is itself hot. This becomes more severe by heat and is vitiated in autumn. Similarly, Kapha gets accumulated in the winter or cold season and becomes severe in the spring. During rainy season, due to the consumption of water and plants having increased acid levels, pitta gets accumulated and is vitiated due to intense heat in the autumn due to which intense fever is raised. Similarly, Kapha is accumulated by the consumption of sweet water and plants in the Hemanta or early winter and is vitiated during spring due to heat of the sun. therefore, a person will experience fever because of Kapha during spring.

The Samhita advises physicians to consider fevers in autumn and spring separately with varying doshas along with time of onset separately for nidana process. It stresses upon drawing information from the patient more than using instrumental diagnostic procedure.

SPECIFIC CLINICAL FEATURES

Charaka Samhita considers holistic approach for diagnosis which includes various factors. Combination of the three doshas will be considered to find out the specific jwaras. There are different specific clinical features according to doshas like Vata dominant jwara, Pitta dominant jwara, kapha dominant jwara, Vata pitta jwara, Vata kaphajwara, kapha pitta dominant jwara..If a person is suffering from Vata dominant jwara, they will experience

remitting fever with severe temperature variation, increase of fever after consumption of food, rough skin, discoloration on nails, skin, face, stool, urine , pain emanating from toe to upper body and travels to other parts of the body, cold feet, stiffness in calf muscle, loose knees joints, weakness in thighs, intense pain in waistline, flank pain, pain in arm and shoulder, tightness in the chest. (21) Pitta dominant jwara increases during autumn season. Clinical features are intense and include desire for cold things, loose motions, vomiting bile, weakness, yellow or green colored accumulates in skin, eyes (Ni.Sth1/22-24). Kapha dominant jwara is mildly severe and the clinical features are cough with phlegm; fingernails, skin, eyes turn white. In these desire for hot things increases (Ni.sth.1/27). Vata pitta dominant jwara brings out desire for cold things as vata combined with pitta. Vata kapha dominant jwara brings out desire for hot things (chi.sth.3/37).Sannipatajwara is caused due to combination of all three jwaras, it can be vata dominant, pitta dominant or kapha dominant. Vishamajwara causes irregular fevers.

MODERN MEDICAL PARAMETERS

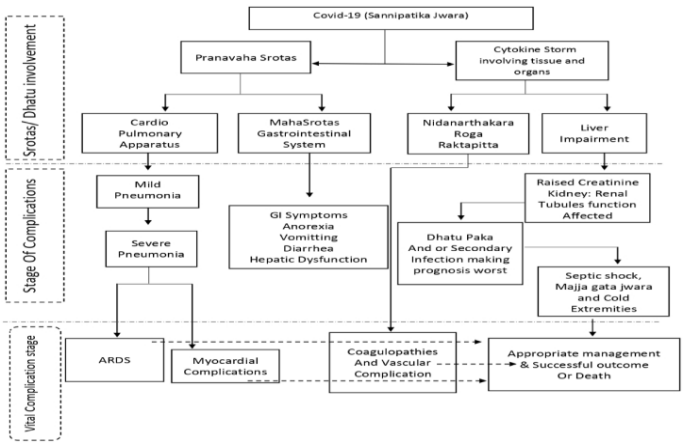
The modern medical parameter for fever is usually done by recording body temperature. It also gives importance to the condition in which the patient feels warm to touch and history of feeling feverish. The basic evidence being derived from history, physical examination and initial laboratory and radiology studies. The organized approach of modern parameters is five types of patterns. They are intermittent, remittent, continuous or sustained, hectic and reluctant. The temperature difference varies between 0.3degree Celsius to 1.4 degree Celsius at given time. The swing in temperature is associated with chills and sweat. It is identified with diseases like tuberculosis and drug reactions. The fungal disease, bacterial pneumonia usually causes continuous fever while malaria results in relapsing fever. The thermal regulation is monitored among the patient and the increased temperature has less significance in diagnosis. The WHO classifies the fever as 12 types prevalent in Indian continent.

Acute fever is usually a sudden increase in body temperature above 38 degree Celsius which does not stay for longer time span. It is mild fever and can be considered as immune response for underlying infection or disease. It can last for few days or weeks. Subacute fever is less severe than acute fever and can infect for weeks or months. It can be seen in few autoimmune diseases. Recurrent fever infects at regular intervals without resolving completely. It is seen in tuberculosis, pharyngitis. Chronic fever is constant increase in body temperature for longer time span usually greater than three weeks. Chronic fever is observed in AIDS and cancers. It is severe in nature and can indicate further complications. Intermittent fever elevates for some time and again comes back to normal which can be seen in malaria. Remittent fever shows periodic changes where temperature increases and decreases but does not return to normal range. The pattern of fever is different in chronic fever as there is continuous increase in body temperature in other fevers. If the body temperature is greater than 41.1 degree celsius it is termed as Hyperpyrexia. It is dangerous as it can lead to heat stroke or organ damage. Low grade fevers show increase in body temperature upto 38.9 degree celsius. Relapsing fever is caused by Borrelia bacteria which cause recurring fevers. Septic fever is an inflammatory response to bacterial infections which cause high fever, chills, low blood pressure. Drug

induced fever is caused due to side effects of medications like painkillers, cancer medications. Idiopathic fever term is used when the cause of fever is not being identified even after evaluation and medical studies.

COMPARATIVE STUDY

In charaka Samhita, fever is diagnosed based on doshas that are vata, pitta, kapha while in modern medicine fever is diagnosed on underlying causes like bacterial or viral infections, immune response or due to any other disease. Modern medicine focuses on parameters like blood test, urine test and instruments like thermometer, stethoscope. Charaka Samhita focuses on inter relation between mind, body and soul. It considers urine color, appearance of individual and doshic imbalances to diagnose fever. Charaka Samhita mentions the benefits of langhana(fasting), tikta rasa drugs(bitter tasting drugs) for treatment of jwara.Jwaras can be cured using drugs like Nimba, triphala, musta, vatsaka. While according to modern medicine pyrexia is treated by drugs like paracetamol, ibuprofen, aspirin which can have side effects. Charaka Samhita and other ayurvedic books in Indian medicine system has considered jwara(fever) as disorder capable of causing epidemic by vikrutvayu or jala or desha that is contaminated air, water and land. Controlled line of treatment is mentioned in literature to manage jwara. We can see that the specific clinical features that are mentioned in Charaka Samhita corelates with the specific clinical features in modern medicine. Clinical features of covid are fever, cough, loss of taste, body ache, loss of smell, shortness of breath. All theseclinical features are present in vatakaphajwara which is mentioned in Charaka Samhita. In disorders like Pneumonia, Sepsis, Chikungunya, Dengue, Malaria the clinical features were also found to be similar to the clinical features of specific type of jwaras in Charaka Samhita



A Study of UV – Visible And IR Spectral Data Of Lycopene In Selected Solvents Extracted From Biological Sources

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Abstract: Lycopene is one of the carotenoid pigments naturally occurring in red fruits and vegetables. The most common source for scientific studies on lycopene is from the sources like tomato, watermelon and papaya. It is an antioxidant containing polyene chain with high chemical reactivity, when present in the human system and shows reaction with several oxidizing agents and free radicals generated during several detoxification reactions. The role of lycopene in removal of toxic molecules generated is well recorded. They find major role in prevention of human health disorders including heart diseases. It occurs in cis and tans isomers. Lycopene is synthesized only in plants and its molecular structure undergoes several modifications depending on the presence of solvents. The extraction method adopted includes obtaining the lycopene solid from the aqueous layer which is generally discarded in regular Benzene extraction method. The study of spectral data in selected solvents is carried out with extracted lycopene sample and an attempt is made to elaborate and interpret the spectral data using FT-IR and UV-Visible spectrophotometer. The structural studies help us in understanding possible mechanisms involved in the role of lycopene in alleviating life style disorders and mal-functions in several organ systems.

Key words: Antioxidants, solvent extraction, benzene extraction, UV – Visible spectroscopy and FT – IR spectral data.

I. INTRODUCTION

Fruits and vegetables are the main source of natural antioxidant components *(1).* One of the most efficient carotenoid antioxidants is lycopene *(2).*Studies have shown that Lycopene is a natural pigment which protects the body by neutralizing the negative effects of oxidants and free radicals in the body, regular intake of lycopene containing food reduces heart diseases and risk of body tumor especially prostate cancer*(3,4).*Some of natural sources of lycopene are tomato, watermelon, papaya, pink Guava and apricots*(5).*Lycopene is a Polyene which is tetra terpene hydrocarbon, an acyclic open chain, unsaturated carotenoid consisting of 13 double bonds of which 11 are conjugated double bonds arranged in linear array and the molecular formula of lycopene isC_{40} H_{56} having molecular weight of 536.85 Da. Lycopene in nature is of all trans forms since lycopene is unstable in heat, light and chemical reaction conditions, seven bonds in lycopene isomerizes into mono or poly cis *(6).* Lycopene is soluble in chloroform, benzene and other organic solvents but insoluble in water*(7,8).* In this work, lycopene is extracted from watermelon, papaya, guava by solvent extraction using benzene as the main solvent and checking the purity of the extracted lycopene by performing

TLC, and spectral analysis of the extracted lycopene sample in UV – visible spectroscopy under selected solvents and FT-IR spectroscopy

II. MATEIAL AND METHOD

2.1: Material

Biological sources: Citrullus lanatus (Watermelon), Psidium guajava (pink guava), Carica papaya (papaya).

Chemical: Benzene, Na_2CO_3, Acetone, Chloroform, ethanol, toluene, xylene, THF, Silica gel-G.

2.2: Methods

2.2.1: Methodology: Lycopene extraction, most of the research papers were achieved by using tomato source. As the structure of lycopene practically remains same in all the remaining sources, three major sources were selected for this project namely Citrullus lanatus (watermelon), Psidium guajava (pink guava), Carica papaya (papaya). The selected sources are rich in lycopene content and few research papers were published from these sources *(9,10).*The method includes a common procedure in which 150g of pulp sample was taken and was finely blended by mixer to obtain a paste. 30g of paste is weighed and transferred into the separating funnel. 30ml of equal volume of Benzene is added successively into the separating funnel for every five times of each stage and stirred for 15 minutes. The aqueous layer containing the target lycopene in upper layer is formed by agitating the solvent in the funnel. Now the mixture is filtered into a beaker using funnel to remove insoluble fiber using a pinch of Sodium Carbonate (Na_2CO_3). The filtrate organic solution is kept for evaporation in the hot air oven by adding boiling chip. The organic liquid undergoes complete evaporation in 2-4hours leaving behind brownish red solid lycopene compound. The high yield in papaya and low yield in other two sources indicated the content of target compound in the respective sources. The method was employed for all the other sources in the research papers *(11, 12).*

The purity of sample extracted was checked using thin layer chromatography. The lycopene extracted from the three samples were analyzed in UV-Visible spectral data under different solvents and FT-IR spectral data, were studied and interpreted.

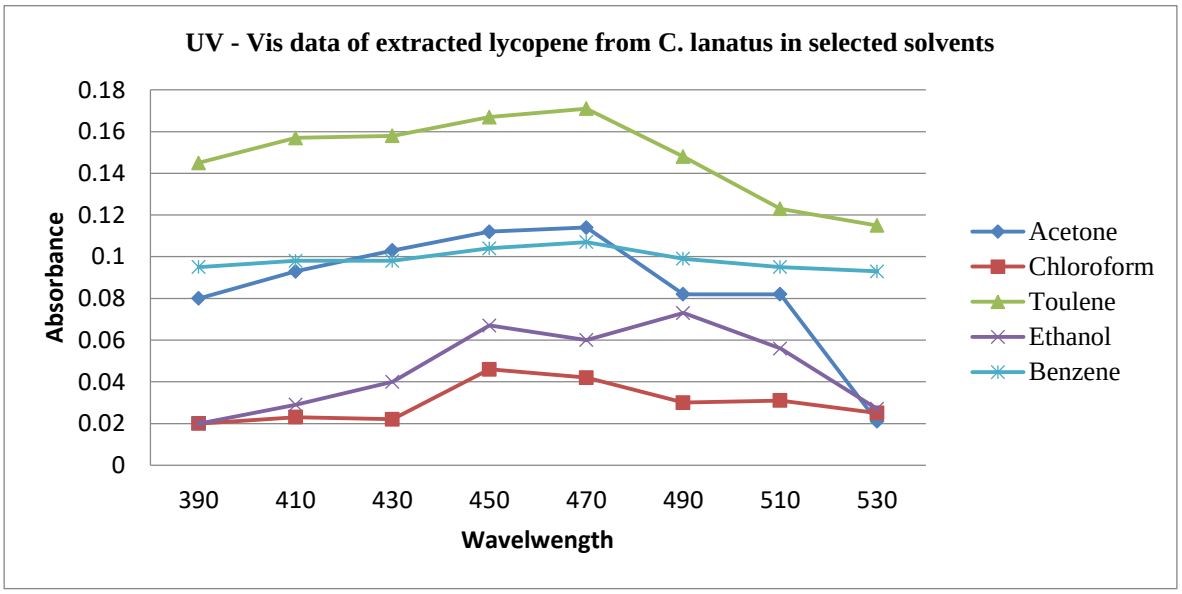
III. RESULTS AND DISCUSSION

3.1: Thin Layer Chromatography Results: TLC was performed using Benzene, THF, Xylene. The reported Rf value for lycopene extract is 0.64 *(12).*

3.2: UV visible spectroscopy

UV visible spectroscopy was performed after TLC. Lycopene extracted from watermelon, papaya, and guava was subjected with selected solvents based on the solubility property of

the lycopene. The solvents used in UV visible spectroscopy are acetone, chloroform, benzene, ethanol *(7, 8)* and toluene. Lycopene extracted from three fruits were dissolved into all the above mentioned solvents separately and the spectral data was noted and graphs were plotted accordingly



UV – Visible data of extracted lycopene from C. papaya in selected solvents

The spectral data obtained in benzene extracted lycopene sample is checked using acetone solvent showed the peaks at 420nm, 454nm, 470nm and 510nm respectively are found almost typically same for the sample analyzed in the sample solvent (11). This helps us to draw conclusion that the sample extracted is pure and methodology is correct. The 11 double bonds in the molecule are responsible for the prominent peaks in which the electronic transition gives the spectral output. The peak at 420nm is prominently absent in all the sources used in the project. It can be reasoned to solvent compound interaction during UV – Visible analysis, it requires further more studies. The research papers with the spectral data 420nm peak observed is due to use of acetone solvent extraction in which solvent compound interaction gives the peak. The project team has used the other solvents like ethanol and toluene and the results obtained require further study and interpretation

3.3: Infrared spectroscopy

The FT-IR spectral band obtained is typically similar to that of Aghel N et, al., 6(1), 9-15, 2011. The FT - IR graphs obtained from Bruker alpha in ATR of each from 3 different fruits samples indicated common peaks 1045 cm^{-1} region which is a common observation in lycopene indicating C-H and C-C bending and stretching. Other groups such as lipid groups in 2800 - 2900 cm^{-1} and C-C and C-H out the plane bending at 600-900 cm^{-1} and water molecules in 3000-3500 cm^{-1} is observed *(14).* The present work on lycopene is carried out using three different sources and the graphs obtained for pure sample is unique and requires

further study and interpretation. This project aimed to produce FT-IR data for the sources and the comparison to the standard KBr based IR data requires more studies.

Table 3.15: FT-IR of lycopene from Aghel N et,al., 6(1), 9-15, 2011

Wavelength	Phenomenon
3100 (cm^{-1})	CH str (SP2)
2918.92, 2851.05 (cm^{-1})	CH str (SP3)
1670, 1640 (cm^{-1})	C= C str (Trans)
1446.92, 1400 (cm^{-1})	CH2 (Bending)
1101.07, 1000, 957.33(cm^{-1})	CH (Trans OOP)
612.84 (cm^{-1})	R2C=CR

IV. DISCUSSIONS AND CONCLUSION

Lycopene extracted from benzene - solvent extraction method is adopted for the sources namely, watermelon, papaya and guava are widely used. The benzene layer is usually discarded after the solidification of lycopene in aqueous phase. In normal procedure the benzene layer having substantial amount of lycopene is evaporated along with the solvent. Presently the Benzene layer was used for extraction of lycopene by evaporation method. The extraction of lycopene in this work is that benzene evaporation is too long 2-4 hours. In the available literature to get UV – Visible spectra, the solvents used are benzene, chloroform and acetone *(11).* Apart from this the spectra are also obtained by using toluene and ethanol solvents. A total of five solvents were employed for every dilute solution of lycopene to get spectra. The absorbance graphs obtained shows minimum interference due to the presence of β carotene from the available sources. From the present work the □max value obtained in all solvents shows peak at 450nm and 470nm except in toluene and ethanol solvents 480nm and 490nm were obtained in toluene and ethanol. This work helps to determine the concentrations and thereby quantifications. The organic solvents such as chloroform and ethyl alcohol help to study the lypophilic characteristics of β carotene. The structural analysis of lycopene in different solvents can be done with the spectral data. The reported vibrational wavelength of FT-IR spectrum is 3100 cm^{-1} in most reported works, it corresponds to C-H bond stretching (sp^2). There are several peaks in spectra between 2920 cm^{-1} and 2850 cm^{-1} indicating symmetric and asymmetric of C-H bond. From 3360 to 2800cm-1 all the graphs showed similar peaks due to the presence water and lipid. The bending stretching of C-H and C-C bond is observed between 1044 to 1445 cm^{-1}. Since the conjugated bond system involves absorption location between 1640 to 1680 cm^{-1} the lower value for C-C double bonds indicates the solvent interference. The molecule of lycopene is characterized by the presence of not only double bonds and also cyclohexene ring and cyclopentene, the IR graphs shows only stretching and bending frequencies of C-H and C-C bonds. Since lycopene is an isoprenoid lipid molecule which is nontoxic, it can be employed as antioxidant, anti-inflammatory medicine. The project on FT-IR spectrum gives input to study the structural relation with different organic solvents and thus can be used as potential drug in chemotherapy

EFFECTS OF SELECTED CARBONATED BEVERAGEON CULTIVATED MICROORGANISMS FROM PUBLIC TOILET

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bstract:

This study was conducted by cultivating microbes from a public toilet in a nutrient agar plate as the primary culture. The antimicrobial effect was determined by disk plate method, a common laboratory procedure. In our research work, Minimum Inhibitory Concentration was determined by using different media ratios and the selected beverage-Coke on uniform amounts of microbial inoculum. At the end of the study, it was found that even though coke is used to clean the toilet according to the latest social media information like Instagram, it does not act as an antimicrobial agent as no zone of inhibition was seen around the colonies but on the contrary, a much heavier growth was observed in areas around coke-infused disks due to high sugar content acting as a source of nutrient for the growth of microorganisms.

Keywords: Carbonated beverage-coke, Instagram, antimicrobial effect, Minimum Inhibitory Concentration, disk plate method.

Introduction:

Carbonated beverages, also called soft drinks, are among the most widely consumed refreshment beverages worldwide. One such carbonated beverage used in our research work is Coke also known as Coca-Cola which is consumed by more than 1.8 million people around the world. It was invented by John Stith Pemberton in Atlanta, Georgia as a patent medicine. It was introduced on May 8^{th,} 1886, thus making it 137 years old. The name coco refers to coca leaves and cola refers to cola nuts, a source of caffeine. The preparation of cola drink is not exactly known. As per Wikipedia, Coca-Cola is sold in many flavours like caffeine, lime, vanilla, and many more (https://en.wikipedia.org/wiki/Coca-Cola).

Public toilets are important infrastructure built to provide proper sanitation in cities worldwide. They should be properly maintained to be sterilized and free of pathogenic microorganisms using some strong cleaner, without which it can cause contamination and increase the risk of infection. The chemicals used to clean the toilet are often liquid acid products(Domex, Harpic, Lysol, etc.) used in both diluted and undiluted forms.The compositionincludes Polycarboxylate, NTA or Trisodium Methyl Glycine Diacetate, Citric acid, Sulfonic, Lactic acid, Formic acid, Isopropanol, and water(https://www.kviconline.gov.in/pmegp/pmegpweb/docs/commonprojectprofile/ToiletCleaner.pdf). The main aim is to clean the floor, sink, taps, and the rim and bowl. These are used for cleaning the public toilets as frequently as up to 3 times a week.

The social media information (https://www.youtube.com/watch?v=U22suBkohC4) explains the effects of cola as a toilet cleaner, mainly its erosive effects as a cleaner not explaining its antimicrobial properties. This trend was in a boom globally during the initial COVID period (early 2020) as carbonated beverages were more affordable than toilet cleansing agents.Our study mainly aims to check whether coke acts as an antimicrobial agent and can kill or inhibit the growth of microbes that were isolated from public toilets.

According to a few studies [1,2] conducted on the effects of Coke and other carbonated beverages and their effect on plant growth, it was seen that unsweetened carbonated drinks like soda water might aid in the growth of plants due to the presence of carbon dioxide but are ultimately harmful.

As stated in the study by Adel Alkhedaide *et al.*[3] on the chronic effects of soft drink consumption on the health state of Wistar rats and also in the study byD Amato *et al*[4] on the acute effects of soft drink consumption to check the calcium and phosphate metabolism in adult rats. The studies concluded that long periods of coke consumption led to detrimental histological alterations in the bones and livers of rats and also affected the phosphate and calcium metabolism leading to hyper phosphaturia and hypercalciuria.

On testing the antimicrobial effect of concentrated coke on bacteria and germs causing food poisoning like *Escherichia coli, Enterococcus faecalis, Salmonella enteritidis*, etc. as stated in the study by Şeker Dağ*et al*[5], it was observed that coke showed considerable antimicrobial effect.

Materials and Method:

In our present study,Coca-Cola was used to check the antimicrobial properties against the culture cultivated from public toilet. It was procured from the supermarket and further work was carried out in the laboratory of Vijaya College, RV road, Bengaluru.

The following is the list of ingredients and nutritional facts present in Coke:

Listed ingredientsas per source(https://en.wikipedia.org/wiki/Coca-Cola)

- Carbonated water
- Sugar (sucrose or high-fructose corn syrup (HFCS)depending on country of origin)
- Caffeine
- Phosphoric acid
- Caramel colour (E150d)
- Natural flavourings

Nutrition facts as per label for 100ml

- Energy – 44kcal
- Carbohydrate – 10.9g
- Total sugars – 10.6g
- Total fat – 0g

- Total protein – 0g
- Sodium – 8.5mg

Microorganisms isolated from public toilet were cultured in Nutrient agar mediawhich is a general-purpose solid medium which supports the growth of a wide range of microorganisms. It is used to cultivate non-fastidious microorganisms i.e., those organisms that do not require any special nutrient supplementation for their growth. Nutrient agar is one of the most widely used nutrient mediums as it contains many nutrients and is suitable for the growth of several bacteria of *Salmonella* species which are one of the most widely found organisms in public toilets along with *E. coli* and *Staphylococcus.*

Composition of Nutrient agar media:

1. 0.5% peptone, which acts as a main source of organic nitrogen for bacterial growth.

2. 0.3% beef extract is a water-soluble substance that contains vitamins, carbohydrates, salt, and trace amounts of nitrogen.

3. 0.5% NaCl, helps in maintaining salt concentration in the medium which is similar to the cy to plasmic salt on centration of the microorganisms.

4. 0.5% agar is used as a solidifying agent (If agar is not added, the nutrient broth is obtained).

5. Distilled water, water is essential for all living organisms' growth and provides a medium to transport nutrients.

6. pH is adjusted to 7.4

In our research work, MIC was determined to check the growth of microorganisms.

Minimum Inhibitory Concentration (MIC) was determined to check which concentration of coke had the least growth of microorganisms thereby preparing a dilution series of coke in nutrient broth. The composition of nutrient broth is the same as nutrient agar except that in broth, agar is not added. The nutrient broth was poured into 7 test tubes along with coke in various ratios as shown in Table 1. 1mL of inoculum which was cultured in 0.9% salinewas added to all the tubes which were later incubated for 72 hours at 37^{o} C in an incubator (Fig 1).

After 72 hours, the result was checked for the colorimetric absorbance that was measured at 600nm with saline as blank

After MIC, antimicrobial activity was checked using disk plate method.

In this method, nutrient agar was prepared, poured and allowed to solidify in two sterile petri plates. To this, a loop full of microbes from the parent culture plate (Fig 2) which was cultivated from the public toilet was streaked. Antimicrobial disks were prepared manually

using sterilized cotton and soaked in Coke. These disks werelater placed onto the agar plates and the plates were incubated at 37^{o} C for 48 hours in an incubator to check for growth and zone of inhibition. The plates were observed later for the results.

Result, Observation and Discussion:

In our current study,as tabulated in Table 2, and plotted in Graph 1, the result of MIC was observed after 72 hours of incubation (Fig 3), and it was found that the negative control (tube with 12mL of coke and 0mL of broth) showed the most absorbance of 0.45 at 600nm with least turbidity (turbidity is proportional tothe growth of microorganisms),indicating the least growth of microorganism.

Similarly, the positive control (tube with 12mL broth and 0mL coke) showed the least absorbance of 0.09 at 600 nmwith the most turbidity, thus showing the most growth of the microorganism. The 3 tubes (SL no. 3,4 and 5 respectively) where the quantity of coke and broth were almost equal i.e., 8mL broth+ 4mL coke, 6mL broth+ 6mL coke, and 4mL broth+ 8mL cokeshowed very close absorbance values which were quite lower than the negative control, thus indicating a combination of nutrient broth and coke acts as an excellent media for growth of microorganisms. Further, the result was analysed for antimicrobial activity and the plates were checked after 48 hrs (Fig 4 and Fig 5). It was seen that the area around the coke-soaked discs showed excessive and healthy growth of microorganisms in opposition to the zone of inhibition expected.

The colonies formed in the plates are smooth, round, concave, and pink in colour (Fig 4 and Fig 5). Further the microorganisms were stained (Gram staining) and observed under 100X, they were observed to be Gram-positive cocci.

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Eisenia fetida: A Bioremedial Worm forSanitary Napkins and Diapers

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Abstract

Sanitary napkins and baby diapers are widely used around the world by menstruating women and babies. Once used, they are either dumped in landfills or incinerated which releases harmful gases such as carbon monoxide into the environment. Such material contains plastic, cotton, and synthetic substances which take hundreds of years to bio-degrade under normal conditions, hence polluting the earth's surface. The present study aims to use the earthworm species *Eisenia fetida* to fasten the process of biodegradation.

Layers of fresh compost (which included waste materials, cow dung slurry, and water, were allowed to decompose for 15 days), cow dung, *Eisenia fetida*, fine compost, hay, used and unused sanitary napkins and diapers, and water were used to set up the experimental setting for degradation. The weights of the napkins and diapers initially and weekly were observed which ultimately decreased. Used diapers were set up for four to five weeks, and their weight decreased from 103g to 17.3g once every seven days, bacteria were isolated from vermicompost and the earthworms' gut by cultivating them on nutrient agar plates. Gram staining was used to further define the bacterial colonies. Gram-positive cocci, bacilli, Gram-negative rods, cocci, and bacilli containing spores and other variety in the bacterial population was seen. According to the results of the current study, vermiremediation is a very efficient, environmentally benign, and zero-waste approach for the disposal of sanitary napkins that can be used widely to reduce environmental contamination caused by them.

1. Introduction

Sanitary napkins and baby diapers are usually made up of cotton, plastic, cellulose, fluff pulp, polyethylene, adhesives, superabsorbent, and release paper. These take hundreds of years to decompose in landfills[1]. The plastic present in them contaminates the soil and may reach underground water bodies. With many disease-causing bacteria, the problems arise due to improper disposal of hygiene products. According to recent statistics, every year around 12.3 billion used sanitary pads and 20 billion pieces of used diapers are dumped into landfills in India alone. The current study aims to use earthworm species *Eisenia fetida* in degrading sanitary napkins and baby diapers by vermiremediation[2].

Eisenia fetida is a species of earthworm that is used both domestically and industrially. These worms are usually 3.5-13cm in length and 0.3-0.5cm in diameter with a flexible body. They are usually reddish brown in color and can vary in gradients. Upon multiplication, they help to quicken the process of biodegradation process efficiently by breaking down decaying natural remains and this is used as high-quality organic compost,

rich in nutrient matters like nitrogen, carbon, and sulphur. Earthworms are members of the Clitellata subclass within the larger phylum Annelida and are non-microscopic, but rather readily observable organisms. These oligochaete annelids play a crucial role in soil ecosystems worldwide.

Vermicompost is the product of the decomposition process by worms in the presence of several natural ingredients like vegetable peels, fruit peels, cow dung, hay, dry leaf,etc. After the preparation of fresh compost, the worms are added to it and let for decomposition. After a period of 45 days fully formed compost is obtained. This product is used for the rearing of earthworms[3].

Bacterial isolation also helps in the degradationof some of the important bacteria present in Gram- positive and Gram-negative species. These help in faster decomposition by enzyme activity. Thisprocessaims to use earthworms and bacteria in the process of biodegradation by mimicking natural environments [4].

2. Materials and Methods

Eisenia fetida is a species of earthworm widely found in India. It is commonly known as red wiggler worm or manure worm and is used in the process of vermicomposting[5].These worms were collected from the Biocentre in Hulimavu, Bengaluru.

Firstly, compost was freshly prepared by adding kitchen waste such as vegetable and fruit peels, hay, wastepaper, dry leaves, and water. These materials were put into a big bin along with cow dung slurry tofacilitate the formation of compost. This setup was kept in a shady place and left to decay for a period of15 days with stirring in between once every 2 days. After the incubation period, a semi-degraded compost was formed and used for further experimental setup. In the current study, sanitary napkins and baby diapers are treated in vermicompost with *Eisenia fetida*. The pads and diapers were procured from Jan aushadhi Kendra. The sanitary pads consisted of cotton, layers of polyethylene, adhesives, synthetic fibers, etc. Similarly, the diapers consist of cellulose, polyethylene, and a super absorbent polymer, as well as tapes, elastics, and other adhesive materials, which take a long time to biodegrade[6, 7].

The morphological study of *Eisenia fetida* was carried out using a wax dissection box by crude method. The photographs of the earthworms were taken and morphologically analyzed. The worm was reddish brown in appearance and was 2-4cm in length, around 3-4mm in width. Next was the experimental setupwhere a total of six rectangular pots of size 1ft were used, out of which two were used for sanitary napkins, two for diapers, and two for control. Layers of freshly prepared compost, hay, and decomposed compost, along with cow dung slurry were added to the pots. In between these layers used and unused sanitary napkins and diapers were placed. Upon the samples 50- 60g of earthworm were added to each pot, these samples were later covered by compost, hay, and perforated tiles to maintain humid conditions for the earthworms to grow. The controls consisted of only decomposed compost with unused sanitary napkins and diapers, mimicking the conditions

in a landfill. These were kept for an incubation period of4 weeks with weekly checks for the parameters of weight analysis of napkins and diapers along with analysis of microbial diversity in earthworm gut and vermicompost. The weight analysis was done once every 7 days, where the napkins and diapers were carefully removed from the pots and kept for 4 hours of direct sunlight as a part of drying, later the weights were recorded in grams on a weighing machine and compared with the control.

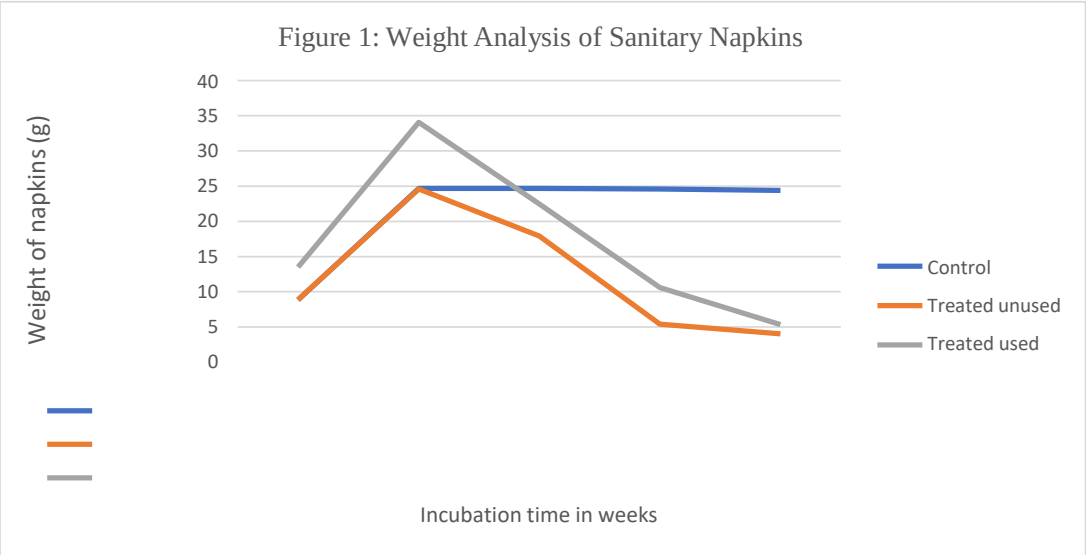
The examination for microbial activity and diversity included the preparation of 50ml Nutrient agar(NA) for bacterial examination and 50ml Martins Rose Bengal agar (MRBA) for fungal examination, which was poured into two petri plates each for solidification after autoclaving at 121˚ for 20 mins.

The microbial diversity was checked in earthworm gut and the compost present in pots. This was done once in a week. Earthworms were isolated in a wax dissection box and dissected at the gut region using asharp sterile blade and forceps. Little amounts of cotton and compost were found inside the gut. With a sterile loop, the material inside the gut was taken and streaked onto the plates, incubating them for 48 hours. Similarly, small amounts of compost were taken from pots and subjected to the process of serial dilution. Serial dilution is a technique that is used to obtain a precise measurement of bacterial or other microbe population in soil samples. 1g of sample was taken, mixed with 10 ml of saline prepared, and then serially diluted further. Later, 1ml of 10^{-3} dilution was spread plated onto NA and MRBA plates. The plates(NA) were incubated in an incubator at 37˚ for 48 hrs and the MRBA plates were incubated at room temperature. After the incubation period, the plates were checked for bacterial and fungal growth.

3. Results and Discussion

The setup for biodegradation consisted of controls for napkins and diapers (without earthworms), used and unused pads, and diapers. These were initially weighed, and the weights were individually checked in grams every seven days. A sudden increase in weight is seen in 1st week due to the absorption of water present in the compost by the pad and diaper.

Degradation of sanitary napkins



	0th Week	1st Week	2nd Week	3rd Week	4th Week
Control	8.85	24.68	24.68	24.6	24.4
Treated unused	8.85	24.6	17.92	5.41	4.03
Treated used	13.53	34.07	22.5	10.6	5.36

The above graph(Fig1) represents the weekly degradation of control, used, and unused sanitary napkins. The initial weights of control, unused, and used pads are 8.85g, 8.85g, and 13.53g.

The weights in 1st week have increased due to the absorption of water by the cotton in the sanitary pads. In 2nd week, the control weight remains the same as in 1st week, 24.68g.The treated unused napkin was reduced from 24.6g to 17.92g and the treated used napkin was reduced from 34.07 g to 22.5g. In 3rd week, the control weight was reduced to 24.6g. The treated unused napkin reduces from 17.92g to 5.41g

and the treated used napkin reduces from 22.5g to 10.6g. In the final week of incubation, the control napkin weight was reduced to 24.4g. The treated unused napkin was reduced to 4.03g and the treated used napkin was reduced to 5.36g.

The rate of degradation of used and unused sanitary napkins are 84% and 85% respectively, whereas the rate of degradation of control is 1.1%.

The formula for calculating the rate of degradation = (Initial weight- final weight ×100) ÷Initial weight.

The above gaph (Fig 2)represents the weekly degradation of control, used, and unused baby diapers. The initial weights of control, unused, and used diapers are 22.6 g, 103.6g, and 22.6g.

The weights in 1st week have increased due to the absorption of water by the gel in the diapers. In 2nd week, the control weight remains almost the same as in 1st week,47.7g. The treated unused diapers were reduced from 75.79g to 50.01g,and the treated used diapers were reduced from 47.72g to 26.6g. In 3rd week, the control weight was reduced to 47.5g. The treated unused diapers were reduced from 50.01g to 33g and the treated used diapers were reduced from 26.6 g to 25.4g. In the final week of incubation, the control diaper weight is reduced to 24.4g. The treated unused reduces to 17. 39g and the treated used diaper reduces to 14.24 g.

Degradation of baby diapers

The rate of degradation of used and unused diapers is 77% and 70% respectively, whereas the rate of degradation of control is 2.1%.

The biodegradation of treated unused and used pads and diapers has been influenced by the action of the earthworm species *Eisenia fetida* in the vermicompost. Along with the earthworms, the bacterial flora present in the environment of the earthworms' gut and the vermicompost have played an important role in determining the rate of degradation of given material by feeding on them[8].

The above table represents the different types of bacteria present at different times during this experiment. It was observed that GNB AND GPB were majorly seen in the process, which may have contributed more than other types of bacteria.

The weight of used sanitary napkins was 34.07g in 1st week, and the weight of unused napkins was 24.6g, which has been reduced to 5.36g and 4.03g, respectively in a period of 4 weeks whereas the control is reduced from 24.68g to 24.4g. Hence the rate of degradation of used and unused sanitary napkins is 84% and 85% respectively, whereas the rate of degradation of control is 1.1%. Similarly, diapers have the rate of degradation of used and unused diapers are 77% and 70% respectively, whereas the rate of degradation of control is 2.1%.

In about four weeks, just a 0.28g and 0.35g weight difference was noticed when comparing the control weights in napkins and diapers, which do not include any earthworms in their setup. With these numbers, it can be assumed safe to mention that the earthworms and bacteria feeding on the raw materials have played a significant part in the degrading of sanitary napkins and diapers along with an increased number of bacterial colonies each week helping in the degradation process[9].

BIOREMEDIATION A SUSTAINABLEAPPROACH TO POLLUTION

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ABSTRACT

The breakneck increase in human development and progress is also adversely affecting the population by introducing toxic chemicals into nature. To reduce its concentration, one such method devised is bioremediation. It is efficient, environmental friendly, and cost- effective, used for thedetoxification of pollutants from the environment.

INTRODUCTION

The increasing population is leading to a higher rate of urbanization and demand for the production of daily household materials. Industrial productions release harmful pollutants such as particulate matter, carbon monoxide, heavy metals, plastic wastes, and microplastics which accumulate in the environment over a period of time. Some of the other types of waste materials like raw sewage, sanitary napkins, diapers, and plastic bags are dumped into landfills leading to decreased soil fertility, a pungent smell in the neighbourhood,etc.

I. WHAT IS BIOREMEDIATION

To reduce the harmful levels of such pollutants many physical, chemical, and biological techniques such as incineration, and photodegradation. One such biological technique is Bioremediation. Bioremediation was discovered by George. M. Robinson in the year 1960. He worked on oil-degrading microbes and was used on a large scale for cleaning of sun oil pipeline spill at Ambler; Pennsylvania in the year 1972. It is a process that uses living organisms such as microorganisms, to reduce levels of pollutants in the environment. 'Bio' means living and 'remediation' means to resolve (which literally translates to resolve using living organisms.) The biological agents used for the degradation of contaminants are known are bioremediates.

II. TYPES OF BIOREMEDIATION

Bioremediates can be of different types, some of the important ones are using bacteria, fungi, worms, and plants. Bioremediation using bacteria is known as microbial remediation, bioremediation using fungi is known as myco remediation, bioremediation using worms is known as vermiremediation, and bioremediation using plant is known as phytoremediation. A number of criteria, including the concentration and chemical characteristics of the contaminant, the site of occurrence, and the nutritional, atmospheric, and temperature requirements needed for optimal growth must be taken into consideration for bioremediation to be effective.

III. MICROBIAL BIOREMEDIATION

Bacteria are microorganisms belonging to the Kingdom Monera. Microbial bioremediation uses these bacteria that are either aerobic or anaerobic in nature that help in the biodegradation of contaminants, by which their concentrations can be brought to safer limits. This type of bioremediation uses microorganisms or their derivatives to reduce the concentration of toxic elements. Different bacteria such as Pseudomonas sp., Dechloromonas sp., Bacillus etc., are mostly used in bioremediation. These bacteria break down or degrade the pollutants by their inherited natural mechanisms resulting in biodegradation or biotransformation which in turn convert harmful substances present in wastewater, polluted soil, and oil spills (Fig.1) into simpler hydrocarbons. Different pathways can be adapted by the microbe for detoxification such as:

1. **Biosorption** by bacterial cells through cell surface adsorption, extracellular precipitation, and intracellular accumulation through special components- biosorption is a process of binding of heavy metals, dyes or other metals to the cell walls of bacteria.

   Volesky defined biosorption as the adsorption of substances from a solution by biological materials using physiochemical pathways of uptake, such as electrostatic forces and ion/proton displacement. The accumulation of substances by biosorption is known as bioaccumulation.

2. **Remediation Via Siderophore Formation:** siderophores are formed by bacteria due to iron deficiency in them. These siderophores pick up iron from their environments and bind to them, which the bacteria intakes. This method can be exploited for microbial bioremediation.

3. **Mechanism of Bacteria through Biosurfactant Production:** biosurfactants are microbial excretes that the bacteria produce to reduce inter surface tension. Products suchas glycolipids and fats can be obtained. This mechanism is mainly used by bacteria like *Pseudomonas putida* for bioremediation of oil spills.

IV. MYCO REMEDIATION

Fungi are known as the ultimate degraders of complex organic matter, involved in decay processes, and known to degrade wood including lignin and cellulose, and other plant-based materials, which are common waste products in agriculture. They can also degrade a variety of pollutants, such as heavy metals, insecticides, and petroleum compounds. They are useful for cleaning up the environment since they can absorb and store pollutants in their fruiting bodies. Most of the fungi are aerobic and are present in marine environments which degrade microplastics present in oceans. Mycoremediation, the practice of employing fungi to break down and remove pollutants from soil, water, and air, involves a considerable contribution from fungi species. Fungi are useful in this process because they possess special qualities for metabolizing different types of contaminants. Fungi have

enzymatic machinery both inside and outside of their cells, and they can secrete acids, which allows them to attack and metabolize a variety of compound types, including both inorganic and organic contaminants. Highly used fungi are mushrooms of different kinds and white rot wood fungus *(Fig.2).* These help in bioremediation by degrading lignocelluloses using extracellular enzymes. They can also be grown on any carbon source,which will be utilized and bio-transformed into other simpler substances.

Furthermore, advances in Recombinant DNA technology and Genetic engineering have opened up new possibilities for improving the efficiency and specificity of bioremediation using bacteria and fungi. For example, they can be engineered to produce enzymes that break down specific substances and can be further exploited.

V. PHYTOREMEDIATION

Phytoremediation is the use of plants and soil-associated microorganisms to reduce the toxicity of contaminants. Plants are able to absorb and break down pollutants through a variety of mechanisms, including Phytostabilization, phytoextraction, and biofiltration. These processes involve the use of specific plant species that are able to tolerate and accumulate high levels of contaminants.

1. **Phytostabilisation:** In this process, plants tend to accumulate metals near their rhizosphere and help stabilize it by mobilizing it with a substrate.

2. **Phytoextraction:** In this process, the plants accumulate pollutants in their rhizosphere and mobilize them for uptake by plant roots to aerial parts of a plant and destroy organic pollutants by degradation process known as phytodegradation.

3. **Biofiltration:** This process is carried out by water plants which help in the uptake of water contaminants to the aerial parts of the plant. Phytoremediation has been used successfully to clean up contaminated sites, such as abandoned industrial areas and landfills. It has also been used to treat wastewater and air pollution. White willow, Indian grass, poplar trees, Indian mustard, sunflower, and water hyacinth are the best plants for phytoremediation. These plants clean the soil and water of pollutants and heavy metals.

VI. VERMIREMEDIATION - INTRODUCTION

Earthworms are known as a farmer’s friend due to their ability to help in increasing soil fertility. They help in increasing the availability of nutrients in the soil, better cycling of elements, removing unwanted debris, and helping in maintaining soil structure. Earthworms are mainly used for the preparation of different types of vermicompost. In India, different types of earthworms are used for preparing vermicompost depending on the requirements and are further used as manure for plant growth. It is a sort of compost made of nutrients enhanced by adding earthworms which are created by feeding the organic waste products to earthworms, who then digest and excrete the material which is nutrient-rich and microorganism-rich, soil-health-enhancing compost. Vermiremediation which is

also known as “earthworm facilitated remediation”, is a type of bioremediation that is carried out by preparing vermicompost using different species of earthworms, using them for bioremediating different contaminants by detoxifying them. It is a natural, aerobic, odorless,and green process that can be carried out in small as well as large quantities in any given space. It is known to decrease soil toxicity and enhance plant growth in a soil-contaminated area.

VII. GENERAL MORPHOLOGY OF EARTHWORM

Earthworms are elongated, narrow, and vermiform in shape. A mature worm measures about 150mm in length and 2.5-5 mm in width. These organisms belong to the Phylum Annelida, Order Haplotaxids, and are usually dark brown to reddish brown incolour due to the presence of porphyrin pigment present in them which helps from harmful UV rays. These organisms exhibit bilateral symmetry and also have metameric segmentation i.e., external segmentation corresponds to internal segmentation of the body. Around 100-150 segments are seen depending on the species of earthworm.

Prostomium and peristomium present, act as mouth and a boring part (to bore into the soil). A thick girdle-like collar is present in the 14, 15,16th segments called clitellum,this has glands that secrete mucus and also help in cocoon formation. The locomotory organ of earthworms is Setae, made from a hard substance called chitin, which helps in the overall movement of the worm. Anus is present at the end, through which excreta is let out.

TYPES OF VERMICOMPOSTING

Vermicomposting can be of two types based on the quantity:

1. **Vermicompost in a Bin:** this method is used in small scales such as home composting, kitchen waste compost production, preparation of manure for the garden, etc.

2. **Vermicompost in a Vermicomposting Pile:** this method is used in large-scale processes, mainly in farming and agriculture.

II. GENERAL VERMICOMPOSTING

Vermicompost is prepared mainly by using organic waste such as kitchen waste, dry leaves, flowers, paper, fruit and vegetable peels, animal excreta, farm waste, animal dung such as cow dung, etc. along with water.

All of these are added in layers along with generous amounts of cow dung and water. It is left to sit for a minimum of 21 days with continuous stirring of the contents in between for uniform decay. After decaying, fresh compost is obtained, this is mixed with earthworms and added to plants as manure.

III. VERMICOMPOSTING IN LARGE SCALE

Large-scale vermicomposting is done for farming, tea compost, landscaping, rearing of

earthworms, or for sale as compost for plants. It is mainly done in two ways: Windrow and Raised bed

1. **Windrow Method of Composting:** Windrows are typically built on a concrete floor. It could be on top of the soil or in a hole. Windrows are stacked in a straight line and include feedstocks that can reach a height of three feet. It will be necessary to create an earthworm bed with soil, straw, leaves, etc. The entire pile is covered with PVC covering during the composting process to shield it from predators and potential environmental hazards. Compost is made using a windrow technique, which involves piling organic waste, including crop wastes and animal dung, in long rows. Large amounts of compost can be made with this process. Usually, these rows are converted to organic material after composting.

2. **Raised Bed:** Axes are used to lift the soil on the ground in this method of farming so that a bed can be made. Anything that gives worms a habitat that is somewhat steady is considered bedding. Over the bedding, the feedstock is spread uniformly to maintain moisture. After the preparation, PVC is laid out over the bed to maintain the moist environment and create a shady place for the multiplication of earthworms.

IV. VERMIREMEDIATION

The same technique of vermicomposting is used for vermiremediation where suited earthworm species are selected and then mixed with vermicompost left well within the contaminated area. These worms along with certain bacteria help in biodegradation of contaminants present hence detoxifying soil. Vermiremediation mainly includes five steps: ingestion, accumulation, transformation, degradation, and egestion.

1. **Ingestion** is eating the given substrate (organic material) by the earthworm

2. **Accumulation** is the process of an assemblage of ingested material in the gut of the earthworm

In India, certain species of earthworms *Perionyx excavatus, Eisenia fetida, Lumbricusrubellis, and Lampitomauritii*are widely used for vermicomposting and vermiremediation due to their adaptability to Indian soil for better functioning and high survival rate in the environment. After the process of vermiremediation, the leftover compost can be reused as manure for plants and hence is a zero-waste method of removing contaminants from the environment. Hence this method is eco-friendly, affordable, and effective. Current trends in vermiremediation focus on the degradation of heavy metals and plastic-based materials such as bags, sanitary napkins, diapers, boxes, etc which take hundreds of years to completely degrade in nature.

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ROLE Of GENERATIVE AI In INTELLECTUAL PROPERTY RIGHTS: CHALLENGES AND CORRECTIVE MEASURES

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Abstract- Generative AI has revolutionized the field of artificial intelligence by creating novel content by replacing most of human intelligence being trained with real time decision making capability upon give data scenarios, but it has also raised significant challenges and to address an issue regarding intellectual property rights. This research paper explores the in-depth insight towards combination of generative AI and intellectual property, including patents, copyright, trademarks, and data rights. An attempt is made to address issues pertaining to ownership, derivative works, and privacy in trade activity, and data protection, while emphasizing the need for legal frameworks and ethical guidelines to provide a balance between innovation and intellectual property rights. Through a comprehensive analysis of relevant laws and case studies, the research paper provides insights into the challenges and corrective measures to be incorporated in intellectual property rights under generative AI.

I. INTRODUCTION

'Artificial Intelligence' is a software development achieved by data scientist to enable activities of mankind easier. In this era of advanced technology, Artificial Intelligence plays an prominent role in enhancing economy and increasing the usage of the technology globally. Artificial Intelligence is software that makes machine to mimic the capabilities of human intelligence in action upon training provided through historical data. Also, AI is pushing the innovation into new space through many ways and also accelerating technological advancements in the field of computing power, algorithms and handling data.

This newly developed technology can also be very useful in extending casual work like cleaning, shopping and transportation etc. Artificial Intelligence is paving its way into fields like Healthcare by innovation of advanced machineries which can be of great help in diagnosing severe diseases in man-kind with prescription and the treatment recommendation. One of the best known healthcare technologies is PathAI that offers one of the best Machine Learning and Artificial Intelligence tools in healthcare that allows Pathologists to make accurate diagnoses. PathAI reduces errors during the process of cancer diagnosis and offers a range of new techniques for individual medical treatment..

In recent years, the field of artificial intelligence (AI) has witnessed significant advancements, particularly in the area of generative AI. Generative AI models, such as GPT-3 and StyleGAN, have demonstrated remarkable capabilities to create original and realistic content across various domains, including text, images, music, and more. These models have the potential to revolutionize industries such as entertainment, marketing, and creative arts by automating content creation processes and enabling new forms of expression [1]. One of the best known healthcare technologies under generative AI is Babylon Health that has

developed a chatbot that uses generative AI to ask patients about their symptoms and deliver personalized medical advice.

However, the rise of generative AI has also brought forth complex challenges with respect to intellectual property rights. Intellectual Property refers to the inventions, literary and artistic expressions, designs and symbols, names and logos. The ownership of such concepts lies with the creator, or the holder of the intellectual property.

As AI models generate content that closely resembles human creations, it hosts legal and ethical issues that must be addressed. One of the most important of these is the question of copyright, which determines who owns the rights to creative works and how to use them. Companies relying on generative AI without knowing the local legislation about generative AI copyright are risking reputation issues or legal fines. Additionally, the integration of existing copyrighted materials in training data and the potential for infringement raise concerns about the boundaries of ethical values to make responsible AI with respect fairness with unbiased condition and the application of traditional intellectual property laws in the AI context.

The significance of exploring intellectual property rights in generative AI lies in establishing a clear legal and ethical framework that supports both innovation and the protection of creators' rights. By understanding the challenges and considerations surrounding IP in generative AI, stakeholders can work towards developing robust legal frameworks, ethical guidelines, and industry standards that strike a balance between encouraging AI advancements and preserving the rights of content dsigner and IP holders. This research aims to investigate the complexities of intellectual property rights in generative AI and examine the challenges faced in determining ownership, addressing derivative works, protecting trade secrets, and ensuring compliance with privacy and data protection laws.

By analyzing the current legal landscape, international approaches, and ethical considerations, the study provides insights and recommendations to navigate the evolving junction of generative AI and intellectual property rights. Addressing the mentioned issues, the research work aims in contributing to the development of a comprehensive and balanced framework that fosters responsible innovation, encouraging creativity, and safeguarding intellectual property rights in the context of generative AI.

II. STUDIES AND FINDINGS

In the context of generative AI, several types of intellectual property rights come into play:

- Copyright: It grants legal rights to creators for their original works like writing, photograph, audio recordings, video, sculptures, architectural works, computer software, and other creative works like literary and artistic work. It covers generated content, such as AI-generated stories, poems, artwork, or music, by granting exclusive rights to the creator for a specific period.

- Patents: It is usually granted for inventions. Unlike copyright, the inventor needs to apply (file) for patenting the invention. When a patent is granted, the owner gets an exclusive right to prevent others from using, selling, or distributing the protected invention. A patent protects an invention for 20 years, after which it can be freely used. It protect inventions, including novel processes, algorithms, or methodologies used in generative AI models.

- Trademarks: It includes any visual symbol, word, name, design, slogan, label, etc., that distinguishes the brand or commercial enterprise, from other brands or commercial enterprises. In generative AI, trademarks can be relevant when the models generate content that includes or resembles existing trademarks without authorization

- Trade Secrets: Trade secrets encompass valuable and confidential business information that provides a competitive advantage. In the context of generative AI, trade secrets can include proprietary training data, specific model architectures, or unique algorithms used in the AI models.

Significance of IP Protection in Generative AI:

- Encouraging Innovation in society: Intellectual property rights provide incentives for AI developers and organizations to provide their contribution creating and optimizing generative AI models. Robust IP protection promotes innovation by ensuring that creators can benefit from their creativity, leading to the development of advanced AI technologies.

- Rights for designer: IP protection grants designer gets an exclusive right to prevent others from using, selling, or distributing the protected invention and ensures they receive recognition.

- Preventing Unauthorized Use: IP protection helps deter unauthorized use, reproduction, or distribution of AI-generated content. It allows designers to enforce their rights and take legal action against infringement, protecting their investment and commercial interests [4].

Fair use vs copyright infringement:

Copyright infringement is a serious crime that can result in imprisonment. The ignorance of IP law while using copyrighted material will not excuse anyone's liability or organize any kind of legal defense against claims made by copyright owners.

Fair use doctrine allows for limited use of copyrighted material without needing permission from the copyright holder if said usage falls under certain categories, such as

- Criticism/commentary
- News reporting
- Teaching
- Research

Intellectual Property (IP) in the AI Regime:

AI technologies, including generative AI, it has become increasingly important to prevent unauthorized use of intellectual property

- Copyright Protection: Developers and users of AI should respect and comply with copyright laws by obtaining proper licenses and permissions for copyrighted content used in training data or generated outputs. This helps prevent unauthorized use and infringement of copyrighted works.
- Licensing and Permissions: AI developers should be mindful of licensing requirements when using copyrighted materials as training data. Obtaining appropriate licenses and permissions from rights holders allows for the legal use of copyrighted content, ensuring compliance with IP laws and preventing unauthorized use.
- Continuous monitoring: Developing tools to monitor and detect unauthorized use of AI-generated content can help identify instances of infringement. These monitoring systems can scan online platforms, social media, and other sources to identify unauthorized uses and provide a basis for taking appropriate legal action.
- Awareness: Promoting awareness and educating AI developers, users, and the general public about intellectual property rights, copyright laws, and the importance of respecting IP can help prevent unintentional infringements.
- Ethical Guidelines and Policies: Adopting and adhering to ethical guidelines and policies that prioritize respect for intellectual property rights can provide a framework for responsible AI development and usage.
- Legal Enforcement: In cases of clear infringement or unauthorized use, enforcing IP rights through legal means becomes essential. Rights holders can take legal action to protect their IP and seek remedies for damages incurred due to unauthorized use [5].

Current Legal framework and Gaps in India:

In India, the legal framework regarding generative AI and intellectual property is still evolving, and there are certain gaps and challenges that need to be addressed. While the existing legal framework, including the Copyright Act of 1957, provides some protection for intellectual property rights, specific regulations directly addressing generative AI are lacking.

This creates uncertainties and ambiguities in determining the legal status of AI-generated works and the responsibilities of AI developers and users.

Gaps in the current legal framework in India:

I. Data Protection and Privacy: While the Personal Data Protection Bill, 2019 is pending approval in India, there is still a need for comprehensive legislation addressing data protection and privacy concerns specifically related to AI. Clear guidelines are required to ensure the collection, storage, and usage of data in generative AI models complies with privacy regulations.

II. Fairness: The concept of fairness in the context of generative AI is not well-defined under Indian law. The lack of clear guidelines makes it challenging to determine the boundaries of permissible use of AI-generated content.

III. Ownership: The Copyright Act does not explicitly address the issue of ownership of AI-generated works. This raises questions about whether the AI system or the human developer should be considered as owner of the content. Guidelines are needed to determine the rights and responsibilities of both parties.

IV. CONCLUSION

Several directions and recommendations can be considered to address the challenges and considerations related to intellectual property rights in generative AI:

Addressing the issues through Policy and Regulation: Governments and regulatory bodies should proactively address the legal gaps and uncertainties surrounding generative AI.

Balancing Innovation and Intellectual Property Rights: Providing a balance between encouraging innovation and protecting intellectual property rights is essential. Encouraging collaboration and dialogue among AI developers, content creators, and rights holders can help establish fair and equitable frameworks for the use and protection of AI-generated content

Promoting Responsible AI Development and Usage: Promoting responsible AI development entails establishing ethical guidelines and principles for generative AI. Educating AI developers, users, and the public about the ethical implications and potential risks associated with AI-generated content will be crucial to ensuring responsible and ethical AI usage.

Clear legal frameworks, ethical guidelines, and collaborative efforts among stakeholders are needed to address issues related to authorship, ownership, licensing, and responsible AI usage.

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BIG DATA ANALYTICS OPPORTUNITIES IN EDUCATION

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ABSTRACT:

Big statistics has proven to be extremely treasured in assisting us increase our perspectives and horizons. A hitherto unseen quantity of instructional records has been produced due to the fast advancement of cellular gadgets and communique technologies. We are capable of extract new and significant insights from the instructional records that is to be had, which could help college students, instructors, and the education ecosystem as an entire. These insights may be acquired thru rising, notably bendy and scalable procedures to information processing and analysis. So one can optimize information retention and improve getting to know performance and efficiency for college students, this newsletter gives new opportunities for big information analytics. First, we suggest seeking to expect student learning results the usage of supervised mastering algorithms, along with class or regression, as a way to deliver early comments on anticipated overall performance. Previous to and at some point of the direction selection process. 2nd, we advocate the use of these predictions to manual module, direction, and content tips that maximize pupil ability, reflecting gaining knowledge of skills, areas of hobby , their educational and profession goals. . 1/3, with a view to produce quantifiable gains in studying results and long-term expertise retention, we advise concentrating at the mechanisms of the pupil's gaining knowledge of process and trying to check the proper shape, style, tempo, and organization of the expertise acquisition process. Sprint. In the long run, by using combining the formerly introduced gaining knowledge of optimization techniques, we hope to create a flexible delivery method that permits college students to receive knowledge more speedy and keep it longer.

INTRODUCTION:

Large volumes of information are amassed about everything of our lives inside the age of overwhelming facts, from a huge range of resources and in a ramification of codecs. This is particularly real with the rise of wireless conversation cords, smartphones, and different cell devices. Seventy times as a whole lot records can be located within the Library of Congress as can be produced with the aid of human beings in a unmarried day [1]. Each enterprise and academia are paying more and more attention to massive information as an rising era and a symbol of the instances. Our capability to technique, extract, and examine facts from previously unheard-of quantities of records has proven crucial to enhancing our information of the world. However, dealing with massive petabyte information sets gives huge problems in every manner, from collection, illustration, scalability of processing, real-time analytics and visualization, storage, renovation, retrieval, transmission, get admission to, and protection. A number of work has gone into developing new facts processing and evaluation technology which can deal with big records exponential boom in terms of all of its crucial functions, which include volume, range, pace, variability, authenticity, and complexity. We will now derive actionable insights

from large statistics at the right moment to pressure price and impact throughout a diffusion of programs thanks to new, adaptable, and scalable procedures to statistics processing and analytics.

PERFORMANCE PREDICTION

The goal of predicting pupil gaining knowledge of outcomes is to estimate how well a group or person scholar will perform on a given gaining knowledge of venture. This may assist college students retain extra in their expertise, carry out better on formal exams, and be happier with their academic revel in with the aid of providing direction, suggest, and insightful early feedback. Students who're at a excessive threat of failing also can be identified the usage of it. In the end, standardized tests can be replaced by using an green and honest prediction version, with a view to lessen the strain of tests and help college students locate the first-rate paths. Instructors and college students are negatively impacted by workload [4]– [6]. Furthermore, universities can use educational overall performance prediction to help narrow down the pool of first-year applicants and choose the first-rate applicants for admission. In addition to presenting more sensible steerage, performance predictions can help pick out which modules, guides, and even precise path content components will maximum in all likelihood maximize student capability and significantly lower the risk of failure, which could permanently sabotage their motivation and excitement.

A Predictive gaining knowledge of performance device forecast framework is illustrated

The input data can contain of the taking after information

- Personality (extroversion or extrovert), age, gender, magnificence, school, medical records, and cutting-edge fitness are among the simple info.
- Own family facts, including the quantity of kids, dad and mom' marital repute, location of employment, and level of training;
- Reviewing previous curriculum, past overall performance information, and attendance logs;
- academic pursuits: after-faculty sports, average and variance in homework time, and day by day/weekly pre- and submit-magnificence reviews; complete analyses in their curricula and the content material of the assignments which might be being assessed
- Collaboration: peer-to-peer exchanges and teamwork each inside and out of doors of the classroom; • more academic resources: greater route from family individuals or tutors employed;
- Amusement: the average quantity of time after faculty spent mingling with pals.

The machine mastering algorithm could first need to learn to create a mapping characteristic among the historic scholar data and their corresponding ancient performance measures. This

would permit it to be used for real-time overall performance predictions in reaction to new, unseen pupil records.

INTELLIGENT COURSE RECOMMENDATION

A massive variety of courses and modules are generally available to secondary and postsecondary college students, both in formal school room settings and more at ease online learning environments. Particularly as first-years, they're not usually positive a way to make the right decision. Sometimes, they could heed the advice of their elders, take the instructors' recognition into account, or, extra frequently, pick out a path completely on the premise of its perceived stage of enchantment or problem, certain assessment requirements, or maybe a agenda that works for them. It is glaring that this sort of advert hoc selection regularly results in a subpar preference and is unable to provide a comprehensive exam and evaluation of the potential course healthy.

The input facts for such recommender systems need to consist of the subsequent: scholar profiles, demographic facts, past educational overall performance, the sphere of hobby, the students' career preferences, and records relating the courses, consisting of attendance statistics, student evaluations, elegance schedules, and so on. Following the data retrieved from academic facts, a ranking score primarily based on the predicted overall performance prediction might be assigned for each of the candidate publications. The behavior of path selection and the connection between students, the courses they took, and their final grades can be studied the use of association regulations [12]. Statistics on pupil demographics may be analyzed the usage of stereotype reasoning [13]. With regards to the subjects wherein they may be clearly talented, college students commonly excel. And is the reason why the route priority and anticipated performance are matched. The consequences displaying that students report better stages of knowledge of task in addition aid this impact. To guarantee that the authorities or the institution's curriculum necessities are fulfilled and that significant lengthy-term goals, which include a supported career path, are supported, this reasoning, however, may be barely changed or restrained. Every scholar can therefore predict which courses they'll in all likelihood carry out nicely in.

For you to maximize and encourage students' studying progress at the direction, the recommender machine also can be accelerated to the level of man or woman courses, offering pointers on precise understanding items, subjects, or supplementary mastering sources [2]. For first-yr university students who from time to time struggle with the dissonance among their high school performance and the higher schooling curriculum—which often calls for them to take preparatory publications to bridge prerequisite content material gaps so as to progress—this sort of recommender device extension would be crucial. Whilst paired with flair assessments and profiles, ancient evidence on the direction composition stage should offer precise information about what content material, at what complexity, pace, and in what order could maximize expected pupil overall performance and know-how retention stage [2].

Sensible recommendation systems can assist users choose from a spread of open publications and online getting to know sources by using supplying pointers for topics, courses, knowledge items, and subjects. E-mastering platforms are broadly employed for a large number of training and educational functions.

DATA-DRIVEN LEARNING ANALYTICS

Individuals acquire knowledge in various methods. Let's have a look at 3 wonderful learning styles as an illustration. Kinesthetic learners research great through "hands-on" experiences like taking notes and taking part in activities, auditory rookies are more likely to study efficaciously by using hearing, which includes whilst reading aloud to improve recitation, and visible learners are much more likely to examine exceptional through seeing, which include when looking pix and demonstrations and reading [14]. A report in [15] states that there are versions within the approaches that students engage with each other while running at the same task. The performance and assessment of the institution venture in the framework of collaborative getting to know are impacted by way of these discrepancies. Retaining cognizance, reflecting, taking part in person, and allocating contributions in a manner that in all fairness balanced are all intrinsically more likely to supply higher.

PERSONALIZED LEARNING

Human beings can differ substantially of their studying efficacy and efficiency even in the equal learning environment and conditions because of variations of their personalities, cognitive patterns, expertise bases, and getting to know capacities. Achieving every learner's complete potential and, therefore, helping them succeed in their academic and expert endeavors. With the upward push of microlearning, multi-media gaining knowledge of, and the flipped school room, which promote energetic getting to know with more individualized reports, gaining knowledge of personalization has been identified as an powerful and bendy interface between the scholar and the understanding to allow effective and sticky knowledge transfer. For instance, content material can be carried out in micro-studying, where facts is given in easily absorbed portions to promote effective learning [16].

CONCLUSION:

Due to the popularity of social media and the huge use of e-learning, unparalleled volumes of educational information are being amassed. Massive records analytics allows giant mining and analytics of instructional facts, which blessings the schooling network substantially. The various methods that massive statistics analytics can substantially enhance schooling are protected in this paper.

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Recognizing Software Engineering Difficulties in Software SMEs

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ABSTRACT:

Small and medium-sized software enterprises (SSMEs) are a vital part of emerging markets. Due to their size, they are not capable of adopting advanced software engineering techniques or automated software engineering tools in the same way large and ultra-large companies are. After performing a thematic analysis of the interview transcripts, found a number of common challenges such as lack of testing, code-related issues, and inaccurate effort estimation. observed that in order to introduce advanced automated software engineering tools and techniques, SSMEs need to adopt contemporary best practices in software engineering like automated testing, continuous integration and automated code review. Moreover, suggest that software engineering research engage with SSMEs to enable them to improve their knowledge and adopt more advanced software engineering practices.

Index Terms—empirical study, case study, software SMEs

I. INTRODUCTION

Small and medium-sized enterprises (SMEs) are vital to economic growth of a country and account for 95%–99% of all enterprises in 36 OECD member countries [1]. Software SMEs (SSMEs) including software startups are among the key drivers in software industry and important for a country's competitiveness and innovation [2]. For example, a recent study [3] shows that the Thai software industry accounts for $4 billion in 2020 with a steady growth over the years. The country's software sector comprises of over 8,000 software companies, large and small, with more than 100,000 software engineers [3]. With the transformation plan known as Thailand 4.0, the software industry has become a cornerstone for the long-term plan of the country as it supports the development of technology clusters and future industries [4], [5]. Similar trends are also found in other Asian developing countries.Nonetheless, SSMEs are facing several challenges while developing their software products. A technical report [9] out- lines some of the major weaknesses of SSMEs include configuration management, quality assurance, and project assessment and control. Unlike large or ultra-large software companies, SSMEs do not have much manpower. Moreover, SSMEs may still use traditional software development approaches and tools and rely heavily on manual tasks performed by their programmers, which are costly and tedious approaches. Thus, by identifying the software engineering challenges faced by SSMEs, can recommend state-of-the-art automated software engineering (ASE) techniques that SSMEs can adopt to reduce the cost and increase the speed of their software development and delivery. Only when the challenges leading to the weaknesses are understood can they be addressed and advanced software engineering practices be adopted.

Our study aims to fill in the gap by investigating the soft- ware engineering challenges that specifically occur in SSMEs located in the Asian culture, especially in Thailand, and also to study their tool usage for future recommendation of automated software engineering (ASE) tools and techniques. Due to the different working cultures from Western region [10], this study reveals new insights into Thai, and possibly Asian, SSMEs.

II. THE STUDY

This study investigates current practices being used in the day-to-day software development routines in Thai SSMEs and identifies the challenges they are facing in terms of costs, time, and software quality that prevent the adoption of advanced software engineering practices. According to the guidelines by Benbasat, aim to study a few entities (i.e., SSMEs) in their natural setting without experimental control or manipulation. Thus, a case study is an appropriate method for our aim. use semi-structured interviews [12] and thematic analysis [13] to extract the common challenges found by the companies. start by identifying research questions. Then, design the interview guide and perform semi-structured interviews with the companies' employees. Lastly, perform thematic analysis on the transcript and create a theme map to identify common software engineering challenges.

A. Research Questions

1) **RQ1 (SE Challenges):** *What are the challenges in the SSMEs' day-to-day software development?* The answer to this research question will identify the issues that need to be addressed in order to adopt advanced software engineering practices.

2) **RQ2 (Current Practices):** *What tools are being used?* By considering the tools the companies are using as a proxy, can gain insights into their current practices. The answer to this question will help us to align recommendations of advanced practices and automated tools and techniques with the current practices.

B. The Studied Companies

The challenges and practices of four Thai SSMEs: Company A (pseudonym), ProGaming, Roots, and Zwiz.AI. An overview of the four companies is shown in Table I. Their software products/services cover different business types including games, e-learning, chatbots, and enterprise solutions. Company A offers an online e-learning platform with more than 1,800 courses, 10,000 users a month, and 280 educators. ProGaming has developed more than 50 games, which have been downloaded 2 million times. They also provide game development services to Thai organizations. Roots offers business consultancy and serves several large enterprises in Thailand. Zwiz.AI provides AI chatbot services which are serving more than 30,000 businesses and helping more than 10 million users. All of them are small (<50 employees) and three of them are very small (<25 employees).

C. *Interview Design*

The goal for the interviews is to explore the challenges in software development in the four companies. perform semi-structured interviews which are based on a general grouping of topics and questions, instead of a predefined set of questions [12]. This method performs a verbal discussion with one programmer at a time. The interview script is updated after each interview especially when the interviewees start providing the same answers (saturation effect). The interview process terminates when no new insights or observations are made. The interview is recorded and then transcribed. The maximum duration of each interview is set to 30 minutes.

The interview participants are suggested by the executives of the companies based on their suitability for the project. The subjects must satisfy the following inclusion criteria to be included in the interview: (1) the subject must be a full-time employee and must have worked at the company for at least one month, (2) the subject must be involved in the software development such as a CTO, a technical lead, or a developer. To address the possibility of participants being forced by their managers to participate, the authors took multiple steps to mitigate the issues and the participation or non-participation

should not have had any negative effect on the employees.

D. *Semi-structured Interviews*

The semi-structured interviews occurred at the companies' offices in February 2020[1]. The first author visited each company and performed the semi-structured interviews in a dedicated room provided by the companies. The interviews were in Thai and the recordings from the interviews were transcribed. The initial questions used for the interviews are listed in Table II. These questions were used to start the conversations and the interviewer could ask more follow-up questions depending on the answers of each interviewee. *Thematic Analysis*

III. **Discussion**

Outcomes: The case study is part of an ongoing multi- national industry-academia collaboration project to support SSMEs in the adoption of suitable automated software engineering tools and techniques, similar to those that are successfully used in large and ultra-large companies.

The presented study was intended to identify the challenges of SSMEs in an emerging market like Thailand and address the identified challenges through automated software engineering. While performing this study as part of the project, identified one particular challenge which needs to be addressed before further advanced practices or automated software engineering can be adopted: lack of testing. Contemporary best practices in software engineering are to use automated testing tools to test the software in continuous integration settings, and automated software engineering often requires a large amount of testing. Without automated testing, there is no foundation for improving the software development process.

Lessons Learned: An important lesson learned is the observation that before one can attempt to support SSMEs in the adoption of automated software engineering tools and techniques, one must first ensure that the SSMEs have adopted contemporary best practices in software engineering. In the context of the ongoing project, the study results led to a change of the project's focus and aims: Instead of introducing the most advanced automated software engineering tools and techniques, the project will focus on the effect of the adoption of best practices in software development like automated testing, continuous integration, and automated code review.

Takeaway Messages: Knowledge transfer between soft- ware engineering research and industry has been a key factor in the success of the adoption of automated software engineering tools and techniques. Such cooperation and knowledge transfer usually occurs in large and ultra-large companies. SSMEs, especially in emerging markets, often are not able to participate in such cooperation and knowledge transfer. Research should, therefore, engage SSMEs in order to facilitate the adoption of automated software engineering tools and techniques so that the gap between SSMEs and large and ultra-large companies does not widen.

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Keystroke Dynamics Data Collection and Analyzing from Android Users

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Abstract:

Keystroke dynamics is one of the most popular behavioral biometrics that are currently being used as a second factor of authentication for many web services and applications. One of the reasons that makes it really popular is that it is a resettable biometric, which meets one of the main usability requirements of authentication systems. With the recent advances in mobile technologies, developers and researchers utilized several machine learning algorithms to identify smartphone users based on their keystroke dynamics. The biggest problem that faces researchers in this area is the ability to collect datasets from smartphone users that could be used to train the machine learning algorithms and, hence, create accurate predictive model. This paper introduces a native Android application that collects keystroke dynamics from Android smartphone users. This application opens the door for researchers to recruit participants from all over the world to contribute to the data collection of keystroke dynamics. Our application allows researchers to study the impact of several parameters, such as hardware brands, users' geolocation, native language text direction, and several other factors, on the accuracy of machine learning classifiers. It also helps maintain a standard benchmark for keystroke dynamics. Having a standard benchmark helps researchers better evaluate their work based on consistent data collection procedures and evaluation metrics. This paper explains the main building blocks of the application, the algorithms used in the implementation, the communication protocol with the database server, the structure and format of the generated dataset and the feature extraction approaches. As a proof of concept, the app was used to develop a novel feature-set that identifies Android users based on features.

Keywords: Keystroke Dynamics, Machine Learning, Android Application, Behavioral Biometric, Smartphone, Data Collection, Feature Extraction.

INTRODUCTION

Keystroke dynamics is currently considered one of the most popular behavioral biometrics that are being considered, as a second factor of authentication, to authenticate users to different services and applications (Lu et al., 2020). There are two different implementations for user authentication using keystroke dynamics: one-time or static authentication and continuous or dynamic authentication. In one-time authentication, a personal profile is created for the users based on their typing patterns and then used only at login time to authenticate those users to the target ser- vice or application (Chen et al., 2021). In

continuous authentication, a personal profile is crated for the users and then used at scheduled time periods to verify the identity of those users as along as the service is running or the session is active (Baig and Eskeland, 2021). The main two problems that face researchers in this area are 1) the lack of data collection tools for different smartphone operating systems, and 2) the lack of standard benchmarks, which makes it difficult for researchers to compare the accuracy of their predictive models without questioning the impact of the used datasets.

This paper addresses these two problems by introducing, a native Android application that could be used to collect keystroke dynamics data from Android users. The proposed application al- lows researchers to study the impact of different at- tributes on the feature selection and the accuracy of machine learning classifiers. These attributes include the smartphone hardware brand, users' geolocation, and native-language text-direction. Our application also helps in maintaining a standard benchmark for keystroke dynamics on Android platform,

DESIGN AND IMPLEMENTATION

User Interface Design

The app has several user interface windows. Figure 1 shows five screenshots of the application that show some its functionalities. Due to ethics requirements, the app starts with a digital con- sent, as shown in Figure 1(a). The digital consent is used to: 1) explain the data collection project to the user, 2) emphasize that users' participation in the data collection is voluntarily, 3) illustrate that participants will receive no direct benefits from participating in this research study, 4) assure that data will be saved in an anonymous format with no direct links to the identity of participants, 5) inform the user that the app collects information about the device and the way users type on the keyboard, 6) provides contact information in case the user has questions at any time about the study or the procedures, and finally 7) request the user's consent. Users have to confirm that they have read the consent, they voluntarily agree to participate, and they are 18 years of age or older in order to proceed to the next window. Otherwise, the application will shut down and will not allow them to proceed to the data collection window.

Data Collection Logic

The data collection logic depends mainly on the event handling mechanism. Different alternatives for event handling have been considered before implementing the data collection logic. One important decision de- sign was the design of the keyboard.

The first approach we examined was to use the built-in keyboard in Android and create touch event listeners to listen to touch events on the keys. Al- though this approach is the optimum implementation, it has limitations on extracting timestamps

The second approach we examined was to create option was to create a keyboard as an Input Method Editor (IME). To implement this option, we have to complete three tasks: 1) creating a class that ex- tends Input Method Service class, 2) create a settings- activity to pass

options to the IME service, and 3) create a setting user interface that should be displayed as part of the standard system settings on the android de- vice. Although this option sounds promising since it allows users to change the input method and set our keyboard as the default one for all applications, our surveys show that users did not like to change their defaults password and did not like the extra step on the setting menu.

The Server Side

The server side consists of two parts: the front- end and the back-end. The front-end is built using HTML5, java script, bootstrap and php. The front- end allows administrators to run several queries and display data in four different formats: 1) view data by user id, 2) view data by session id, 3) view data in a summary table, and 4) view raw data. shows screenshots of the front-end interface. Figure 2(a) shows a query by user's ID. There are currently 100 users registered in the system but not all of them completed the 30 samples. We are using bootstrap badges, which are numerical indicators of how many items are associated with a link.

Participants felt that they were tracked although we assured them that data is collected in anonymous format. One of the main reasons for getting these strong concerns from participants is related to the Android handle permissions in the recent releases. Android classifies the access to GPS location in the Android device as a dangerous permission and therefore, developers has to request that permission at runtime, which raises more concerns from the user's perspective compared to the old traditional way of accepting all permissions at installation time.

FEATURE EXTRACTION

When we designed the communication module inside the application, the highest priority was to transfer as much raw information as possible to the server. We made a critical design decision by no per- forming any data processing before the transmission stage because we did not want to lose any opportunity to utilize the raw data in the future by creating a new feature or analyzing certain information, etc. While this approach preserved the raw contents, it required a per-processing step to re-format the data before the feature extraction phase.

The data collection was done over 2 weeks with invitation emails sent to over 1000 users and research groups. We also created a home page for the project to answer all questions from participants and referenced the ethics approval obtained from our home university. Throughout the data collection phase, we received 211,304 records for touch events from volunteered from all over the world.

The raw data was sent as a collection of 32 touch events (records) for each successful attempt for each user. Because users had to type the keyword", each successful attempt generated 16 touch-down events and 16 touch-up events

FEATURE ENGINEERING AND EXPERIMENTAL ANALYSIS

We extracted unique features from each user- attempt. Our generated features are grouped in 12 groups . We extracted these features for all users. The app can be used to collect all features and report them back to the research administrators for further processing. As a proof of concept, we created a data-frame using pandas libraries in python for 10 valid users, 10 instances each. We used the generated dataset to train various ma- chine learning models. These models were evaluated based on 10 K-fold cross validation. The experimental results show that Naive Bayes achieved 96% classification accuracy, Decision table achieved 89% classification accuracy, whereas Random Forest achieved 100% classification accuracy. We believe that this ap- plication can be used on a wide range within the re- search community to provide a standard data collection environment. Having such a tool helps improve the quality of comparative analysis between research findings because the same collection tool was used to generate the datasets used in these comparisons. This first version of the app is currently in review on Google Play store and we are planning to give researchers the ability to configure the IP address of the destination server so that they can customize the app for their needs. We are also planning to create an open source project to invite researchers from all over the world to collaborate in the development of this tool so that we can advance the research in this field.

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Study of Impact of Micro Finance In India

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Abstract

Micro finance is not a new concept in any part of the world, different definitions have been derived to understand the concept of micro finance over the years. The concept of micro-finance was existing in the earlier period in India by money lending groups in Kerala and now the modern version of Micro Finance in India was started from the 1970s, where many of the micro-finance institutions were set up like Annapurna micro finance Pvt Ltd ,Arohan Financial Services Pvt Ltd.,Asirvad micro finance PvtLtd. Bandhan Financial Services Pvt Ltd. SKS Micro finance Ltd (SKSMPL), Spandana Sphoorty Financial Ltd (SSFL),Share Microfin Limited (SML),Asmitha Microfin Ltd (AML),ShriKshetra Dharmasthala Rural Development Project(SKDRDP),Bhartiya Samruddhi Finance Limited (BSFL) and Bandhan Society Cashpor Micro Credit (CMC) etc.,

The whole micro finance set up was given by the Government of India towards the alleviation ofpoverty. The companies gained prominence from90s, the most famous of those is the SEWA organization or Self-Employed Women's Organization bank.

a) To promote social and economic development among weaker sections of the economy.

b) To strengthen self-help groups and use them as a tool towards economic development.

c) To promote higher education, women empowerment, financial liberation of women and supportwomen entrepreneurs

Conclusion

Microfinance has emerged as a powerful tool in empowering women entrepreneurs and promoting higher education. By providing access to financial resources, microfinance enables women to start and expand businesses, fostering economic independence and societal progress. Women entrepreneurs contribute significantly to local economies, creating jobs and inspiring communities. The ripple effect of empowering women through microfinance is profound, as it often leads to improved living standards, better health care, and enhanced educational opportunities for their families.

Additionally, microfinance institutions often provide more than just financial support; they offer training, mentorship, and networking opportunities. This holistic approach helps women to develop essential business skills, confidence, and resilience. As women entrepreneurs succeed, they become role models, encouraging more women to pursue

entrepreneurship and higher education.

Promoting higher education through microfinance is equally crucial. It addresses the financial barriers that many face, enabling access to quality education. Higher education equips individuals with knowledge and skills necessary for innovation and leadership, driving economic growth and social change. When women attain higher education, they not only improve their own prospects but also influence future generations by valuing education.

In conclusion, the synergy between microfinance, women entrepreneurship, and higher education creates a virtuous cycle of empowerment and development. Microfinance acts as a catalyst, breaking down financial barriers and opening doors to opportunities.

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National Happiness and Taxation

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Abstract:

Tax is a primary source for the government towards the welfare of the country. Public expenditures financed through taxes cover a wide range of spending made by the public to provide subsidies to farmers, in healthcare, education, infrastructure and many more Government welfare schemes.They may have effects on the happiness of individuals and society due to the fact that taxes are collected from individuals by force, and public expenditures are made for the needs and economic development of the country.

happiness is an emotional state characterised by feelings of joy, satisfaction, contentment, and fulfillment. While happiness has many different definitions, it is often described as involvingpositive emotions and life satisfaction. Tax factors plays an important role towards national happiness in areas such as health, relationships, education and skills, housing quality, finances and the environment.

This research aims to identify the effects that different types of taxes have on happiness, considering that the main feature of the tax systems should be related to being fair, otherwise they fail to be sustainable. Accordingly, the individuals trust the national government to make the right decisions for their country .

Studies also shows the level of income inequality in a society also may affect levels of happiness. Ultimately, happiness research is consistent with the strongest justification for adopting a progressive tax structure-income has declining marginal utility thus redistribution can increase total welfare in a society.

Conclusion

The relationship between national happiness and taxation is complex and multifaceted, involving economic, psychological, and sociopolitical dimensions. The literature generally suggests that well- designed tax policies, particularly those that are progressive and fund public goods and services, have a positive impact on national happiness. Key findings include:

1. Progressive Taxation: Countries with progressive tax systems tend to report higher levels of happiness. This is attributed to the reduction of income inequality and the perception of fairness in such systems.

2. Public Goods and Services: The effective use of tax revenue to fund public goods and

services like healthcare, education, and infrastructure significantly enhances the well-being of citizens. Access to these services alleviates stress and improves overall quality of life.

3. Perceived Fairness: The perception of fairness in the tax system plays a crucial role in public acceptance and satisfaction. Transparent and equitable tax policies foster trust in governmentand contribute to higher levels of happiness.

4. Tax Compliance and Administration: Simplifying tax systems and ensuring efficient administration can positively affect attitudes towards taxation and enhance happiness. Complexity and perceived inefficiency can lead to dissatisfaction and decreased well-being.

5. Income Inequality: Progressive taxation helps reduce income inequality, which is often linked to higher national happiness. Equitable wealth distribution creates a more cohesive society and improves social well-being.

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MICROBES USED AS A TOOL FOR BIOREMEDIATION OF HEAVY METALSFROM WASTEWATER

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Abstract: The drastic increase in population rate, in a developing country like India has led to rapid industrialization and has been a major contributor in polluting the environment. The pollutants released into the surroundings contain hazardous chemicals, domestic products, organic and inorganic substances, heavy metals, and other toxic elements. These are let out into water bodies which cause adverse effects on living organisms and humans. The wastewater containing toxic effluents can seep over time into the ground causing deterioration in groundwater quality. The industries that induce the pollutants into surface and groundwater sources may not strictly regulate pollutants to safe limits. If the industrial effluents are not treated properly before lett ing them out into water bodies, they can cause serious damage to mankind. The present study aims at analyzing the microbial characterization of wastewater from the Peenya industrial area and Rajarajeshwari Nagar of Bengaluru. These samples also to analyse the types of of heavy metals such as nickel, lead, cadmium, chromium, mercury etc present in waste water by Atomic Absorption Spectroscopy. The isolated microorganisms were incubated with waste water sample to monitor the utilization of heavy metals. After quantification it was observed that microorganisms present in the collected samples were Gram-negative *Pseudomonas* and a Consortium of bacteria. Both these microbes were efficiently utilized heavy metals Cadmium, Chromium and Lead present in waste effluents.

I. INTRODUCTION

Water is inorganic, transparent, tasteless, odorless, nearly a colorless chemical substance forming the hydrosphere layer of the earth. It plays a vital role in the lives of living organisms being an essential nutrient in metabolism, hydration, carrying nutrients to the cell, and much more. Due to more and more production of industrial products to meet human needs, water pollution is now turning into a crisis which is leading to changes in the environment[1]. Huge quantities of toxic effluents released into the water bodies play a major role in causing pollution. Industries such as leather, tanning, chemical, pesticide, oil and refineries, dyes, and pharmaceutical industries use a variety of heavy metals like cadmium, manganese, arsenic, lead, copper etc., a variety of chemicals containing sulfides, carbonates, nitrates, other organic and inorganic compounds are used and these are released as effluents into the water bodies, improper and lenient wastewater treatments are done by the industries as it is expensive and excessive amounts of energy is needed [2]. Water is used as irrigation in

growing fruits, vegetables, and crops not only that the air we breathe surrounded by these heavy metals all these accumulations lead to increased toxicity to the lives of aquatic and other living organisms, thus declining the quality of water.

The correct definition for heavy metals varies among various authors. These are sometimes defined as metals with high density with a high atomic number or mass number with the features of metalloids both physical and chemical characteristics with essential and non-essential features involved in characterizing the heavy metal. The consumable limits of heavy metals like cadmium, zinc, lead, arsenic, and others range from 0.2mg/kg to 99.4 mg/kg as recommended by WHO. The common heavy metals density range is around 5g/cm3, and beyond this level leads to toxicity and chronic diseases like neurotoxicity, carcinogenic, infertility, liver and kidney damage, and other health hazards. These toxins accumulate in the water and are unable to be detected through the naked eye, by taste, or odor it can only be analysed by chemical estimations [3]. Thus, the 1-1.3 % of the water that is available for consumption if left for further toxification due to lack of management and control may lead to scarcity of water in the future generation. concentration. This method is found to be effective, efficient, quick, eco-friendly,

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Analysis and Characterization of Microorganisms from Heavy Metal containing Waste Water

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Abstract:

In overcrowded metropolitan cities emerging in nations like India, industries compete with one another forgrowth and advancement to meet people's needs. Toxic chemicals and heavy metals are not effectively removed from theeffluents that are produced. This could harm living organisms, and plants when effluents are dumped directly or indirectlyinto water bodies. The current study aims to characterize and analyse the microorganisms present in the effluents collectedfrom the Rajarajeshwari sewage outlet and Peenya industrial discharge in Bengaluru. Lead, Cadmium, and Chromiumheavy metals were present in the collected samples. The microorganisms from the effluents were isolated and Bio-chemical tests were done for identification. The consortium of bacteria and Gram negative Pseudomonas was found to be abundantly present. The enumeration of bacteria was observed by calculating CFU/ml(ColonyFormingUnit/ml).

Introduction

Water is a natural resource available in groundwater, rivers,lakes, and oceans. Human civilization is contaminating these water bodies with rapid urbanization which is leading to over consumption and over-dependence on water like daily usage in manufacturing industries for the upstream and downstream processes. The release of effluents directly into the water bodies without treatment of the effluents and toxic chemicals has led to a rapid spike in the heavy metals in water. An increase in toxin levels has led to the death of aquatic bodies and made the water to be unfit for daily human needs, this contaminated water acts as a vector for transmission of diseases.This can be with heldby the detoxification process using techniques such as bioremediation [1]. Bioremediation is a technique that employs the use of living organisms like microbes and bacteria to de contaminate affected areas [2]. It is used in the removal of contaminants, pollutants, and toxins from soil,water, and other environments. The use of either naturally occurring or deliberately introduced microorganisms to consume and break down environmental pollutants,to clean a polluted site [3].It has been introduced recently in mostparts of the world for the betterment of our living habitats. Bioremediation is mostly used in the reductionof pollution in various polluted means, here we have used this technique the for reduction of Heavy Metal contamination in waterbodies. Two major areas are selected -Rajarajeshwari Nagar of Bangalore South and Peenya Industrial area of Bangalore North for bioremediation

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Biodegradation of plastic by *Pseudomonas aeruginosa*

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Abstract

The threat of plastic pollution has become a global concern for the environment, resulting to the exploration of sustainable measures that reduce its adverse effects. Bioremediation is one such method that uses microorganisms to degrade soil and water contaminants, it is cost effective, eco-friendly and renewable. *Pseudomonas* is a ubiquitous genus of bacteria that can be used in biodegradation of several kinds of plastic. The current studies focus on the utilization of *Pseudomonas aeruginosa* for the biodegradation of polythene. *Pseudomonas* strain was isolated from soil contaminated with plastic waste. Based on morphological, physiological, biochemical, and pigmentation shifts the isolated strain was identified as *Pseudomonas aeruginosa*. This strain was capable of degradation of polythene material in 16 days of incubation with the highest percentage being an 11.5% reduction**.**

Keywords: *Pseudomonas;* Contaminated site; Plastic; Biodegradation

1. Introduction

Bioremediation is a process by which microbes degrade target pollutants at the site of contamination. This can be done by altering the environmental conditions and providing them with the required nutrients. Bioremediation is a new treatment technology based on fundamental processes of microorganisms to utilize synthetic organic molecules as a sole source of energy. Bioremediation usually involves redox reactions where either an electron acceptor is added to stimulate the oxidation of a reduced pollutant or an electron donor is added to reduce an oxidized pollutant. Bioremediation exploits the catabolic diversity of microorganisms to transform contaminants into eco-friendly products. Many species of bacteria and fungi have evolved the metabolic capacities to degrade plastics [1]. However, the event of biotechnology for the removal of plastics from commercial effluents remains to be adequately addressed even today. Various approaches are being developed to treat the plastic. The constraints are the availability of suitable microorganisms that can overcome their culturing limitations from their natural habits to the effluent conditions. *Pseudomonas* is a genus of aerobic, non-sporulating, motile Gram-negative Bacilli. This genus is found to have considerable heterogeneity [2]. This genus of bacteria is well known for its metabolic versatility allowing it to inhabit a range of environments and utilize an unusually wide range of polymers [3].

Earlier studies have shown *Pseudomonas aeruginosa* to be capable of degrading diesel, crude oil, n-alkanes, and polycyclic aromatic hydrocarbons (PAHs) in petroleum [4]. *Pseudomonas* is manifested with the capacity to degrade several aliphatic, aromatic, polyaromatic hydrocarbons and various derivatives, among a vast variety of miscellaneous organic compounds [5]. *Pseudomonas aeruginosa* is a predominant microbial species for phenol degradation [6,7]. *Pseudomonas aeruginosa* KBM13 exhibited maximum degradation of phenol at a concentration of 500 mg/L [8].

Plastic usage has transformed our lives in various ways. The production and utilization of plastics are always increasing due to the rising demand. They are inexpensive, strong, lightweight, corrosion-resistant, have duration and International Journal of Science and Research Archive, 2024, 11(02), 1054–1060

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Isolation,Characterization and Growth Study of *Pseudomonassp.*from Plastic Contaminated Soil

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Abstract:

An aerobic microorganism with the ability to utilize phenol as a carbon and energy source was isolated from a site contaminated with plastic wastes. The isolate was identified as a Pseudomonas sp. based on morphological, physiological, and biochemical tests. The isolated strain showed optimal growth at 25 ℃ and pH of7. The phenol utilization studies with the Pseudomonas sp. showed that the complete assimilation occurred in 24 hours. The microorganism metabolized phenol up to 53mM concentrations. The bacterial strain was immobilized in alginate beads and its phenol degradation efficiency was observed to increase many folds.

Keywords: Aerobic Microorganism, Phenolutilization, *Pseudomonassp*. Plastic Waste Contamination, Alginate Bead Immobilization

Introduction

The phenolics comprise characteristic pollutants in wastewater and effluents discharged from petrochemical, textile, tannery, and coal gasification units [1]. Since these compounds are toxic even at low levels, they pose a threat to the biosphere and especially to aquatic life. Biodegradation of phenolics by certain anaerobic, aerobic bacteria and fungi has been reported [2]- [12]. Diverse microorganisms, including many species of bacteria and fungi, have evolved the metabolic capacities to degrade hydrocarbons. Bacteria are often the dominant hydrocarbon degraders in aquatic systems. Microbial cell remediation efficiency for xenobiotic pollutants remains a major challenge to microbial and process engineers. Hence, some strategies have been proposed to overcome the issue. The use of microbial immobilization technique is one of them. Nevertheless, the application of free microbial cells for wastewater treatment in activated sludge processes creates issues such as solid waste disposal. Immobilize d microorganisms have proved to be effective in addressing phenol-containing waste water with little sludge yield and have been receiving increasing attention [13]-[15].

Immobilized cell technology has been widely applied in various research and industrial applications. The purpose of the present investigation has been to study the bio degradation of phenol using free and immobilized *Pseudomonas sp.*

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