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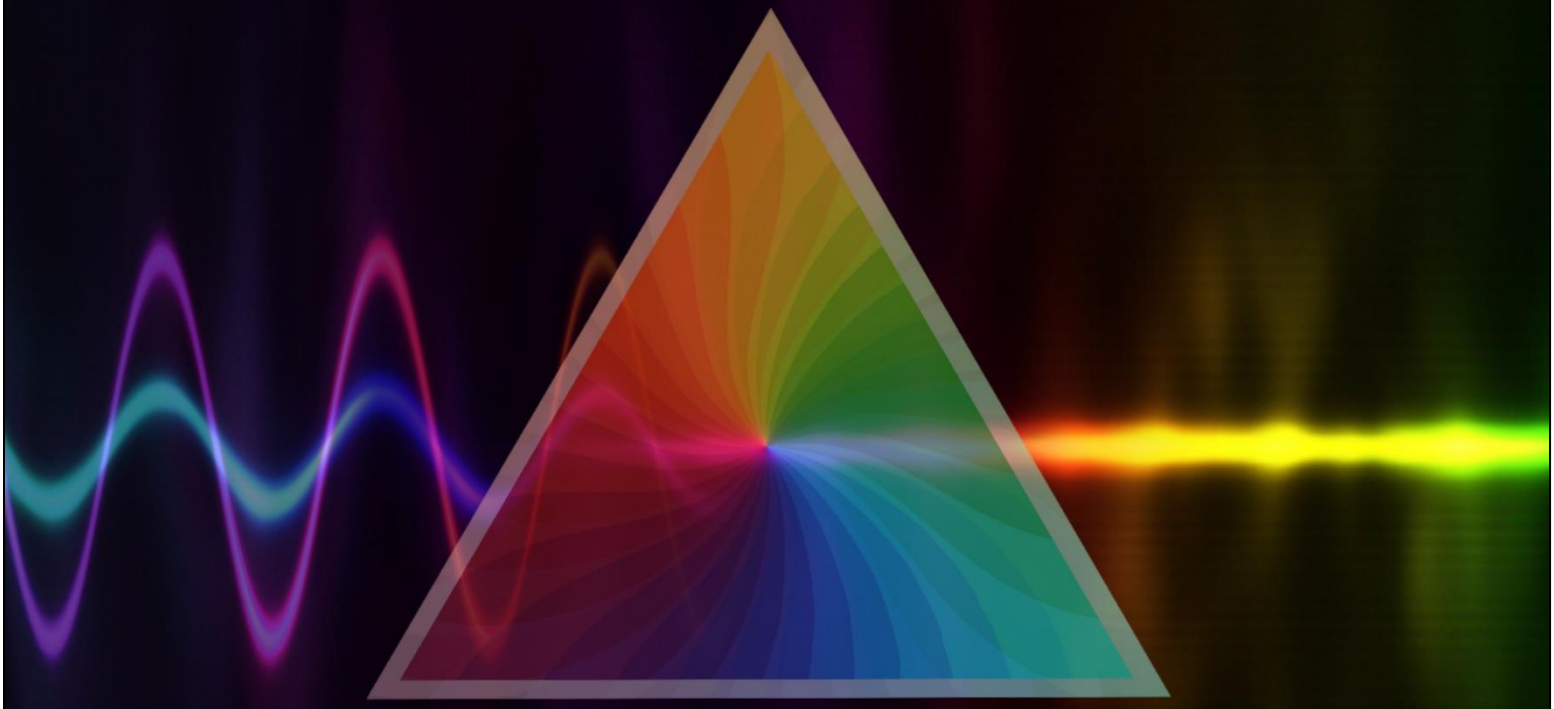
The Scientific Spectrum: Theory, Application and Innovation



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Smt. S. B. Patil
Dr. Yogesh Raghunath Ahire
Dr. S. S. Bhosale
Mr. R. S. Kamble

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Editor

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PREFACE

Science, in its many forms, continues to shape the world in profound and transformative ways. From understanding the universe's fundamental laws to improving the quality of human life, scientific inquiry drives both progress and innovation. The Scientific Spectrum: Theory, Application, and Innovation is a comprehensive exploration of how scientific theory evolves into application and innovation across various disciplines.

This book brings together contributions from experts who examine the interplay between scientific theory and its real-world applications. It aims to offer readers a deep understanding of how fundamental principles in fields like physics, biology, chemistry, and technology are not only studied but also translated into practical solutions that benefit society. The journey from theory to application, and ultimately innovation, is critical to fostering advancements in scientific knowledge and technology.

The chapters in this volume explore both the traditional and emerging branches of science, with a particular focus on interdisciplinary research that blends theory with practical implementation. Additionally, the book highlights cutting-edge innovations and examines their potential to solve global challenges in areas like healthcare, environmental sustainability, and energy.

As we explore the scientific spectrum, we invite readers to consider how theory, application, and innovation intersect in shaping the future of science and technology. Whether you are a researcher, educator, student, or practitioner, this book provides valuable insights into the transformative power of science.

We hope that this collection inspires further research and innovation and stimulates critical thought about the ongoing relationship between theory and practice in the scientific world.

- Editors

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SURFACTANT ASSISTED SYNTHESIS AND CHARACTERIZATIONS OF COBALT FERRITE NANOPARTICLES VIA CHEMICAL CO-PRECIPITATION METHOD

Rohit R. Powar*[1], S. B. Warke[1], S. K. Sawant[1] and R. B. Chopade*[1,2]

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Abstract:

Magnetic cobalt ferrite nanoparticles (NPs) was synthesized at controlled temperature by chemical co-precipitation method using sodium dodecyl sulphate (SDS) and high purity analytical grade nitrates. The synthesized material is characterized by X-ray diffraction studied (XRD), Scanning electron microscopy (SEM) and Fourier Transform Infrared Radiation (FTIR) techniques. The sample was sintered at 850 ^{0}C for 5h. The X-ray diffraction analysis confirms the formation of single phase cubic spinel structure with formula AB_2O_4. The lattice constant, X-ray density, crystallite size, site radii (r_A, r_B), bond length (A-O, B-O) on tetrahedral (A-site) and octahedral (B-site) were calculated for the sample. The lattice constant and crystallite size are 8.361 A^0 and 27 nm respectively. The FTIR spectra shows two strong absorption bands around in the range of 400 cm^{-1} and 800 cm^{-1} on the tetrahedral and octahedral sites respectively. The SEM study shows that the average grain size is 0.25 µm with nearly spherical shape micro structured agglomerated cobalt ferrite nanoparticles.

Keywords: Chemical Synthesis, Nanoparticle, Crystallite Size, XRD, FT-IR, SEM.

1. Introduction:

Ferrimagnetic materials contain an iron oxide known as ferrite. The ferrite has a cubic spinel phase with the general formula AB_2O_4, where A is a divalent metal ion such as Ni, Zn, Mn, Cu, Ca, Co, Mg, and B is a trivalent metal ion such as Fe, Sm, Gd, La, Ce, and so on. The arrangement of oxygen ions in this structure provides tetrahedral (A) and octahedral (B) sites. The cations that inhabit the 8 tetrahedral and 16 octahedral sites have a significant role in ferrites' distinct characteristics. Many cations preferentially occupy one of the locations. The microwave properties of ferrites are now in high demand due to modern society's growing needs. Cobalt ferrites are the most often used material in the microwave industry due to their high chemical stability, mechanical qualities, low cost, and ease of manufacture. Their general chemical formula (AB_2O_4) has an inverse spinel structure with one-half of the iron ions occupying tetrahedral A sites and the rest, along with cobalt ions, spread over octahedral B-sites. Cobalt ferrite is a very promising material due to its high coercive force, moderate saturation magnetization, and high Curie temperature. Cobalt ferrite is a hard magnetic material with remarkable physical, chemical and magnetic properties that are influenced by the replacement of

metal cations with different valance state such as Zn^{2+}, Mg^{2+}, Cr^{3+}, Al^{3+} [1-4]. The soft ferrites Ferrites are frequently investigated because of the easy incorporation of these ions into the lattice of ferrite due to the comparable size of cobalt ion, hence these are utilized in transformer cores, electrical motors and generators, information storage systems, ferro fluid technologies [5-6]. Rohit et.al [7] has been prepared Zn substituted cobalt ferrite by chemical co-precipitation method. Electrical and dielectrically properties are appreciably changes by substitution of zinc. Due to low value of dielectric loss tangent zinc substituted cobalt ferrite are suitable for microwave application.

Recently there are several methods have been developed to synthesize the spinel ferrite nanoparticles like co-precipitation method [7-9], forced hydrolysis method [10], sol-gel method [11], reverse micelle method [12], microwave method [13], solvo-thermal method [14]. Therefore in this paper we report modified chemical co-precipitation method is a facile, clean, cost effective chemical method for the synthesis of reproducible stoichiometric composition and desired microstructures, good control of shape and size also good chemical homogeneity.

2. Experimental methods

2.1 Material:

Synthesis of zinc substituted cobalt ferrite nanoparticles includes the precursor materials as cobalt nitrate hexahydrate ($Co(NO_3)_2.6H_2O$), Iron nitrate nanohydrate ($Fe(NO_3)_3.9H_2O$), sodium dodecyl sulphate (SDS) all chemicals were used as received without further purification.

2.2 Synthesis:

The polycrystalline fine particles of spinel cobalt ferrites were prepared by chemical co-precipitation method cobalt nitrate hexahydrate ($Co(NO_3)_2.6H2O$), Iron nitrate nanohydrate ($Fe(NO_3)_3.9H_2O$), sodium dodecyl sulphate (SDS) were used as starting material (AR grade) used as received without further purification. Initial molar concentration proportion of stock solution was prepared in distilled aqueous solution. The ratio of M^{2+} / Fe^{3+} was 1:2 where M^{2+} = (Co^{2+}). Aqueous solutions of 50 ml 0.5 M cobalt nitrate and 50 ml 1 M iron nitrate into a 500 ml beaker. This mixture was then stirrer for 1 hr. An aqueous solution of SDS was mixed with above metal nitrate solution and stirrer at 35^0c for 1 hr on hot plate with slow and constant stirring by using magnetic stirrer with hot plate. Aqueous 25% ammonia solution was added drop wise into above solution until a dark brown precipitate of metal hydroxide at pH 9-10 is obtained. The precipitate was then digested on hot plate at 80 ^{0}C for 2 hrs. The product was then filtered and washed several times by using ethanol and deionized water, followed by air drying at 110 ^{0}C temperature for 24 hrs. The powder mixture was pre-sintered into muffle furnace at 300 ^{0}C for 2 hrs. The powder was milled after cooling in agate mortar for 2 hrs. by using acetone and finally sintered at 850 ^{0}C for 5 hrs. into muffle furnace. The polycrystalline powder was cooled in air and milled in agate mortar to get a fine particle powder.

2.3 Characterization methods -

The cobalt ferrite was analyzed using the PW-1710 Philips X-Ray diffractometer (XRD) using Cu Kα radiation (1.5405 A^o). Fourier-transformed infrared (FT-IR) analysis of the material

was performed using a Perkin Elmer Spectrum One Spectrophotometer using the KBr pellet technique in the 400-4000 cm^{-1} range. The surface morphology of the powder sample was investigated using field emission scanning electron microscopy (FE-SEM).

3. Results and discussion

3.1 X-ray diffraction (XRD) study –

Powder XRD pattern of all polycrystalline Nanomaterial annealed at 850°C for 5 hrs. was carried in the 2θ range 20° – 80°. Figure 1 shows the x-ray diffraction pattern of $CoFe_2O_4$ sample. The main diffraction planes are (220), (311), (222), (400), (422), (511), (440), (620), and (533) with maximum diffraction intensity of (311) plane clearly confirming the formation of cubic spinel structure of $CoFe_2O_4$ sample [15]. The lattice constant for each peak of each sample was calculated by using the Bragg's equation [16].

$$a = d\,(h^2+k^2+l^2)^{1/2} \quad (1)$$

where h, k and l are miller indices of crystal planes. The crystallite size of polycrystalline nanomaterial was investigated based on x-ray line broadening. The average crystalline size of all samples was calculated by using Debye-Scherer equation [17].

$$D = \frac{0.89\,\lambda}{\beta cos\theta} \quad (2)$$

Where λ is the incident wavelength of Cu Kα radiation of the XRD, β is the full - width at half maximum (FWHM) and θ is the Bragg's angle in radian.

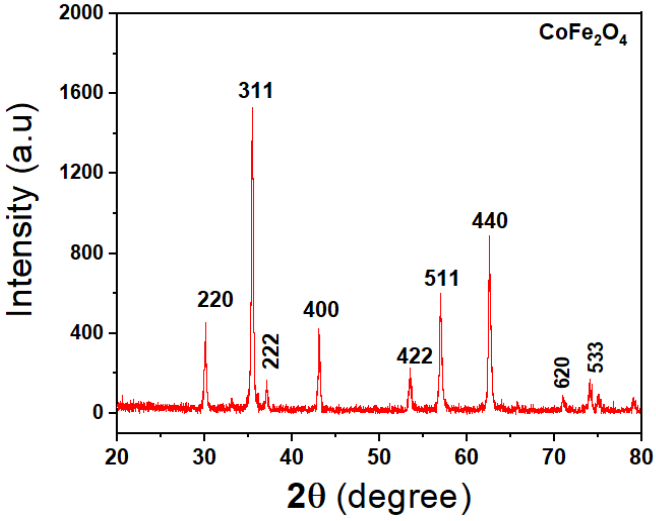

Fig. 1: X-ray diffraction pattern of cobalt ferrite sample sintered at 850 ^{0}C

Table 1: The structural parameters of Cobalt ferrite sample sintered at 850 ^{0}C

Crystallte size (nm)	Lattice constant (A°)	Grain Size (μm)	X-ray density	Absorption bands		Ionic radii (A°)		Bond length (A°)	
				υ_1	υ_2	r_a	r_b	A-O	B-O
27	8.361	0.25	5.279	550	456	0.426	0.678	1.819	2.097

The crystalline size increases this happens due to replacement of Co ions having smaller radius than of Zn ions. Therefore, usually the concentration of zinc ions increases the lattice constant also rises. **Table 1** shows structural parameters such as crystallite size, lattice constant, X –ray density, absorption band.

3.2 Fourier transformed infrared study

The analysis of FT-IR spectra used to confirm the tetrahedral and octahedral sites of spinel ferrite structure and also to confirm impurity phase. The FT-IR spectra shown in fig. 2 indicate two absorption bands in the range of 400 - 800 cm^{-1} which is common feature of the spinel ferrites [18]. Strong and characteristics ensembles for inorganic elements exists in the far infra red region. The bands corresponding to 400-1000 cm^{-1} are related to metal cation and oxygen anion (Fe-O and Co-O) bonds. In two different ways the iron and cobalt cation might coordinate to oxygen namely octahedral and tetrahedral coordination.

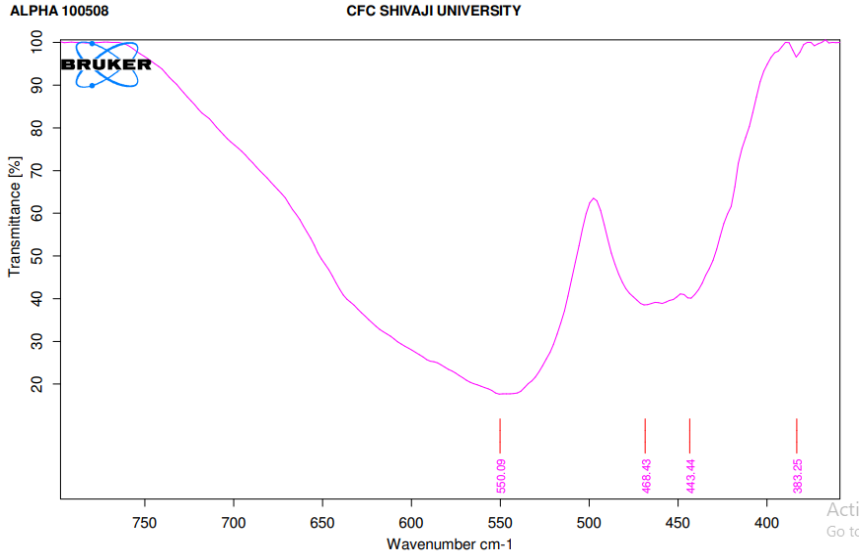

Fig. 2: FTIR spectra of cobalt ferrite sample sintered at 850 ^{0}C

The absorption band υ_1 has a greater wave number of 550 cm^{-1}, while υ_2 has a lower value of 456 cm^{-1}. Higher frequency absorption band (υ_1) assigned to vibration of tetrahedral metal complex, whereas lower frequency absorption band (υ_2) assigned to vibration of octahedral metal complex [19].

3.3 Field -emission scanning electron microscopy study

The FE-SEM images of the sample $CoFe_2O_4$ sintered at 850 ^oC are shown in **fig. 3** as revealed in the figure particles resembles the morphology of nearly spherical in nature. The shape of particles are not uniform for sample indicate agglomeration occur at higher sintering temperature [20].

The polycrystalline surface of cobalt ferrite displays holes caused by gases removal during the sintering process. The particle size of a cobalt ferrite sample is normally determined using the linear intercept method. Zinc substitution and sintering temperature had a significant impact on grain shape and size, with grains measuring around 0.25 μm [7].

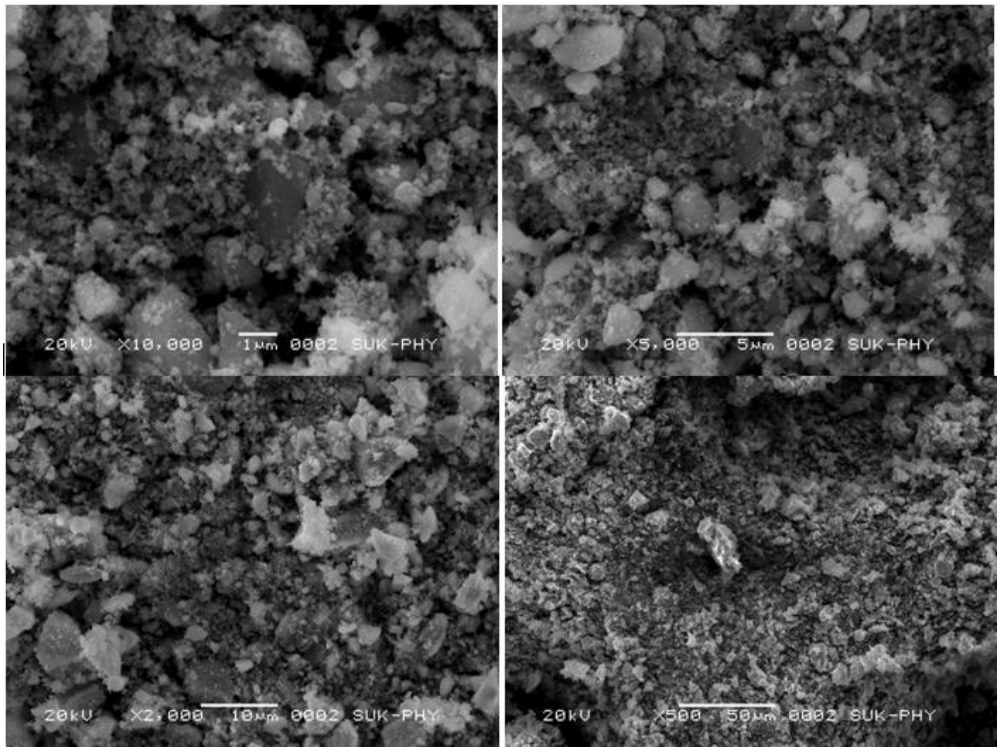

Fig. 3: FESEM images of cobalt ferrite sample sintered at 850 ^{0}C.

Conclusions:

We synthesized single phase polycrystalline nanoparticles of $CoFe_2O_4$ by using nitrates of cobalt, and iron incorporation with SDS by using chemical co-precipitation method. XRD and FT-IR confirmed the pure cubic spinel structure without minor impurity phase (α Fe_2O_3). The average crystallite size and lattice constant was found in the range of 27 nm and 8.364A^0 respectively. The FESEM results proved that the particle size in the range of 0.25 µm. The field emission scanning electron micrograph revealed that the sample was nearly spherical in shape and agglomerates at higher sintering temperature of $CoFe_2O_4$ sample.

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A CENTURY OF CHEMICAL BRILLIANCE: A DEEP DIVE INTO NOBEL LAUREATES

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Introduction:

The Nobel Prize in Chemistry, established in 1901, has consistently recognized groundbreaking contributions to the field of chemistry. These accolades have not only celebrated scientific achievements but have also shaped the trajectory of research and innovation. This paper aims to delve into the rich tapestry of Nobel laureates in chemistry, exploring their significant discoveries, the impact of their work, and the broader trends that have emerged over the past century.

The Evolution of Chemical Research

The early years of the Nobel Prize witnessed a focus on classical chemistry, with awards given for discoveries in areas such as organic chemistry, inorganic chemistry, and physical chemistry. Notable examples include Jacobus Henricus van 't Hoff's work on chemical dynamics and osmotic pressure and Marie Curie's pioneering research on radioactivity.

As the 20th century progressed, the scope of chemical research expanded dramatically. The advent of quantum mechanics led to a deeper understanding of atomic structure and chemical bonding. This theoretical foundation paved the way for advancements in materials science, catalysis, and biochemistry.

Key Themes and Breakthroughs

Several recurring themes have characterized the work of Nobel laureates in chemistry:

- **Molecular Structure and Bonding:** The elucidation of molecular structures and the understanding of chemical bonding have been central to many Nobel Prize-winning discoveries. Dorothy Hodgkin's work on X-ray crystallography, for example, allowed scientists to visualize complex molecules like penicillin and insulin.
- **Catalysis:** Catalysis, the process of accelerating chemical reactions, has been a major focus of research. Scientists like Fritz Haber and Carl Bosch developed catalytic processes for ammonia production, revolutionizing agriculture. More recently, Frances Arnold's work on directed evolution has led to the creation of enzymes with novel catalytic properties.
- **Biochemistry and Molecular Biology:** The intersection of chemistry and biology has been particularly fruitful. Discoveries related to DNA structure (Watson, Crick, and Wilkins), genetic code (Nirenberg, Khorana, and Holley), and enzyme mechanisms (Koshland, Boyer, and Walker) have profoundly influenced our understanding of life.

- **Materials Science:** The development of new materials with tailored properties has been another significant area of research. Examples include the discovery of fullerenes (Kroto, Smalley, and Curl) and the development of lithium-ion batteries (Goodenough, Whittingham, and Yoshino).

Impact on Society

The discoveries of Nobel laureates in chemistry have had a profound impact on society. They have led to advancements in medicine, agriculture, energy, and environmental protection. For instance, the development of antibiotics and vaccines has saved countless lives, while innovations in materials science have enabled the creation of lighter, stronger, and more durable materials.

Trends and Future Directions

As we look to the future, several trends are likely to shape the field of chemistry. One trend is the increasing interdisciplinary nature of research, with chemists collaborating with biologists, physicists, and engineers to address complex challenges. Another trend is the growing importance of sustainability and green chemistry, as scientists seek to develop environmentally friendly processes and products.

Conclusion:

The Nobel Prize in Chemistry has recognized a century of extraordinary scientific achievements. The laureates, through their groundbreaking discoveries, have not only expanded our knowledge of the chemical world but have also made significant contributions to human progress. As we continue to explore the frontiers of chemistry, the legacy of these Nobel laureates will continue to inspire and guide future generations of scientists.

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UNDERSTANDING GREEN CHEMISTRY: PRINCIPLES AND APPLICATIONS

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Introduction:

Green chemistry is an innovative and evolving field that focuses on the design and application of chemical products and processes that minimize or eliminate the use and generation of hazardous substances. The core principles of green chemistry emphasize the importance of sustainability, efficiency, and safety, guiding scientists and industries towards environmentally responsible practices. Central to green chemistry is the notion of preventing pollution at the source rather than treating it after it has been created. [0, 1, 2]

This proactive approach leads to the development of more sustainable products and processes that reduce the environmental burden and conserve resources. [3] By incorporating atom economy, green chemistry seeks to maximize the incorporation of all materials used in a process into the final product, reducing waste significantly. Additionally, it advocates for the use of renewable feedstocks over depleting resources, which not only supports environmental sustainability but also ensures long-term economic viability. The adoption of safer solvents and reaction conditions remains pivotal, reducing the risks associated with chemical accidents and exposures. [4, 0, 5]

Green chemistry's applications extend across various industries, including pharmaceuticals, agriculture, and energy production, leading to the synthesis of more environmentally friendly products, reducing toxic emissions, and promoting energy efficiency. As society becomes increasingly aware of the importance of sustainability, green chemistry stands at the forefront of scientific innovation, offering practical solutions to environmental challenges. [6, 7]

The Role of Green Chemistry in Environmental Sustainability -

Green chemistry plays a pivotal role in advancing environmental sustainability by fundamentally altering the ways in which chemical processes are designed and implemented. At its core, green chemistry seeks to minimize the environmental impact of chemical manufacturing and usage through the adoption of principles that emphasize reduction of hazardous substances, conservation of resources, and enhancement of energy efficiency. By prioritizing the use of renewable raw materials and developing processes that produce minimal waste, green chemistry not only reduces the ecological footprint of industrial activities but also offers sustainable alternatives that can be economically viable. [8, 9, 10]

Central to green chemistry is the innovation of new chemical reactions and processes that inherently prevent pollution. This proactive approach contrasts with traditional practices that

often address environmental issues retrospectively. Through catalysis and bio-catalysis, for instance, reactions can occur under milder conditions, reducing energy consumption and limiting the release of potentially harmful byproducts. Furthermore, green chemistry encourages the application of life cycle thinking, which considers the environmental consequences of a product from its inception to disposal. [0, 11, 12]

By fostering a culture of sustainability within the chemical industry, green chemistry contributes to the development of environmentally sustainable products. These products not only meet the current needs without compromising the ability of future generations to meet their own needs but also inspire confidence among consumers by being safer and more environmentally friendly. The adoption of green chemistry principles is thus indispensable for attaining long-term ecological balance and sustainability. [13, 14, 15]

Innovative Technologies in Green Chemistry -

Innovative technologies in green chemistry are at the forefront of transforming the industrial landscape towards environmental sustainability. These advancements focus on reducing or eliminating hazardous substances in the design, manufacture, and application of chemical products. One of the most promising innovations is the development of biocatalysis, which utilizes natural catalysts such as enzymes to perform chemical reactions. This method requires less energy and generates fewer by-products, significantly minimizing environmental impact. [2, 16, 9, 17] Additionally, the use of supercritical fluids, particularly supercritical carbon dioxide, presents a safer alternative to traditional organic solvents, offering a means to extract, purify, and synthesize products with reduced environmental burden. [18]

Another breakthrough is the adoption of renewable feedstocks, where raw materials derived from biomass replace petroleum-based resources. This not only reduces dependency on fossil fuels but also contributes to the reduction of greenhouse gas emissions. Moreover, advancements in photocatalysis harness the power of light to drive chemical reactions, creating opportunities to synthesize products with minimal waste and energy consumption. Electrochemical synthesis is also gaining traction, offering a clean and efficient means to produce chemicals by using electricity, which can be sourced from renewable energy. [2, 8, 3, 19]

The continuous innovation in green chemistry technologies plays a crucial role in paving the way for the production of environmentally sustainable products, aligning industrial practices with ecological preservation and offering promising pathways toward a more sustainable future. [1]

Designing Environmentally Sustainable Products -

Designing environmentally sustainable products is a key objective in green chemistry, aiming to minimize the negative impact of products on the environment throughout their entire lifecycle. This involves considering the environmental effects from the very start of the design process, ensuring that sustainability is integrated into every aspect of a product. To achieve this, designers and manufacturers must carefully select materials that are renewable, biodegradable, or

recyclable, reducing reliance on finite resources and minimizing waste. [20, 12, 21] The manufacturing process itself should also be optimized to reduce energy consumption and eliminate the use of hazardous substances, aligning with the principles of green chemistry which advocate for the reduction of toxic chemicals and pollutants. [22]

Incorporating life cycle assessment (LCA) is crucial in this context, as it provides a comprehensive evaluation of the environmental impacts associated with all stages of a product's life, from raw material extraction through to disposal. This holistic approach helps in identifying areas where improvements can be made, thereby enhancing the product's sustainability credentials. Additionally, engaging consumers and encouraging the adoption of sustainable practices is essential, as it helps build a market for environmentally friendly products. [9, 23, 24] By fostering a collaborative effort between scientists, designers, industry leaders, and consumers, it is possible not only to inspire innovation but also to promote a more sustainable future through the development of products that are safe, efficient, and considerate of our planet's resources. [25]

Case Studies: Successful Implementation of Green Solutions –

In recent years, green chemistry has become a driving force in the development of environmentally sustainable products across various industries. A notable case study can be seen in the transformation of the cleaning products sector. Traditionally reliant on harsh chemicals, the industry has embraced green chemistry principles to produce eco-friendly alternatives. For instance, companies have successfully developed biodegradable detergents by utilizing plant-based enzymes instead of synthetic compounds. [2, 26, 24] This shift not only reduces harmful environmental impact but also enhances biodegradability, leading to less pollution in water bodies. [27]

Another exemplary case comes from the textiles industry. Traditionally one of the most polluting sectors due to its heavy use of water and chemicals, it has witnessed a revolution in the dyeing process. In this context, a pioneering approach using supercritical carbon dioxide instead of water has been adopted, reducing water usage to virtually zero and eliminating contaminated wastewater discharge. This method also drastically cuts down on energy consumption, showcasing a holistic approach to sustainability. [28, 29, 30] Additionally, the pharmaceutical industry has also made strides by incorporating green chemistry in drug synthesis processes. Here, companies focus on reducing solvent waste and energy usage, leading to cleaner production paths. These case studies underscore how the adoption of green chemistry can not only mitigate environmental impact but also improve economic and operational efficiency, paving the way for more sustainable industrial practices. [2, 31, 11]

Future Trends in Green Chemistry and Sustainable Development –

The future of green chemistry and environmentally sustainable products is poised to witness transformative advancements, driven by innovation, heightened awareness, and stringent regulations. As industries aim to minimize their ecological footprint, green chemistry will become fundamental in designing safer, non-toxic chemicals and processes that reduce waste and

conserve resources. Innovations in catalysis and enzymatic processes are anticipated to increase process efficiency and selectivity, reducing energy consumption and greenhouse gas emissions. [32, 33, 34] Biodegradable materials and renewable feedstocks will become more prevalent, replacing petroleum-based products.

Moreover, the integration of green chemistry principles into circular economy models will enhance sustainability by promoting the reuse and recycling of materials. This will significantly contribute to the reduction of raw material demand and waste generation. Industries are expected to adopt life cycle assessment tools more widely to measure environmental impacts and make informed decisions that align with sustainability goals. The increasing focus on transparency and sustainability in supply chains will drive the development of eco-friendly products, encouraging consumer preference for such options. [32, 25, 35, 36] Additionally, advancements in digital technologies, such as artificial intelligence and machine learning, will play a crucial role in advancing green chemistry. These technologies will optimize chemical processes, aid in the discovery of new sustainable materials, and enhance modeling and simulation for environmental impact assessments, further propelling sustainable development objectives. [37, 32]

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COLLABORATIVE INNOVATION IN GREEN CHEMISTRY: MAKING SUSTAINABLE LIVING REALITY

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Abstract:

Collaborative innovation in chemistry involves multidisciplinary teams working together to develop new chemical product, processes or technologies. Green chemistry and collaborative innovation are crucial for sustainable future. Green Chemistry helps to reduce environmental harm, but it's adoption is slow. This study explores how collaborative innovation can accelerate sustainable solutions in everyday life. It can develop eco-friendly products, reduce waste and promote sustainable practices.

Introduction:

Our daily choices impact the planets health. Harmful chemicals in products we use contribute to pollution, climate change and health issues. Green Chemistry offers a solution, designing eco-friendly products and processes. But progress is slow, collaborative innovation can accelerate sustainable living.

What is Green Chemistry:

"Green Chemistry also known as sustainable chemistry, is the design of products and processes that minimize harm to human health and environment. It aims to reduce or eliminate the use and generation of hazardous substances, promoting eco friendly and sustainable solutions."

It's about

1. Using safe chemicals
2. Reducing waste
3. Saving energy
4. Using renewable resources
5. Designing sustainable solutions

Twelve Principles of Green Chemistry

1. Prevention: Prevent Waste Generation.

Prevent Waste generation by designing chemical processes and products that minimize or eliminate waste.

2. Atom Economy: Maximize Resource Utilization.

Maximize resource utilization by designing chemical reactions that use all atoms in the starting material.

3. Less Hazardous Chemical Synthesis: Use Safer chemicals.

Use safer chemicals and design synthetic methods that minimize the use and generation of hazardous substances.

4. Designing Safer Chemicals: Minimize Toxicity.

Design chemical products that minimize toxicity and adverse environmental impacts.

5. Safer Solvents and Auxiliaries: Use Eco-Friendly Solvents.

Use eco-friendly solvents and auxiliaries that are benign by design.

6. Design For Energy Efficiency: Minimize Energy Consumption.

Design chemical processes and products that minimize energy consumption and minimize energy efficiency.

7. Use Of Renewable Feedstock's: Utilize Renewable Resources.

Utilize renewable resources such as biomass or bio-waste as feedstock's for chemical production.

8. Reduce Derivatives: Simplify Chemical Processes.

Simplify chemical processes by minimizing the number of steps and derivative.

9. Catalysis: Enhance Reaction Efficiency.

Enhance reaction efficiency and selectivity through the use of catalysts.

10. Design For Degradation: Plan for Self Disposal.

Design chemical products that degrade safely and do not persist in the environment.

11. Real Time Analysis for Pollution Prevention: Monitor and Control Pollution.

Monitor and control pollution in real-time through the use of online monitoring and control systems.

12. Inherently Safer Chemistry for Accident Prevention: Design Safe Chemical Processes.

Design chemical processes that are inherently safe and minimize the risk of accidents.

Advantages of Green Chemistry:

I) Environmental advantages

. It reduces pollution by minimizing harmful chemical emissions.

. It conserves natural resources by using renewable materials.

. It protects biodiversity by reducing toxic waste.

II) Economic advantages

. It's Saves industries money by reducing waste and energy consumption.

. It creates new business opportunities in sustainable markets.

. It generates jobs in green industries, boosting local economics.

III) Social advantages

. It improves public health by reducing exposure to toxic chemicals.

. It enhances quality of life through cleaner air, water and soil.

. It promotes community development through sustainable practices.

IV) Innovation advantages

. It drives innovation through sustainable solutions.

. It accelerates the development of new technologies.

. It fosters knowledge sharing and best practices.

Conclusion:

Collaborative innovation in green chemistry is a powerful strategy for making sustainable living a reality. By working together, industries and communities can develop innovative solutions that reduce environmental harm, promote public health and support economic growth.

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PREPARATION OF SCHIFF BASE BY MICROWAVE

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Abstract:

The Schiff bases were prepared with aromatic aldehyde and aromatic amine using yogurt and lemon juice as a catalyst under microwave irradiation. This reaction is rapid, efficient, and solvent-free and involves the one-pot synthesis of Schiff bases under microwave irradiation. Using lemon juice and yogurt as catalysts and microwave radiation, the Schiff bases were made with aromatic amines and aldehydes. The one-pot synthesis of Schiff bases under microwave irradiation is the basis of this quick, effective, and solvent-free procedure.

Keywords: Schiff Bases, Nucleophilic Ally, Distilling, Molecular Sieves.

I. Introduction:

We concentrate on the process by which yogurt and lemon juice convert aldehyde and aniline into Schiff bases. By using this approach, the main amine attacks the carbonyl carbon nucleophilic ally, resulting in a hydroxyl molecule that, when dehydrated, yields Schiff base. The pace at which water is eliminated from the reaction mixture has a major impact on the production of Schiff base in the second phase. The traditional method of creating Schiff bases was first described by Schiff base. It entails condensing a primary amine with a carbonyl compound while distilling and extracting the water at the same time. Molecular sieves are another common tool used to aid in the elimination of water during this condensation. The creation of a double bond between carbon and nitrogen has important role in organic synthesis.

Chapter No.1

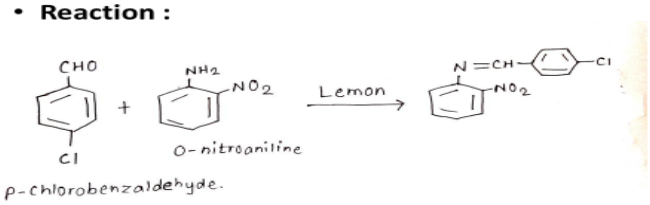
Objective: Using a microwave to prepare the Schiff base

Reagents: lemon juice, o-nitroaniline, and p-chlorobenzaldehyde.

Method: Combine 1.120g of O-nitro aniline and 1.125g of p-chlorobenzaldehyde in a 100 ml conical flask. Add a few drops of lemon juice. Microwave at 640 w for 60 seconds. A lucid resolution is attained. Add a few chunks of ice to the reaction mixture when it has cooled. Use aqueous alcohol for purification after filtering the product wash with water. Send in a refined product for submission.


Preparation of Schiff base by Microwave

- **Reaction :**



- **Results :**

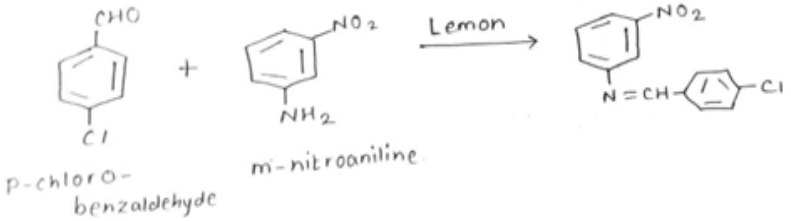
Sticky Product

Chapter No.2

Objective: Using a microwave to prepare the Schiff base.

Reagents: Lemon juice, m-nitroaniline, and p-chlorobenzaldehyde are the reagents.

Reaction:



The outcome

Yield of the product: 1.450 grams.

Physical Constant:

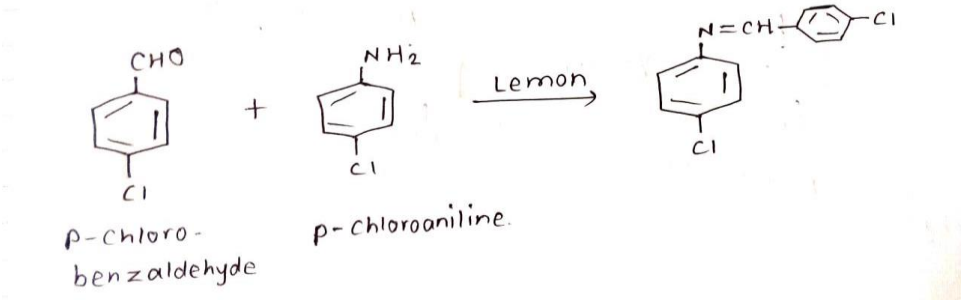
Melting point: 100 degrees Celsius

Chapter No.3

Objective: Utilizing a microwave to prepare the Schiff foundation.

Reagents: P-chloroaniline, lemon juice, and p-chlorobenzaldehyde are the reagents.

Reaction:



The outcome

Yield of the product: 1.130 grams

Physical Constant:

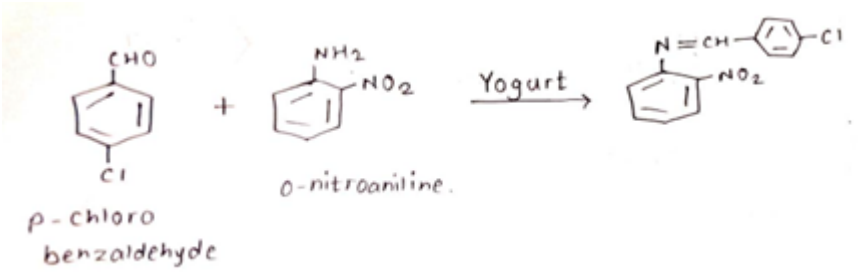
Melting point: 97 degrees Celsius

Chapter No.4

Objective: Utilizing a microwave to prepare the Schiff foundation.

Reagents: O-nitroaniline, yogurt and p-chlorobenzaldehyde are the reagents.

Reaction:



The outcome

Yield of the product: 1.466 grams

Physical Constant:

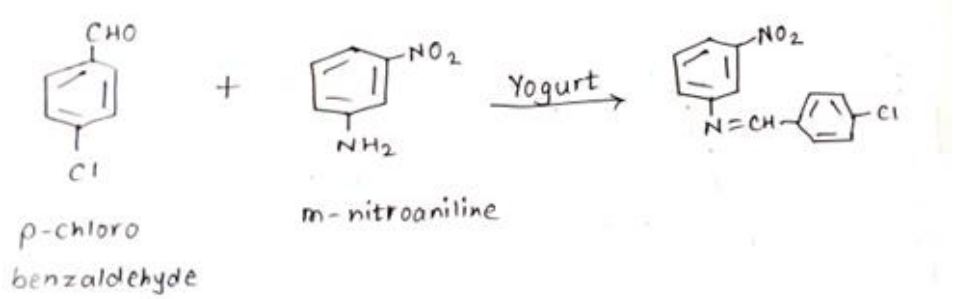
Melting point: 130° Celsius.

Chapter No. 5

Objective: Utilizing a microwave to prepare the Schiff foundation.

Reagents: Include yogurt, m-nitro aniline, and p-chlorobenzaldehyde.

Reaction:



The outcome

Yield of the product: 1.511 grams.

Physically constant:

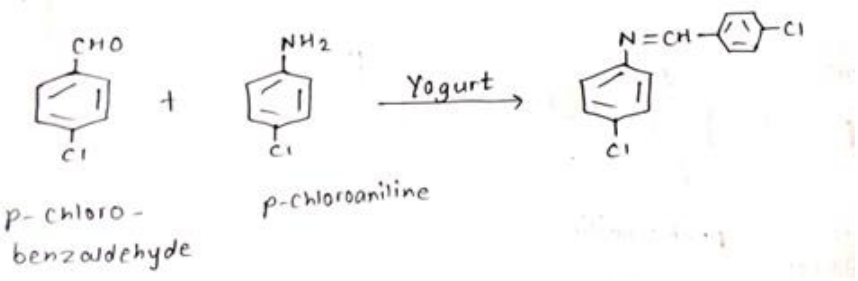
Melting point: 100°C

Chapter No.6

Objective: Preparation of Schiff base by using microwave.

Reagent: p-chloro aniline, p-chlorobenzaldehyde, yogurt.

Reaction:



Outcome:

Yield of the product: 0.101 gm

Physical constant:

Melting point: 240 degree Celsius

A concern regarding Schiff Base The general Schiff base formula is RR'C=NR.

Something regarding Schiff Base Any base in a class of bases with the general formula RR'C=NR is referred to as the Schiff base general formula. Which are mostly utilized as intermediates in organic synthesis, and which are often produced by condensation of an aldehyde or ketone with primary amine (such as aniline) and the removal of water. They also generally polymerize easily if created from aliphatic aldehyde.

An amine, like the terminal group of a lysine residue, reversibly interacts with an aldehyde or ketone of substrate to form schiff bases, which are typical enzyme intermediates. Aldehyde and ketones' electrophilic carbon atoms can be the target of amines' nucleophilic attack in a Schiff base reaction. Following this reaction, a molecule with a C=O double bond is substituted with a C=N double bond.

Uses:

1. Given their crucial roles in the processes of decarboxylation, transamination, and C-C bond cleavage in living things, schiff bases have broad-spectrum activity against a variety of organisms.
2. In order to synthesize hormones, neurotransmitters, and pigments, two important processes are decarboxylation and transamination.
3. Schiff base, one of the promising immobilization alternatives for biopolymer in a variety of industrial applications, has drawn a lot of attention in the chemistry of polymer-based macromolecules.

   One crucial biological chemistry reaction is the production of Schiff bases.

Something about Aniline and Benzaldehyde

1. Aniline is a chemical molecule that is the archetypal aromatic amine, with an amino group and a phenyl group connected. Its primary application is in the production of industrial chemicals such as polyurethane precursors.
2. An organic molecule containing a formal substituent on the benzene ring is called benzaldehyde. The most widely used aromatic aldehyde in industry, it is also the most basic.
3. It’s a clear liquid with an aroma reminiscent of almonds.
4. The chemistry of polymer-based macromolecules, such as Schiff base, has drawn a lot of interest from numerous industry sectors as a potential biopolymer immobilization substitute.

   In biological chemistry, the production of Schiff bases is a crucial process.

Results and Discussion:

Using lemon juice as a catalyst

Sr. No.	Aldehydes	Anilines	Yield of product	M.P.
1.	p-chloro benzaldehyde.	o-nitro aniline.	Sticky Product	-
2.	p-chloro benzaldehyde.	m-nitro aniline.	1.450 gm	110°C
3.	p-chloro benzaldehyde	p-chloro aniline.	1.130 gm	97°C

Using yogurt as a catalyst

Sr. No.	Aldehyde	Aniline	Yield of product	M.P
1.	p-chloro benzaldehyde.	o-nitro aniline.	1.466 gm	130°C.
2.	p-chloro benzaldehyde.	m-nitro aniline.	1.511 gm	100°C.
3.	p-chloro benzaldehyde.	p-chloro aniline.	0.101 gm	240°C.

We got following Results by using lemon juice and yogurt with p-chlorobenzaldehyde and different anilines gives Schiff base. And in above results it's observed that using yogurt high yield obtained as compare to lemon juice. Therefore, yogurt is best catalyst for formation of Schiff base.

Conclusion:

My anxious mind pushes me to go for synthesis of Schiff bases from aniline and benzaldehyde in presence of two different catalyst such as lemon juice and yogurt. I did the synthesis of Schiff bases from two different way using different catalyst. I observed that the method of synthesis of Schiff bases using yogurt is superior over other method.

Thus, finally I concluded than Schiff base can be easily prepared from using yogurt at 640w in microwave. This method is more favourable over the other method. It is eco-friendly method.

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USE OF FERTILIZERS AND PESTICIDES IN MAHARASHTRA AND IMPACT OF PESTICIDES ON CROP PROTECTION AND ECOSYSTEM HEALTH

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Introduction:

Maharashtra, a significant agrarian state in India, has seen substantial use of fertilizers and pesticides to enhance agricultural productivity and protect crops from various threats. The state's diverse climatic conditions and extensive agricultural lands have necessitated the employment of these agrochemicals to ensure adequate food production and economic stability for its farming community. Fertilizers, comprising essential nutrients like nitrogen, phosphorus, and potassium, are applied to the soil to promote plant growth and increase yields. [0, 1, 2]

They have become an integral part of modern farming practices in Maharashtra, driving the green revolution across the region. The adoption of chemical fertilizers has led to marked improvements in crop quality and output, pivotal to meeting the food demands of a growing population. [3, 4]

Pesticides, on the other hand, are employed to safeguard crops against pests, diseases, and weeds that could potentially devastate agricultural harvests. In Maharashtra, the prevalence of pests such as bollworms in cotton and aphids in sugarcane has prompted widespread pesticide application. While these agrochemicals have played a critical role in protecting crops and securing the livelihood of farmers, their usage also raises significant concerns regarding environmental and ecosystem health. [5, 6, 7]

The indiscriminate and excessive use of pesticides can lead to issues like soil degradation, water contamination, and the disruption of local biodiversity, creating a complex scenario where the benefits of enhanced crop protection must be balanced against the long-term health of the ecosystem. [8]

Types of Fertilizers and Pesticides Commonly Used in Maharashtra

In Maharashtra, a state known for its diverse agricultural practices, both organic and inorganic fertilizers are commonly employed to enhance crop productivity. Organic fertilizers, including compost, manure, and green manure, play a significant role in enriching soil with essential nutrients and improving soil structure. These organic amendments are frequently used by farmers practicing sustainable agriculture. Inorganic or chemical fertilizers, such as urea, diammonium phosphate (DAP), and potassium chloride, are also extensively applied due to their immediate nutrient availability and ease of use. [9, 5, 10, 3]

These synthetic fertilizers supply critical nutrients like nitrogen, phosphorus, and potassium, which are vital for crop growth and yield. [11]

Pesticides are equally important in Maharashtra's agricultural landscape to manage pests and diseases that threaten crops. Commonly used pesticides include insecticides such as organophosphates, carbamates, and pyrethroids, which are effective against a wide range of insect pests. Herbicides like glyphosate and atrazine are frequently utilized to control weed populations that compete with crops for nutrients, water, and light. Fungicides, including chlorothalonil and mancozeb, are applied to mitigate fungal infections that can devastate crop yields. [12, 13, 14, 5]

Moreover, biopesticides derived from natural organisms or substances are gaining traction among farmers looking to reduce chemical inputs and minimize environmental impact. [15] Together, these fertilizers and pesticides form the backbone of Maharashtra's agricultural inputs, playing a crucial role in boosting productivity and ensuring food security. However, their usage warrants careful management to mitigate the potential adverse effects on ecosystem health. [11, 5]

Benefits of Using Fertilizers for Crop Yield in Maharashtra

In Maharashtra, the strategic use of fertilizers significantly enhances crop yield, proving to be a vital component in the agricultural landscape. Fertilizers supply essential nutrients like nitrogen, phosphorus, and potassium, which are often deficient in the soil due to continuous cropping cycles. These nutrients are crucial for the healthy growth and development of plants, leading to increased photosynthesis and better crop productivity. [5, 16, 11]By correcting nutrient deficiencies, fertilizers ensure that crops have a steady supply of the elements they need to thrive. [5]

The region's diverse agricultural profile, which includes staples like rice, wheat, and pulses, as well as cash crops like sugarcane and cotton, benefits immensely from the application of fertilizers. Enhanced soil fertility through fertilization also enables farmers to adopt more intensive farming practices, allowing for multiple cropping cycles within a year. This leads to higher overall agricultural output, which is particularly important in Maharashtra, where agriculture is the backbone of the rural economy. [17, 18, 19]

Additionally, using fertilizers can lead to more uniform crop growth, which facilitates better management and harvesting. With higher yields, farmers can achieve better financial outcomes, contribute to food security, and meet the demands of both local and national markets. In summary, the judicious use of fertilizers in Maharashtra not only boosts crop yield but also bolsters the agricultural sector, supporting economic stability and growth. [20, 12]

Effectiveness of Pesticides on Crop Protection

Pesticides play a significant role in crop protection and their effectiveness in maintaining agricultural productivity cannot be underestimated. In Maharashtra, the use of pesticides has been widely adopted to combat various pests that threaten key crops like cotton, sugarcane, and pomegranates, among others. The immediate benefit of pesticides lies in their ability to reduce pest populations quickly and efficiently, thereby minimizing crop losses and securing farmer incomes. [21, 22, 23]

They act on different biological pathways, disrupting the life cycles of harmful organisms, and thus, ensuring healthier plants.

Moreover, pesticides are effective in protecting crops from a variety of specific threats, including insects, fungi, and weeds. By safeguarding crops from these adversaries, pesticides contribute to retaining higher yields and better quality produce, which is essential for meeting both local and national food requirements. This is particularly crucial in a high-density agricultural area like Maharashtra, where pest outbreaks can have devastating economic impacts. [5, 12, 24]

However, it is important to consider that while pesticides are effective in the short term, their misuse or overuse can lead to potential negative outcomes. Pesticide resistance among pests is a growing concern, necessitating the need for integrated pest management strategies. Additionally, the non-target effects of pesticides can disrupt beneficial insect populations and lead to ecological imbalances. Thus, while their role in crop protection is undeniable, sustainable practices must be promoted to mitigate any adverse long-term impacts on ecosystem health. [25, 26, 12, 27]

Environmental Impact of Pesticide Use in Maharashtra

The extensive use of pesticides in Maharashtra, an agricultural hub in India, has led to considerable environmental repercussions. Pesticides, designed to protect crops from pests, diseases, and weeds, have far-reaching impacts beyond their intended targets. The chemical runoff from agricultural lands contaminates nearby water bodies, affecting aquatic ecosystems and reducing biodiversity. Pesticides such as organophosphates and carbamates are particularly notorious for their persistence in the environment and their ability to bioaccumulate through the food chain, posing risks to non-target organisms, including beneficial insects, birds, and mammals. [28, 29, 5, 30]

The soil health in Maharashtra has been compromised due to the over-reliance on chemical pesticides. Essential soil microorganisms that contribute to nutrient cycling and soil fertility are adversely affected, leading to a decline in soil biodiversity and an imbalance in soil ecology. This degradation in soil quality also reduces the resilience of crops to future pest infestations, creating a vicious cycle of dependency on chemical inputs. [31, 32, 22]

Furthermore, pesticides can volatilize and drift from their application sites, leading to air pollution and potential health risks for nearby human populations. The exposure to these chemicals has been linked to respiratory issues, skin conditions, and even long-term ailments such as cancer. The ecological harm extends beyond immediate crop fields, causing a cascading effect on the ecosystem's health, ultimately threatening the sustainability of agricultural practices in Maharashtra. [33, 34]

Sustainable Practices and Alternatives For Reducing Pesticide Impact

Sustainable practices and alternatives are essential for reducing the impact of pesticides on crop protection and ecosystem health in Maharashtra. One effective strategy involves the adoption of integrated pest management (IPM) practices, which combine biological, cultural,

mechanical, and chemical methods to control pests. IPM focuses on monitoring pest populations and promoting the use of natural predators, crop rotation, and resistant crop varieties, thereby minimizing reliance on chemical pesticides. [35, 7, 36]

Additionally, organic farming presents a viable alternative, emphasizing the use of natural inputs such as compost, green manure, and biological pest control agents, which enhance soil health and biodiversity. [18]

Moreover, the implementation of precision agriculture technology can significantly reduce pesticide use by allowing farmers to apply precise amounts of chemicals only where needed. This technology utilizes data analytics, GPS, and sensor systems to monitor crop health and pest presence, enabling targeted interventions. Farmers can also adopt agroforestry practices, which integrate trees and shrubs into agricultural landscapes, providing habitat for beneficial organisms that suppress pest populations naturally. [5, 37, 38]

Education and training programs are critical to empowering farmers with the knowledge and skills to implement these sustainable practices effectively. Such programs should focus on the benefits of reducing chemical inputs, the importance of maintaining ecosystem health, and methods for observing and addressing pest issues without resorting to synthetic pesticides. Increasing awareness and accessibility to these alternatives can foster a more sustainable and resilient agricultural system in Maharashtra, ultimately benefiting both crop productivity and environmental health. [39, 40, 41]

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STUDY OF OPTIMIZATION PROBLEMS IN LINEAR ALGEBRA: METHODS, APPLICATIONS AND ALGORITHMS

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Abstract:

Optimization problems play a critical role in numerous fields such as data science, machine learning, operations research, and signal processing. This paper investigates the close relationship between linear algebra and optimization theory, covering key optimization problems like linear programming, quadratic programming, least squares, and eigenvalue optimization. We examine the mathematical foundations that connect optimization to linear algebra, explore algorithms such as gradient descent, interior-point methods, and semidefinite programming, and demonstrate applications in machine learning, control systems, and numerical analysis. Finally, we discuss ongoing challenges and propose directions for future research.

1. Introduction:

Optimization problems are at the core of a wide range of scientific and engineering disciplines. Whether designing an efficient neural network, minimizing the cost in operations research, or solving systems of equations in computational physics, optimization techniques are ubiquitous. Many of these problems can be formulated in terms of matrices and vectors, which lie at the heart of linear algebra.

Optimization problems often involve minimizing (or maximizing) a scalar objective function, subject to certain constraints. Linear algebra provides the tools to represent these problems, manipulate them, and compute solutions efficiently. Linear algebra concepts like eigenvalues, singular value decomposition, matrix factorizations, and vector spaces are frequently used in optimization.

The paper will first cover foundational concepts from linear algebra, then explore classical and modern optimization problems, followed by algorithms and their applications, and finally discuss challenges and future research.

2. Mathematical Preliminaries

This section provides the necessary background in linear algebra to understand the optimization problems that follow.

2.1 Matrices and Vector Spaces

Matrix Operations: Addition, multiplication, and transposition. These operations form the basic building blocks for optimization algorithms.

Vector Spaces: Vectors are central to optimization problems. Operations such as projections, norms, and linear combinations of vectors are fundamental to understanding how solutions are represented in optimization problems.

2.2 Eigenvalues and Eigenvectors

Given a square matrix A, an eigenvalue λ and an eigenvector v satisfy:

$$Av = \lambda v$$

Eigenvalue problems often appear in optimization, particularly in stability analysis and dimensionality reduction problems such as Principal Component Analysis (PCA).

2.3 Singular Value Decomposition (SVD)

The singular value decomposition of a matrix $A \in R^{m\times n}$ is given by:

$$A = \cup \sum V^T$$

Where U and V are orthogonal matrices and Σ is a diagonal matrix with singular values. Singular value decomposition is crucial for solving least squares problems, and it appears in applications like image compression.

2.4 Norms and Inner Products

Norms: The l_2-norm (Euclidean norm) of a vector $x \in R^n$ is given by $\|x\|_2 = \sqrt{x^T x}$. Norms measure the size or length of vectors and are used in objective functions for optimization.

Inner Product: The dot product $x^T y$ is used to measure the alignment of vectors. It plays a role in calculating gradients for optimization.

2.5 Matrix Factorizations

Matrix decompositions like LU, QR and Cholesky are used in numerical methods to solve linear systems and optimization problems. For example:

QR Decomposition: A=QR, where Q is orthogonal and R is upper triangular.

Cholesky Decomposition: For positive definite matrices, $A = LL^T$, where L is lower triangular.

3. Classical Optimization Problems in Linear Algebra

3.1 Linear Programming (LP)

Problem Definition:

Minimize a linear objective function:

Minimize $c^T x$

Subject to linear constraints:

$$Ax \leq b$$

Where $A \in R^{m\times n}, c \in R^n$ and $x \in R^n$. The solution space is a convex polyhedron, and the goal is to find the optimal point within this space.

Methods:

Simplex Algorithm: This algorithm traverses the vertices of the polyhedron to find the optimal vertex.

Interior-Point Methods: These methods solve LP problems by moving through the interior of the feasible region.

Applications:

Supply chain optimization, resource allocation, network flow problems.

3.2 Quadratic Programming (QP)

Problem Definition:

Minimize a quadratic objective function:

$$\text{Minimize}\ \frac{1}{2}x^T Qx + c^T x$$

Subject to all constraints:

$$Ax \leq b$$

Where Q is a symmetric positive definite matrix.

Methods:

Active Set Methods: Solve QP by iteratively guessing which constraints are active.

Interior-Point Methods: Efficiently solve QP by leveraging linear algebra techniques.

Applications:

Portfolio optimization, machine learning (support vector machines), control systems.

3.3 Least Squares Problems

Problem Definition:

Given a matrix A and a vector b, solve:

$$minimize\ \|Ax - b\|_2^2$$

This is equivalent to solving the normal equations:

$$A^T Ax = A^T b$$

Methods:

Direct Methods: Using matrix factorizations (QR, SVD).

Iterative Methods: Conjugate gradient method for large sparse problems.

Applications:

Regression analysis, curve fitting, signal processing.

3.4 Eigenvalue Optimization

Problem Definition:

Maximize or minimize a function involving the eigenvalues of a matrix, for example:

$$\lambda_{max}(A)$$

Methods:

Rayleigh Quotient: For symmetric matrices, the maximum eigenvalue can be found by maximizing the Rayleigh quotient:

$$\frac{x^T Ax}{x^T x}$$

Power Iteration and Lanczos Algorithm: Efficient methods to approximate the largest eigenvalue.

Applications:

Stability analysis, vibration analysis, structural mechanics.

4. Convex Optimization and Linear Algebra

4.1 Convex Sets and Functions

A function f(x) is convex if for all $x_1, x_2 \in dom(f)\ and\ \theta \in [0,1]$:

$$f(\theta x_1 + (1-\theta)x_2) \leq \theta f(x_1) + (1-\theta)f(x_2)$$

Convexity ensures that local minima are global minima.

4.2 Semidefinite Programming (SDP)

Problem Definition:

Minimize a linear objective function over the cone of positive semidefinite matrices:

Minimize $c^T x$

Subject to:

$$F_0 + \sum_{i=1}^{n} x_i F_i \geq 0$$

Where F_i are symmetric matrices.

Applications:

Control theory, combinatorial optimization and quantum mechanics.

5. Modern Algorithms in Optimization Problems

5.1 Gradient Descent

Algorithm:

An iterative method to minimize a function $f(x)$:

$$x_{k+1} = x_k - \alpha_k \nabla \mathrm{f}(x_k)$$

where α_k is the step size. Variants include stochastic gradient descent (SGD) and momentum-based methods.

Applications:

Deep learning, neural network training.

5.2 Interior-Point Methods

Interior-point methods solve optimization problems by iterating within the feasible region. Linear algebra techniques like solving KKT systems (Karush-Kuhn-Tucker conditions) are involved in each iteration.

5.3 Conjugate Gradient Method

This method is used to solve large, sparse systems of linear equations that arise in optimization problems. It works by generating conjugate directions along which minimization occurs.

Applications:

Numerical optimization, solving the normal equations in least squares problems.

5.4 Semidefinite Programming (SDP)

Semidefinite programs are solved using interior-point methods, where linear algebra (e.g., matrix factorizations) plays a key role in maintaining feasibility.

6. Applications of Optimization in Linear Algebra

6.1 Machine Learning

Principal Component Analysis (PCA): Dimensionality reduction using SVD.

Support Vector Machines (SVM): Solving convex quadratic programming problems for classification tasks.

6.2 Signal Processing

Least Squares Estimation: Filtering and denoising signals using linear algebra.

SVD in Image Compression: Reducing dimensionality for image storage and transmission.

6.3 Control Systems

Linear Quadratic Regulator (LQR): Optimizing state-space systems.

Kalman Filtering: Recursive optimization for state estimation.

7. Challenges and Open Problems

7.1 Scalability

Solving large-scale optimization problems efficiently, especially when matrices are sparse and large, remains an ongoing challenge.

7.2 Numerical Stability

Ill-conditioned matrices can cause numerical instability in optimization algorithms, requiring more robust methods.

7.3 Non-Convex Optimization

Many real-world problems are non-convex, making global optimization challenging. Recent developments in deep learning address this issue.

7.4 Quantum Computing

Quantum algorithms for solving linear algebra problems (e.g., HHL algorithm) could revolutionize optimization, enabling faster solutions to large-scale problems.

Conclusion:

The paper reviewed the intersection of linear algebra and optimization, covering classical problems, modern algorithms, and real-world applications. As optimization techniques evolve, linear algebra will continue to play a crucial role in both theoretical advancements and practical applications.

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THE INDIAN CONTRIBUTION TO THE NUMBER SYSTEM: A HISTORICAL PERSPECTIVE

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Introduction:

The development of the number system is a cornerstone of human civilization. It has been instrumental in advancements in mathematics, science, technology, and commerce. While the exact origins of numbers are shrouded in antiquity, the Indian subcontinent has played a pivotal role in shaping the modern number system. This paper explores the significant contributions of Indian mathematicians to the development of the decimal system, the concept of zero, and the numeral system. A Deeper Dive into the Indian Contribution to the Number System

The evolution of the number system is a fascinating journey that has shaped the course of human civilization. While the exact origins of numbers remain shrouded in antiquity, the Indian subcontinent has undeniably played a pivotal role in its development. This paper delves into the intricate tapestry of Indian contributions to the number system, exploring the Vedic roots, the revolutionary concept of zero, and the elegant Hindu-Arabic numeral system. By examining these key developments, we can appreciate the profound impact of Indian mathematicians on the foundation of modern mathematics.

The Vedic Civilization and the Decimal System

The Vedic civilization, which flourished in the Indian subcontinent around 1500 BCE, provides the earliest evidence of a sophisticated mathematical system. The Vedas, a collection of sacred texts, contain references to numerical concepts and mathematical operations. One of the most notable contributions of the Vedic period is the development of the decimal system. This system, based on the number ten, is the foundation of modern mathematics and is used worldwide.

The decimal system is characterized by its use of ten digits (0-9) and its place-value system, where the value of a digit depends on its position within a number. This system is more efficient and flexible than earlier systems, such as the Babylonian base-60 system and the Egyptian hieroglyphic system. The Vedic texts, including the Rig Veda, Yajur Veda, and Atharva Veda, contain numerous references to decimal counting and mathematical operations.

The Concept of Zero: An Indian Innovation

One of the most significant contributions of Indian mathematicians to the number system is the concept of zero. While the Babylonians had a placeholder symbol for zero, it was the Indian mathematicians who first developed the concept of zero as a number in its own right. The concept of zero was crucial for the development of the decimal system and for the advancement of mathematics.

The earliest known use of zero as a number appears in the Bakhshali Manuscript, a mathematical text dating back to the 7th or 8th century CE. This manuscript uses a dot to represent zero, and it demonstrates a clear understanding of the concept of zero as a number. The Indian mathematician Brahmagupta, who lived in the 7th century CE, also made significant contributions to the theory of zero. He defined zero as the result of subtracting a number from itself and developed rules for arithmetic operations involving zero.

The Indian Numeral System

In addition to the decimal system and the concept of zero, Indian mathematicians also developed a unique numeral system. This system, known as the Hindu-Arabic numeral system, is the basis of the modern number system used throughout the world. The Hindu-Arabic numerals are distinct from earlier systems, such as Roman numerals, in their simplicity and efficiency.

The Hindu-Arabic numerals are believed to have originated in India around the 3rd century CE. They were later transmitted to the Arab world and eventually to Europe, where they became widely adopted. The Hindu-Arabic numeral system is characterized by its use of ten digits (0-9) and its place-value system. This system is more efficient and flexible than earlier systems, and it has been instrumental in the development of mathematics and science.

Conclusion:

The Indian subcontinent has played a crucial role in the development of the number system. The contributions of Indian mathematicians to the decimal system, the concept of zero, and the Hindu-Arabic numeral system have had a profound impact on the course of human history. These innovations have enabled advancements in mathematics, science, technology, and commerce, and they continue to shape our world today.

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MEMRISTOR TECHNOLOGY: BRIDGING THE GAP IN MEMORY AND PROCESSING

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Abstract:

The growing need for high-performance computing and data-intensive applications exposes the limitations of traditional memory and processing architectures like the von Neumann architecture, which suffer from limitations due to the separation of memory and processing units. Memristor technology, with its unique capability to retain the history of electrical states, presents a promising solution by offering non-volatile memory combined with in-memory processing capabilities. This paper examines the fundamental principles of memristors, their advantages over conventional memory technologies, and their potential applications. Despite their promising features, memristors face challenges including material stability, CMOS integration, and standardization. This paper also highlights future research directions and potential advancements in memristor technology. By bridging the gap between memory and processing, memristors have the potential to transform computing systems, driving advancements in artificial intelligence, the Internet of Things (IoT), and beyond.

Keywords: Memristor, Memory, Processing

1. Introduction:

The continuous evolution of high-performance computing and the surge in data-intensive applications have put unprecedented demands on existing memory and processing architectures. Traditional systems, such as those based on the von Neumann architecture, has limitations due to the physical and functional separation of memory and processing units. This separation leads to inefficiencies in data transfer, higher latency, and increased energy consumption, which are significant impediments in meeting the performance needs of modern computing tasks.

Memristor technology emerges as a promising solution to these challenges. Memristors, or memory resistors, are unique electronic devices capable of retaining a memory of past electrical states without the need for continuous power. This property enables them to function as both memory storage and processing units, potentially revolutionizing the way data is handled within computing systems. Unlike traditional memory technologies, memristors offer non-volatile memory with high-speed read/write capabilities, scalability, energy efficiency, and robust endurance, making them ideal candidates for next-generation computing architectures.

2. Fundamentals of Memristor Technology

2.1 Definition and Working Principle

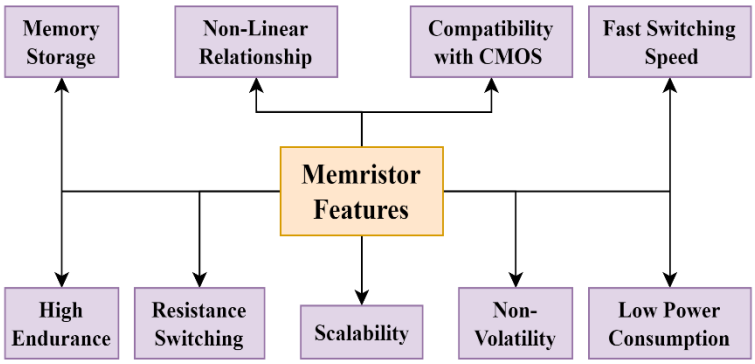
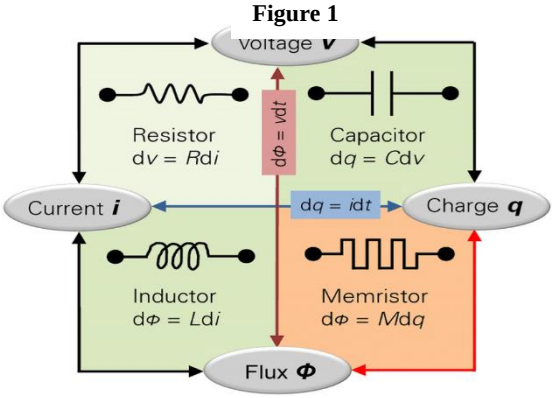


Figure 1

A memristor, short for "memory resistor," is a fundamental passive circuit element that maintains a relationship between the time integral of current (charge) and the time integral of voltage (flux linkage). The figure 1 is representation of the fundamental relationships between the basic passive circuit elements—resistor, capacitor, inductor, and memristor—and their associated electrical variables (voltage, current, charge, and magnetic flux). This device is unique because its resistance, or memristance, changes based on the history of voltage and current that has passed through it, allowing it to retain a memory of past electrical states. When the current flows through a memristor in one direction, its resistance increases, and when the current flows in the opposite direction, its resistance decreases. This non-volatile characteristic makes memristors capable of retaining information even when the power is turned off.



2.2 Memristor: Development and Features

The concept of memristors (memory resistors) dates back to 1971 when Leon Chua, a University of California, Berkeley engineer, predicted their existence in a seminal paper titled "Memristor—The Missing Circuit Element." Chua theorized a two-terminal device that could retain memory of past electrical activity, exhibiting hysteretic current-voltage characteristics. However, it wasn't until 2008 that a practical memristor was fabricated by Stanley Williams' team at Hewlett-Packard (HP) Labs using titanium dioxide thin films. This breakthrough sparked widespread research, and subsequent advancements led to various memristor types, including spin-based, phase-change, and graphene-based devices. In the 2010s, memristor-based neuromorphic computing, analog computing, and non-volatile memory applications gained traction, with companies like HP, Intel, and IBM actively developing memristor technologies. Today, memristors are being explored for artificial intelligence, machine learning, and edge computing applications, paving the way for next-generation computing architectures.

This figure 2 highlights the key features of memristors, showcasing their unique capabilities and advantages. Memristors offer memory storage through their ability to retain resistance states, demonstrating a non-linear relationship between voltage and current. They are compatible with CMOS technology, making integration with existing systems straightforward.

Memristors are characterized by fast switching speeds, enabling quick data processing, and they exhibit high endurance, enduring many read/write cycles. Their resistance switching capability allows for dynamic changes in resistance, contributing to their scalability and potential for high-density memory applications. Memristors are non-volatile, maintaining their state without power, and consume low power, making them energy-efficient. These features collectively make memristors a versatile and promising component for advanced memory and computing technologies

3. Advantages of Memristor Technology

3.1 Non-Volatility and Data Retention

Memristors are inherently non-volatile, meaning they retain stored information even when the power is turned off. This characteristic is a significant advantage over traditional volatile memory technologies like DRAM and SRAM, which require continuous power to maintain data. Memristors' non-volatility makes them ideal for applications that need persistent storage without a constant power supply, such as in mobile devices, IoT sensors, and various low-power applications. Their ability to remember the last resistance state they were in allows for rapid resume and boot times, enhancing the overall performance and user experience in electronic devices.

3.2 High-Speed Read/Write Operations

One of the most notable advantages of memristors is their high-speed read and write capabilities. Memristors can achieve read/write speeds that rival or exceed those of traditional DRAM and SRAM, making them suitable for applications requiring fast data access and processing. This high-speed operation is crucial for real-time computing applications, such as artificial intelligence, machine learning, and edge computing, where quick data processing is essential. The ability to perform high-speed operations without the latency associated with data transfer between separate memory and processing units further enhances their efficiency.

3.3 Scalability and High-Density Integration

Memristors are highly scalable and can be fabricated at nanometre scales, allowing for high-density integration. This scalability makes it possible to pack more memory cells into a smaller area, significantly increasing storage capacity compared to traditional memory technologies. The potential for high-density integration is particularly beneficial in applications where space is limited, such as in wearable technology, implantable medical devices, and compact consumer electronics. Additionally, the small size of memristors supports the development of advanced computing architectures, such as three-dimensional (3D) stacked memory and processing units, which can further enhance performance and efficiency.

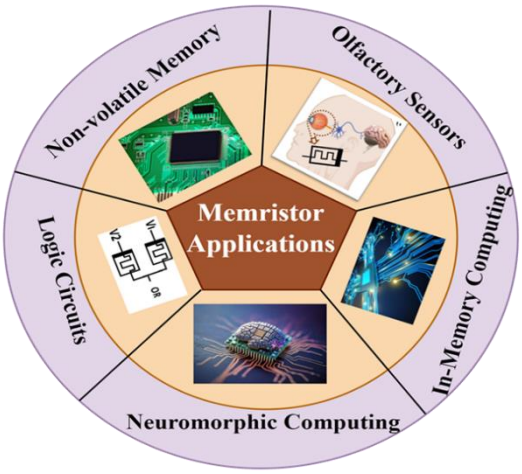
3.4 Energy Efficiency and Low Power Consumption

Memristors are known for their low power consumption, both during operation and in standby mode. This energy efficiency stems from their non-volatile nature, which eliminates the need for constant power to maintain data, and their ability to switch states with minimal energy input. The low power consumption of memristors is particularly advantageous for battery-

operated devices, such as smartphones, laptops, and IoT devices, where extending battery life is a critical concern. Furthermore, energy-efficient memory solutions contribute to reducing the overall power consumption of data centers and large-scale computing infrastructures, aligning with global efforts to minimize the environmental impact of technology.

3.5 Endurance and Reliability

Memristors exhibit high endurance and reliability, capable of withstanding a large number of read/write cycles without significant degradation. This durability contrasts with traditional flash memory, which has limited write endurance and can wear out over time. The robust endurance of memristors makes them suitable for applications that require frequent data writing and rewriting, such as in real-time data logging, continuous monitoring systems, and dynamic data storage solutions. Additionally, the reliability of memristors ensures long-term data integrity, reducing the likelihood of data loss and increasing the lifespan of electronic devices.



By offering non-volatility, high-speed operations, scalability, energy efficiency, and robust endurance, memristor technology addresses many of the limitations of traditional memory technologies. These advantages make memristors a promising candidate for next-generation computing systems, poised to revolutionize the way data is stored, accessed, and processed.

4. Memristor-Based Memory Applications

The figure 3 highlights the wide-ranging applications of memristors, underscoring their potential to revolutionize multiple fields of technology. One of the primary applications is in non-volatile memory, where memristors provide efficient and persistent data storage. Unlike traditional volatile memory that loses data when power is turned off, memristors retain their state, making them ideal for applications requiring reliable data retention without continuous power. This feature makes memristors a promising component for future generations of memory storage devices, including resistive random-access memory (ReRAM) and other advanced memory technologies.

Memristors also play a crucial role in in-memory computing, where they enable computations to be performed directly within the memory. This approach contrasts with traditional computing architectures that separate memory and processing units, leading to latency and energy inefficiencies. By integrating processing capabilities within the memory, memristors significantly enhance data processing speeds and reduce energy consumption, making them suitable for high-performance computing applications. Additionally, their use in logic circuits allows for the development of compact and efficient logic gates, which can be utilized in various digital systems, including microprocessors and digital signal processors.

In the realm of neuromorphic computing, memristors are particularly valuable for their ability to mimic the behaviour of biological synapses. This capability enables the creation of artificial neural networks that closely replicate the human brain's structure and function, paving the way for significant advancements in artificial intelligence and machine learning. Furthermore, memristors are used in olfactory sensors, where they emulate the human sense of smell, providing advanced sensing capabilities for applications in healthcare, environmental monitoring, and security. These diverse applications illustrate the transformative potential of memristor technology in various domains, promising significant improvements in efficiency, performance, and functionality across a wide range of electronic and computing systems.

Conclusion:

Memristor technology stands as a transformative innovation in the realm of electronics, adeptly bridging the gap between memory and processing to enhance device performance and efficiency. With attributes such as non-volatility, rapid switching speeds, low power consumption, and scalability, memristors are well-positioned to revolutionize memory storage and computing applications. Looking ahead, the integration of memristors in neuromorphic computing could lead to significant advancements in artificial intelligence by enabling systems that emulate the human brain’s structure and functionality. Additionally, their role in in-memory computing promises to eliminate traditional data transfer bottlenecks, vastly improving computational speed and efficiency. As research progresses, the versatile applications of memristors are likely to expand into areas such as olfactory sensors, flexible electronics, and reconfigurable circuits, heralding a new era of high-performance, energy-efficient electronic systems and unlocking unprecedented potential for future technological innovations.

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OBSERVATIONAL DIFFERENTIATION OF POMEGRANATE BACTERIAL BLIGHT PATHOGEN *XANTHOMONAS AXONOPODIS* PV *PUNICAE* (XAP) FROM ITS RELATED MEMBER BY PIGMENT PRODUCTION

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Abstract:

Pomegranate is an important horticultural fruit crop. It has occupied a significant portion of Indian and international fruit trade. However, pomegranate yield is adversely affected by a variety of plant pathogens. One of them is *Xanthomonas axonopodis* PV *punicae* (Xap). This pathogen has decreased the yield of pomegranate considerably, sometimes upto 90% or more. Various control measures have been tried for the control of the disease. Generally, the first step is the isolation of the causative agent Xap. In current research work, the bacterial blight pathogens were isolated. 24 different isolates were obtained on the basis of colony morphology. Specifically, circular, mucoid, high convex, cream yellow coloured colonies were selected. In Gram staining, all these cultures were found to be Gram negative and actively motile. When these isolates were streaked on Nutrient Glucose Agar (NGA) plates, then some isolates produced yellow colonies while some produced dark brown coloured pigment. This pigment was typically the fuscan pigment produced by members of genus *Xanthomonas*. The other organism *Pantoea agglomerans* is morphologically similar to *Xanthomonas* but does not produce fuscan pigment. The fuscan pigment producing strains were further studied for their physiological and biochemical characters. They were confirmed as pomegranate bacterial blight pathogen after such study. Thus, fuscan pigment production can be used as a tool for differentiation of *Xap* and *P. agglomerans.*

Keywords: Pomegranate, Xap, *Pantoea agglomerans,* Fuscan Pigment

Introduction:

Pomegranate (*Punica granatum L*), belonging to family Lythraceae, is an ancient favourite fruit of tropical and subtropical countries of the world[1]. It is one of the important commercial fruit crops of an Indian farmer. It is called as ‘fruit of paradise’. In India, it is mainly cultivated in Maharashtra, Karnataka & Andhra Pradesh[2]. In Maharashtra, it is cultivated in Solapur, Beed, Jalana, Sangli, Nashik, Ahmednagar, Pune, Dhule, Aurangabad, Satara, Osmanabad, Wardha & Latur districts. Thus, pomegranate has occupied export market worldwide.

However, pomegranate is suffering from various phytopathogens. One of them is *Xanthomonas axonopodis* PV. *Punicae.* It produces a disease commonly known as bacterial

blight of pomegranate. The pathogen affects leaves, twigs, stem, buds, flowers & fruits [3]. However, the disease is more destructive when fruits are affected. On the plant parts, the pathogen produces small spots or lesions. The spots are initially small and round. They are surrounded by bacterial ooze. Under favourable conditions, the spots enlarge and get converted into dark brown water filled lesions with indefinite margins & then appear as oily spots. (Hence the disease is commonly known as Telya disease). It results into cracking of fruit, defoliation & sometimes drying & death of plants[4]. It was a disease of minor economic importance till 1998. But the incidences of the disease were ever increasing. Bacterial blight has caused considerable economic losses to the pomegranate farmers. It may cause up to 90 % reduction in yield[5]. The disease is reported to cause 30-50 per cent losses on an average. However, under favourable environmental conditions, 80 to 90 % losses are reported[6].

Various measures are taken to control the disease. Whichever is the method of control, the first step is isolation of pathogen from infected pomegranate plant parts[7]. We have isolated bacterial blight pathogen from infected pomegranate leaves. The pathogen produces yellow, mucoid colonies on Nutrient glucose agar. However, the final confirmation was done by study of pigment production[8].

Materials and Methods:

The bacterial blight pathogen was initially isolated from infected pomegranate leaves. Infected tissues from diseased leaves and fruits were cut by using sterile surgical blade. The cut pieces were suspended in 0.1 % mercuric chloride solution for 30 seconds for surface sterilization. Then they were washed with sterile distilled water for 10-20 seconds to remove the traces of mercuric chloride[9]. These pieces were then transferred to sterile petri plate containing 1 ml of sterile distilled water and gently crushed with sterile surgical blade. Due to crushing, oozing of bacterial cells occurred and the water became slightly turbid. This suspension was streaked aseptically on the surface of sterile nutrient glucose agar plate. The steaked plates were then incubated at 28±2^{o}C for 48 to 72 hours and observed for development of bacterial colonies. After incubation, typical yellow brown, large, moist and elevated colonies were produced. The pathogen was confirmed by morphological characters. In morphological study, Gram staining and motility were studied. The organisms were found to be gram negative short rods arranged singly. They were actively motile. Then, cultural characters were determined. In cultural characters, colony characters and fuscan pigment production ability were studied. The organisms produced mucoid, yellow brown, dome shaped, high convex colonies.

The organism also produced brown coloured fuscan pigment. To study this ability, the organism was streaked on the surface of nutrient glucose agar plate. The plates were incubated at 30^{0}C for 72 hrs. After incubation, the plates were observed for pigment production. Fuscan pigment production is the characteristic feature of *Xanthomonas* species.

Result and Discussion:

The organism *Xanthomonas axonopodis* PV *punicae* produces yellow mucoid colonies on nutrient glucose agar plates. The organism is gram negative short rod and motile. Its close

associate *Pantoea agglomerans* also produces the same morphological and cultural characters. Hence, many times it is confused with the bacterial blight pathogen. One differentiating character between these two organisms is the fuscan pigment production[10]. Xanthomonas axonopodis PV punicae produces brown coloured fuscan pigment while its close associate Pantoea agglomerans does not produce the fuscan pigment. Thus, pigment production is used as a differentiating character for pomegranate bacterial blight pathogen.

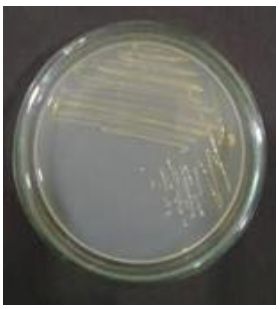

Fig. 1: Xanthomonas axonopodis growth

Fig. 2: Pantoea agglomerans

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A STUDY OF BUTTERFLIES AND MOTH DIVERSITY IN GIB COLLEGE CAMPUS, NIPANI, BELGAUM DISTRICT, KARNATAKA, INDIA

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Abstract:

The present study was carried out to understand the diversity and abundance of butterflies and moths in G.I. Bagewadi, Arts, Science and Commerce College Campus, Nipani, Karnataka, India from June 2024 to September 2024. A total of 16 species of butterflies and moths belonging to16 genera and 5 families were recorded from the present study. From the observed butterflies, family Nymphalidae was the most dominant among the five families with 6 species, followed by Nymphalidae, Papilionidae with 2 species, Lycaenidae have 3 species, Pieridae have 3, Gometridae with 1moth species and crambidae with 1 moth species. The present study added valuable information on diversity of butterflies' fauna and will contribute in developing effective conservation.

Keywords: Butterflies, Moths, Identification, Family, Species.

1. Introduction

Butterflies and moths, belonging to the order Lepidoptera are robust flying insects that are marked by flexible head, slender abdomen, distinct venations, large compound eyes and attractive body coloration. They are regarded as to maintain a good ecosystem and thus diversity and distribution of butterflies and moths in an area shows the state of ecosystem of that area. About 17500 species of butterflies and moth species of about 1,60,000 were described all over the world. The various studies undertaken from June 2024 to September 2024 and total of 14 species of butterflies and 2 moths belongs to 16 genera and 5 families were recorded from the present study at GIBCN campus, Karnataka.

2. Materials and Methods

a) Description of Study site: GIBCN campus is situated in the Belagavi district of Karnataka.

b) Methodology:

Photography and Identification

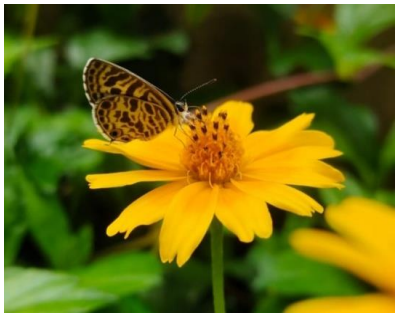
The sampling was carried out using digital camera. The butterflies and moths were observed in sampling sites around the middle of the day when their activity was at its peak. Field sampling was done during June 2024 to September 2024. In case of non-identification of a species, the butterfly and moths was captured with the help of butterfly net.

3. Results and Discussions:

In the present study 14 species of butterflies and 2 moth species were recorded from GIBCN, campus. It has been found that 16 species of butterfly and moths belonging to 16 genera

and 5 families. Family Nymphalidae was the most dominant among the 5 families with 6 species followed by Nymphalidae, Papilionidae with 2 species, Lycaenidae have 3 species, Pieridae have 3 species, Geometridae with 1 moth species and Crambidae with 1 moth species.

Graphium agamemnon



Tarucus ananda

Euthelia aconthea

Junonia lemonias

Papilio memnon

Colitis danae

Hypolimnas bolina

Euploea klugii

Acytolepis puspa

Danaus genutia

Pieris rapae

Eurema hecabe

Ypthima tabella

Zizina otis

Chiasmia emersaria

Spoladea recurvalis

1) *Graphium agamemnon*, it belongs to the family Papilionidae, the tailed jay, is a predominantly green and black tropical butterfly. The butterfly is also called the green-spotted triangle, tailed green jay, or green triangle. Tailed jay is now very common at low elevations and regularly seen in gardens and urban areas due to its food plant. They are very active butterflies and flutter their wings constantly even when at flowers.
2) *Tarucus ananda*, it belongs to the family Lycaenidae, is the dark Pierrot is a small butterfly found in India. Upperside dark spots. Forewings and hind wings are having terminal margins edged with fuscous brownish black and an antennae ciliary jet-black line cilia brown, tail black tipped with white color. Underside more or less dingy white color.
3) *Euthelia aconthea*, it blongs to the family Nymphalidae, is commonly called common baron is a medium sized. These flies with an often glides and stiff wing beats. These found in human habitats, evergreen and moist deciduous forests. These have great camouflage.
4) *Junonia lemonias*, it belongs to the family Nymphalidae, the lemon pansy is a common nymphalid butterfly. It is found in gardens, fallow land, and open wooded areas. It is brown with numerous eyespots as well as black and lemon-yellow spots and lines on the upperside of the wings. The underside is a dull brown, with a number of wavy lines and spots in varying shades of brown and black. There is also an eyespot on the lower side of the forewing.
5) The great Mormon butterfly (*Papilio memnon*) it belongs to the family Papilionidae, is a large, colorful butterfly native to Southeast Asia. Size of about the wingspan of 4.7 to 5.5 inches. Female great Mormon butterflies have mimetic and non-mimetic forms, while

males are non-mimetic. Mimetic females have yellow abdomens and color patterns and tails on their hindwings. The great Mormon butterfly is considered a mystical symbol of beauty, nature, perfection, and freedom.

6) *Colitis danae,* it belongs to the family Pieridae, upper side white, base of wings generally irrorated, but to a varying extent, with black scales. This irroration in many specimens is entirely wanting. Forewing with or without a minute black spot on the disco cellulars; apex broadly carmine, edged internally and externally with black, this black border varies in width, but both inner and outer borders meet on the Costa and on the termen, on the latter they unite and sometimes extend as a black line to the tornus.
7) *Hypolimnas bolina,* it belongs to the family Nymphalidae, Jacintha Eggfly is a subspecies of the Great Eggfly, and shares the same species name of bolina under the binomial naming system. It is, however, interesting to note that the subspecies jacintha is the more commonly bred butterfly in commercial Butterfly Parks in the region. Both share the same local host plant - Common Asystasia (*Asystasia gangetica*), which is an abundant weed which sprouts up wherever there is a patch of untended green. The males of Jacintha Egg fly appear very similar to the Great Egg fly on the upper sides, featuring four blue-edged white patches on the fore and hind wings.
8) *Euploea klugii,* it belongs to the family Nymphalidae, The shape of the forewing in the male type varies in different specimens; especially in the divergence of the border of the termen and dorsum. In the male type the forewing is greater in length than in width, with the dorsal margin less convex and the termen oblique and slightly convex. Such differences are less noticeable in female types.
9) *Acytolepis puspa,* it belongs to the family Lycaenidae, the common hedge blue, is a small butterfly. Underside slightly bluish white; the markings, some black, some dusky, but all large and distinct. Forewing is a short bar on the discocellulars, an anteriorly inwardly curved, transverse, discal series of seven, more or less elongate spots. Antennae, head, thorax and abdomen dusky black, the antennae ringed with white.
10) *Danaus genutia,* it belongs to the family Nymphalidae, is the common tiger, is one of the common butterflies of India. It belongs to the "crows and tigers", that is, the Danainae group of the brush-footed butterflies family. The butterfly is also called striped tiger in India to differentiate it from the equally common plain tiger, *Danaus chrysippus.*
11) *Pieris rapae,* it belongs to the family Pieridae, is a small- to medium-sized butterfly species of the whites-and-yellows family Pieridae. It is known in Europe as the small white, in North America as the cabbage white or cabbage butterfly, on several continents as the small cabbage white, and in New Zealand as the white butterfly. The butterfly is recognizable by its white color with small black dots on its wings.
12) *Eurema hecabe,* it belongs to the family Pieridae, the common grass yellow, is a small pierid butterfly species found in Asia, Africa and Australia. They are found flying

close to the ground and are found in open grass and scrub habitats. It is simply known as "the grass yellow" in parts of its range; the general term otherwise refers to the entire genus *Eurema*.

13) *Ypthima tabella,* it blongs to the family Nymphalidae, is a butterfly species in the Satyrinae family, also known as the Sahyadri Baby Five-ring. Marshall and De Niceville described this butterfly in 1883. Some experts consider it a subspecies of *Ypthima philomela*, also known as the baby five ring or baby four ring.

14) *Zizina otis*, it belongs to the family Lycaenidae. Forewing is short, transverse, dusky lunule on the discocellulars and a transverse, anteriorly curved, discal series of seven minute black spots, all the spots more or less rounded, the posterior two geminate (paired), the discocellular lunule and each discal spot conspicuously encircled with white. Hindwing: is transverse, curved, sub-basal series of four spots and an irregular transverse discal series of nine small spots black, each spot encircled narrowly with white.

15) *Chiasmia emersaria,* it belongs to the family Geometridae, is a moth of the family Geometridae. The species is found in India, Nepal, northern Thailand, China, Sri Lanka, Japan and the Ryukyu Islands. The wingspan is about 32 mm in the male and 40 mm in the female. Outer margin of forewing prominently angled at vein 4. Hind tibia of male dilated. Body grey irrorated (sprinkled) with pale and dark brown. Abdomen with dark spots on dorsum. Forewings with sub basal dark speck. Indistinct oblique antemedial, medial, and post medial lines angled below costa and arising from short bands on costa.

16) *Spoladea recurvalis*, it belongs to the family Crambidae, the beet webworm moth or Hawaiian beet webworm moth, is a species of moth of the family Crambidae. It is found worldwide, but mainly in the tropics. The wingspan is 22–24 mm. The moth flies from May to September depending on the location. The larvae feed on spinach, beet, cotton, maize and soybean. When fully grown, they are about 19 mm long.

Conclusion:

Total species in India 1379 species of butterflies. Karnataka state have 319 species. A total of 16 species of butterflies and moths belonging to16 genera and 5 families were recorded from the present study. From the observed butterflies, family Nymphalidae was the most dominant among the five families with 6 species followed by Nymphalidae, Papilionidae with 2 species, Lycaenidae have 3 species, Pieridae have 3, Gometridae with 1moth species and Crambidae with 1 moth species. The present study added valuable information on diversity of butterfly's fauna and will contribute in developing effective conservation.

Acknowledgement:

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BOMBAY SHIELD-TAILED SNAKE (*UROPELTIS MACROLEPIS MACROLEPIS*) FEEDING ON GIANT EARTHWORM AT RADHANAGARI WILDLIFE SANCTUARY, KOLHAPUR, MAHARASHTRA

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Abstract:

Uropeltis macrolepis macrolepis, commonly known as the Bombay shield snake, belongs to the family Uropeltidae. This snake is characterized by its burrowing nature and is endemic to peninsular India and Sri Lanka. The Bombay shield snake primarily feeds on earthworms, caecilians and its burrowing habit makes it well-adapted to hunting these soft-bodied invertebrates. During our observation in the Radhanagari Wildlife Sanctuary, we noted that the Bombay shield snake was preying on giant earthworms that were larger than its own body length. Additionally, the snake took a considerable amount of time to consume the earthworm. This unique feeding behavior of the Bombay shield snake was documented in the field. This finding contributes valuable information to the understanding of predator-prey dynamics in the study region.

Keywords: Bombay Shield Snake (*macrolepis macrolepis*), Feeding Behaviour, Gaint Earthworm, Radhanagari Wildlife Sanctuary.

Introduction:

Snakes are an essential component of the ecosystem's food chains, acting as foragers and predators for a wide range of vertebrate and invertebrate species (Cundal and Greene 2000; Trauth and McAllister 1995). Snakes are bio-monitoring species because they control insect populations and have a predator-prey relationship (Koirala *et al.,* 2016; Bohm *et al.,* 2017). Snakes have morphological variations and an adaptive mode of life that allow them to live in a variety of habitats including aquatic, terrestrial, and arboreal environments (Nande and Deshmukh 2007). In India, a total of 279 snake species have been recorded (Janani *et al.*, 2016), accounting for about 10% of the world snake population, with 80% of them being non-venomous (Kale *et al.,* 2019).

The shield-tailed snake is a non-poisonous, burrowing, and carnivorous snake. This snake is endemic to the Western Ghats of India and Sri Lanka (Bossuyt *et al.,* 2004). Shield-tailed snakes are members of the Uropeltidae family, which includes 25 species comprising seven

genera. Out of them, genus Uropeltis is widely distributed in the Indian subcontinent (Pyron *et al.*, 2016; Jins *et al.*, 2018; Ganesh andAchyuthan 2020).

Methodology:

During a field survey in Radhanagari Wildlife Sanctuary on October 5, 2022, we observed a Bombay shield snake preying on a giant earthworm. The shield-tailed snake identified was *Uropeltis macrolepis macrolepis* (Peters, 1862), using the field guide by Khaire (2015). This predatory behavior was noted at 10:07 AM near Kalamwadi Dam (16°22'13.4"N 74°00'06.8"E) within Radhanagari Wildlife Sanctuary (Fig. 1A). Photographs of this direct evidence were taken with a Canon PowerShot SX50 camera.

Result and Discussion:

Radhanagari Wildlife Sanctuary is a tropical evergreen reserve forest in the Sahyadri ranges. Radhanagari Wildlife Sanctuary is well-known for its dynamic and diverse habitats, which exhibit high endemism of wild fauna. At 1007 h on 5 October 2022, we noted a shield-tailed snake feeding on an earthworm species near Kalamwadi Dam (Fig. 1 A). The Shield-tailed Snake is belongs to the Uropeltidae family and it is commonly known as the Bombay Shield-tailed or Bombay Earth Snake. *Uropeltis macrolepis macrolepis* is categorized under Least Concern (LC) by the IUCN (IUCN 2013). Kumbhar *et al.*, (2018) has reported four specimens of *Uropeltis macrolepis macrolepis*from the Western Ghats at Amba Forest.

Uropeltis macrolepis macrolepis has a black or bluish black body with yellow stripes on each side and ventral side. (Fig.1 B). *Uropeltis macrolepis macrolepis* had caught an unidentified species of giant earthworm (22–24 cm long). The Shield-tailed Snake formed a circle around a small stone to gain additional muscular assistance in engulfing the earthworm. According to Rajendra (1985) and Pyron *et al.*, (2016), the *Uropeltis macrolepis macrolepis* snake actively feeds on insects, caecilians, earthworms, and other invertebrate species.*Uropeltis macrolepis macrolepis* primarily feeds on small creatures such as insects, worms, and invertebrates, but we have noted that, the Shield-tailed Snake was preying on a large-sized worm. From 1007 h to 1103 h, or about 56 minutes, the snake had been engulfing the earthworm even though only one-third of the body region was engulfed.

Fig. 1 A: Shield-tailed Snake caught giant earthworm at 1007h

Fig. 1 B: Shield-tailed Snake preying on giant earthworm at 1103h

Conclusion:

Studying the feeding behavior of shield-tailed snakes enhances our understanding of their ecological roles and interactions within their habitats, focusing on predator-prey relationships. Additionally, this study can inform conservation efforts by identifying key prey species and habitat requirements essential for the survival of these unique reptiles.

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STUDIES ON PREVALENCE OF GASTROINTESTINAL PARASITES TRICHURIS OVIS IN GOATS FROM RAHURI TAHSIL

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Abstract:

The present paper deals with the Prevalence of nematode parasites *Trichuris ovis* collected from the intestine of goats. The high prevalence of *Trichuris ovis sp*. are recorded in the month of March 2023 to February 2024. The high incidence of infection of this *Trichuris ovis sp.* was recorded in winter season (54.54 %) followed by summer season (51.42 %) whereas infection was low in monsoon season (48.83 %). The results of this research clearly indicate that environmental variables and feeding habitats have a direct or indirect impact on the seasonality of parasite infection.

Keywords: Prevalence, Trichuris Ovis, Goats, Rahuri

Introduction:

In India, small ruminants are essential to agriculture and have an important effect on the growth and development of the farming sector (Barua C.C., *et al.,* 2015). The rearing of goats is an essential part of livestock and it helps farmers financially by providing milk and meat products as well as contributing to the national and global economies. Livestock productivity can be negatively impacted by parasitic illness. The main reason for a decrease in meat yield is gastrointestinal parasitic worm infection. One of the main issues that farmers deal with is parasitism (Tribhuwan A.P. *et al.,* 2022). While helminths are complex biota members, population dynamics and community structure have emerged as important subfields of animal helminthology as a result of our increasing awareness of population behavior and structure. Fish helminth parasites are widespread. They often have a high species variety and are widespread. Worldwide, helminthic diseases provide a threat to both small and large-scale farmers; but, in India, the prevalence and effect of these infections are higher due to a variety of agro-ecological conditions that are suitable for a wide range of hosts and parasite species. Gastrointestinal parasites may cause a number of economic losses, including decreased fertility, decreased ability to work, decreased food intake and weight increase, treatment costs, and mortality in heavily parasitized animals (Padwal N. *et al.,* 2011). The quantity and quality of pasture, temperature, humidity, and the host's grazing habits are agroclimatic factors that influence the prevalence of gastrointestinal helminths (Pal and Qayyum 1993). Examine and a longer examining time in the warm-rainy season by the host seasonal prevalence of gastrointestinal parasites is higher during the warm-rainy season than in the dry-cold season. This might be related to the availability (Pathak and Pal 2008) and sufficiently moisture and temperature, which creates the perfect

conditions for the development, sporulation of oocysts, and survival of infectious stage larvae (Faizal and Rajapakse, 2001).

While physical state surroundings influence the inside circumstances, these climatic conditions host behavior that can be affected by habitat and seasonal factors. The research has focused on various aspects of parasites and has been conducted on helminth parasites, including population dynamics of those found in mammalian hosts. The biological basis of the way to control parasite populations can be found in the study of population dynamics. The current study examines the seasonal population dynamics of goats' nematode parasites.

Materials and Methods:

The Goat intestines were collected from slaughter houses from different places of Rahuri during March, 2023 to February, 2024. Covering the three different seasons of the year i.e., summer, monsoon and winter from Rahuri tahsils covering all areas. The small intestine and caecum were kept in different petri dishes containing saline solution. The organs observed and collected the data of infected and non-infected hosts examined. After the separation and identification of several nematode parasite populations from goats. The parasites were preserved in different bottles. Some nematodes were used for the taxonomic study.

$$\text{Incidence of infection} = \frac{\text{Infected host}}{\text{Total host Examine}} \quad X\ 100$$

Table 1: Showing Seasonal variation of nematode *Trichuris ovis sp.* in Goats.

S.N.	Month and Year	Host Dissected	Host Infected	Parasite Collected	Seasonal Variation %	Locality
1	March -23	5	02	09	40	Rahuri
2	April-23	10	07	11	70	Takalimiya
3	May-23	11	05	20	45.45	Mahegaon
4	June-23	09	04	13	44.44	Deolali
5	July-23	07	03	17	42.85	Takalimiya
6	August-23	13	08	15	61.53	Musalwadi
7	September-23	14	07	13	50	Monori
8	October-23	09	3	10	33.33	Rahuri
9	November-23	10	6	14	60	Manori
10	December-23	15	7	21	46.66	Takalimiya
11	January-24	10	5	20	50	Mahegaon
12	February-24	09	06	10	66.66	Takalimiya
		122	63	173		

Table 2: Showing Prevalence (Percentage) of nematode *Trichuris ovis sp.* in Goats.

Seasons	No. of Host Examined	No. of host infected	No. of Parasites collected	Prevalence (%)
Summer (March 2023 to June 2023)	35	18	53	51.42
Monsoon (July 2023 to October 2023)	43	21	55	48.83
Winter (November 2023 to February 2024)	44	24	56	54.54

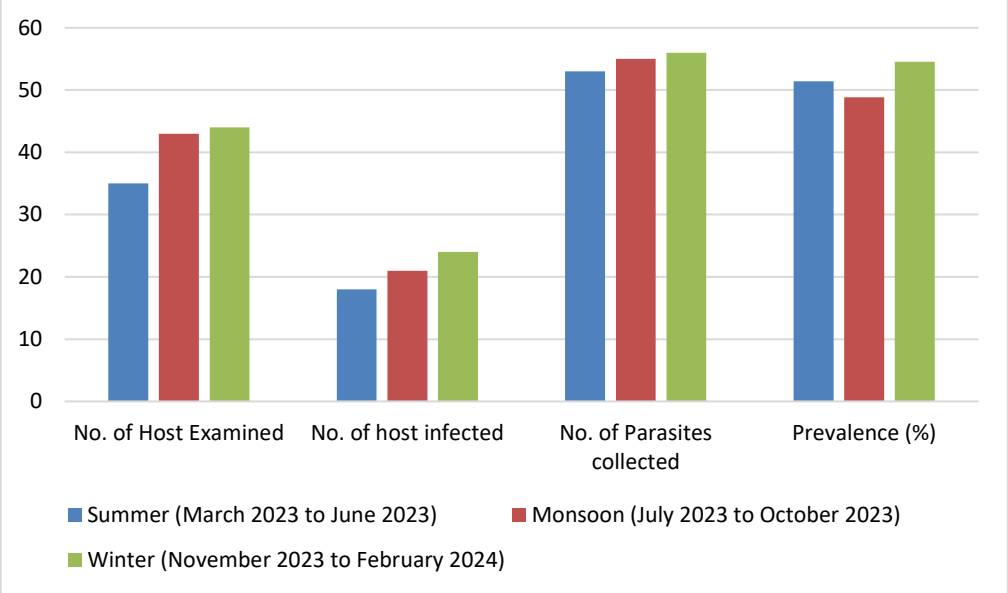

Figure 1: Shows Prevalence of Trichuris ovis from Goats

Result and Discussion

Infection with intestinal parasites affects both large and small farmers worldwide. Severe loss can occur when ruminants, such as sheep and goats, become infected with gastrointestinal parasites. Gastrointestinal parasites can cause economic losses in a number of ways. They result in losses from infertility, decreased productivity, decreased food intake and weight gain, treatment expenses, and mortality in animals with severe parasitic infections (Waller, 2006).

The present study indicates that prevalence of nematode is presented in table 1 and figure 1 of nematode parasites was recorded as *Trichuris ovis* It was found that, high incidence of infection of *Trichuris ovis* were recorded in winter (54.54 %) followed by summer season (51.42%) whereas infection was low in. mansoon (48.83 %). Because of favorable weather and the availability of pastures for feeding during the growing season, parasite infections are more common throughout the winter. Variations in local environmental factors, including humidity, temperature, rainfall, vegetation, and management techniques, can significantly affect the prevalence of this species of Trichuris. The prevalence and distribution of the disease are caused by climate conditions. Helminth infections in sheep and goats are known to be a major cause of

economic losses in resource-poor regions of the world, as they reduce productivity and increase mortality (Over, H.J.*et al.*,1992).

Conclusion:

The results of the data analysis, the current study indicates that the winter season has the highest population of Trichuris Sp., followed by the summer and the low rainy season. This type of results indicates that feeding environments and environmental factors either directly or indirectly affect the seasonality of parasite infection.

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DIVERSITY OF WILD EDIBLE PLANTS AND THEIR UTILIZATION IN GAGANBAWADA TEHSIL, KOLHAPUR, MAHARASHTRA

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Abstract:

Traditional knowledge was started to explore since human life exist, the way and medium of documentation of the knowledge was tedious job since ancient era. The utilization of plants and their parts to treat human ailments is traditionally explored orally and somewhere in the literature. The Indian sub-continent is necessitating the documentation of such knowledge experimentally. The remote areas like Gaganbawada of Kolhapur district need such exploration of utilization of wild edible plants. Gaganbawada is the extreme western part of Kolhapur district having heavy rainfall and also this is connecting link between western Maharashtra and Konkan region. During the survey, 05 villages were taken into consider for field study. The present paper deals with the enumeration of some wild edible plants, their diversity and utilization.

Keywords: Diversity, Gaganbawada, Traditional Knowledge, Utilization.

Introduction:

The plants are not in cultivation practices and not grown by cultivar or gardener are generally known as wild plants. These plant species are generally distributed along roadside, bunds of field, hilly region, barren lands, forests etc. Most of the gardeners, field man, layman, farmer, agriculturists and common people neglected these plants and treat as a weed. Cultivated crops are have a particular set of their growth requiring special care, irrigation, protection, application of herbicides, insecticides etc. and providing stored food material and table food in the season of their growth. Wild plants are available in extreme environmental situation and scarcity providing stable food, vitamins, minerals, secondary metabolites etc. These vigorously growing plant species are cheap and easily available source of food. Gaganbawada region shelters enormous wild plant diversity and required detail survey of edible and medicinally important plant species. Therefore, with this survey and research we are trying to set the culture of study of wild edible plants and medicinally utilized species in the region. The documentation and action programme of exploration will raise popularity, use value, habit and market to the available source in and around the region.

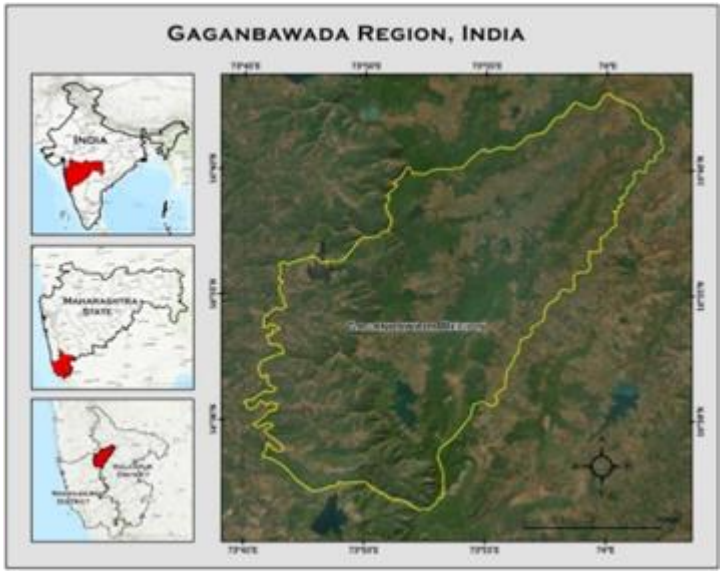
Survey of Literature:

Several districts of Maharashtra are undertaken for the study of wild edible plants. Recently the survey and documentation of wild vegetables and fruits as well as their ethnobotanical importance from Kolhapur district were recorded by Jadhav *et al.* (2011) and Valvi *et al.* (2011). Wild vegetables from Ahmednagar district were explored by Borse and

Gunjal (2022). From Bhandara district nutritive value of some edible plants were documented by Rao (2023). The remarkable work on wild vegetables from Gadchiroli, Gondia, Konkan, Melghat forest, Palghar and Sindhudurg was carried out by Setiya *et al.* (2016), Nimbalkar and Sanghi (2022), Khan and Kakade (2014), Kokate (2015) and Bhogaonkar *et al.* (2010), Patil *et al.* (2017) and Mohite (2023) respectively. It is time need to explore Gaganbawada region of Kolhapur district thoroughly concern with the edible and medicinal plants.

Study Area:

Ganganbawada is the western hilly region of Kolhapur district of Maharashtra state. It is connecting link between western Maharashtra and Konkan region of Maharashtra. Gaganbawada coordinates between latitude16.54^0 N and longitude 73.83^0 E with an average elevation 469 mtr (1562 Feet). It is cool and heavy rainfall area popularly known as Mahabaleshwar of Kolhapur. Gaganbawada situated on Sahyadri top ranges or the Western Ghats, it joins Konkan region through Bhuibavada and Karul Ghats. Though it is 55 km. away from Kolhapur, it is non developed and rural part of Kolhapur district. Gagangad Fort, Palsambe Caves, Morjai Plateau (Sada Ecosystem), Lakhamapur Dam etc. are most important geographical and cultural points of interest in Gaganbawada. The forests of Gaganbawada are extremely rich in biodiversity. Nature lovers will get many surprises in the forest. The forests are extremely rich with many medicinal and endemic plant species.



Map showing study area

Methodology:

Thorough field survey and investigation was carried out in the rainy season for the collection of plant specimen, documentation of edible plants, their location and distribution in 05 villages nearby Gaganbawada viz. Jambhulanewadi, Kumbhavade, Katali, Bhattiwadi and Dindavavnewadi. Collected plant specimen were identified by using direct method of identification by using pertinent literature (Yadav & Sardesai, 2001). Identified specimen were preserved in the herbarium of Padmashri G. G. Jadhav Mahavidyalaya, Gaganbawada. The herbarium specimen was prepared by standard procedure (Survase & Dhabe, 2013). The

documentation of the utilization was carried out by making questionnaire, direct discussion with local inhabitants and the students. For the purpose of campaigning, we arranged an exhibition of culinary art and wild vegetables repeatedly.

Results and Discussion:

During the thorough survey of 05 villages of Gaganbawada region, the wild edible plants found are represented by the plant families viz. *Araceae*, *Apocynaceae*, *Amaranthaceae*, *Costaceae*, *Cucurbitaceae*, *Hypoxidaceae*, *Dioscoreaceae*, *Clusiaceae*, *Asteraceae*, *Leeaceae*, *Oxalidaceae*, *Verbenaceae*, *Caesalpiniaceae*, *Fabaceae* and *Solanaceae*. The plant parts used are Stem tuber/Roots (03 species), Young branches (01 species), Bulbs (01 species), Leaves (11 species), Inflorescence (01 species) and Fruits (04 species). The flowering plant families *Araceae*, *Cucurbitaceae*, *Dioscoreaceae* and *Leeaceae* are represented by 02 species each. The plant species studied during this work are commonly distributed on roadside, bunds of fields and forest patches and easy to collect. The fruits of *Carrisa spinarum* and Leaves of *Smithia sensitiva* has commercial market in the region. The edible plants exhibition and culinary art programme (Plate No. 1) are results into gathering of many officials and common people which was help to know the plants and their daily food preparations.

Conclusion:

The Gaganbawada region has rich source of plant diversity and traditional knowledge. Due to extreme rainfall, dense forest, scanty population and hilly areas it is very tedious job to survey and field work in this particular region. The flora of Kolhapur district comprises 2227 flowering plant species. Out of this approximately 1/3 of the species may distributed in the Gaganbawada region. The detail documentation of edible and medicinal plant species of this region will generate huge source of traditional knowledge. The commercial use of this source will also create production practices, market, employment and small-scale industries, hence will produce job opportunities to coming generations.

Enumeration:

Sr. No.	Name of Plant	Family	Local Name	Use
1.	*Amorphophallus commutatus* (Schott.) Engl.	Araceae	Suran	**Stem Tuber** eaten by cooking
2.	*Carissa spinarum* L.	Apocynaceae	Karawand	**Ripen fruits** are eaten and have commercial value
3.	*Celosia argentia* L.	Amaranthaceae	Kurdu	**Leaves** cooked and eaten
4.	*Colocasia esculenta* (L.) Schott.	Araceae	Alu	**Leaves** used to prepare various recipes
5.	*Costus pictus* D. Don.	Costaceae	----	**Leaves** eaten as raw food

6.	*Cucurbita maxima* Lam.	Cucurbitaceae	Bhopali	**Leaves and Fruits** used to prepare various recipes
7.	*Curculigo orchioides* Gaertn.	Hypoxidaceae	Kali musali	**Roots** nutritive and eaten as raw
8.	*Dioscorea bulbifera* L.	Dioscoreaceae	Dukkar kand	**Bulbs** used to prepare various recipes
9.	*Dioscorea hispida* Dennst.	Dioscoreaceae	Shendwel	**Young apices and Inflorescence** cooked and eaten
10.	*Garcinia indica* (Thouars) Choisy.	Clusiaceae	Ratamba, Amsul	**Fruits and fruit pulp** used to make various recipes
11.	*Launaea procumbens* (Roxb.) Ramayya & Rajgopal	Asteraceae	Pathri	**Leaves** eaten as raw or cooked
12.	*Leea indica* (Burm. f.) Merr.	Leeaceae	Dinda	**Leaves** used to cook as food
13.	*Leea macrophylla* Roxb. ex Hornem.	Leeaceae	Dinda	**Young leaves** used to cook as food
14.	*Momordica dioica* Roxb. ex Willd.	Cucurbitaceae	Jangali Karle	**Fruits** cooked and used to make various recipes
15.	*Oxalis corniculata* L.	Oxalidaceae	Ambuti	**Leaves** eaten as raw
16.	*Rotheca serrata* (L.) Steane & Mabb.	Verbenaceae	Bharangi	**Young leaves** used to make tasteful recipes
17.	*Senna tora* (L.) Roxb.	Caesalpiniaceae	Takla	**Young leaves** used to make nutritive table vegetable
18.	*Smithia sensitiva* Aiton.	Fabaceae	Kavali, Nal	**Leaves** used to make tasteful recipes
19.	*Solanum lasiocarpum* Dunal.	Solanaceae	Chichurdi	**Fruits** used to prepare tasty veg dish

Plate 1: Culinary Art by Utilizing Wild Plants found in Gaganbawada Region

***Dioscorea hispida* (Shendwel)**

***Rotheca serrata* (Bharangi)**

***Rotheca serrata* (Bharangi)**

***Senna tora* (Takla)**

***Colocasia esculenta* (Alu)**

***Colocasia esculenta* (Alu)**

***Rotheca serrata* (Bharangi) *Celosia argentia* (Kurdu) *Launaea procumbens* (Pathri)**

Plate 2: Some Edible Flowering Plant Species found during the Survey of Gaganbawada Region

Celosia argentia

Colocasia esculenta

Cucurbita maxima

Curculigo orchioides

Dioscorea bulbifera

Dioscorea hispida

Momordica dioica

Rotheca serrata

Senna tora

Solanum lasiocarpum

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MEDICINAL PLANTS UTILIZED FOR THE TREATMENT OF URINARY TROUBLE IN HINGOLI DISTRICT, MAHARASHTRA, INDIA

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Abstract:

The medicinal plants survey was administered in Hingoli district of Maharashtra state for documentation the knowledge regarding medicinal plants species used against urinary trouble. The updated botanical name, family, local name, parts used are provided.

Keyword: Hingoli, Medicinal Plants, Urinary Trouble.

Introduction:

Hingoli district occupies an area 4526 km2, which was separated from Parbhani on 1stJuly 1999. District lies between 19°40' to 20°05’ N latitudes and 76°53' to 77°02' E longitudes at the northern a part of Marathwada region. The district is surrounded by Akola and Yeotmal within the North, Parbhani within the West and Nanded within the South-east. 895 mm average rainfall is recorded for the district. the main basin of the district is that the Painganga River, flows within the northern region of the district. The river passes through sengaon and kalamnuri taluka, purna river flows from southern side of sengaon and kayadhu is that the main river of the district. It flows through Sengaon, Hingoli, Aundha Nagnath and Kalamnuri talukas. Major a part of the district is roofed by dry deciduous forest. It comprises five tehsils viz. Hingoli, Kalamnuri, Aundha Nagnath, Vasmat, and Sengaon. The exploratory work of Hingoli district was done by Anil L. Vaidya (1976). In his contribution to the Flora of Marathwada, he has compiled plant wealth as Flora of North-Eastern Parbhani district (Ph.D. thesis). Quarter century is omitted the exploration work of Hingoli region, now it's a separate district, hence the present survey of medicinal plant resources of a particular district was undertaken.

Materials and Methods:

The medicinal plants survey was administered in different seasons and several location of the district. During the survey medicinal values were collected by interviews with the local healer, villagers and tribals of the district. All the collected data were compared with the pertinent literature (Bhuktar 2001, 2002, 2003; Jayshree 2011.). The identification of collected plants species was done with the help of various floras (Naik 1979, 1998; Sharma 1998; Singh 2000, 2001.).

The medicinal plants used against Urinary Trouble of Hingoli District

Plant Name	Family	Parts & Mode of Use
Terminalia arjuna (Roxb. ex DC.) Wight. & Arn.	Combretaceae	Bark decoction is useful in is constipation and urinary trouble
Hygrophila auriculata (Schumach.) Heine.	Acanthaceae	Seeds are used in seminal Debility and Urinary trouble
Alternanthera pungens Kunth.	Amaranthaceae	Leaves decoction with buttermilk is given for the treatment of urine Stone.
Drimia indica (Roxb.) Jessop	Asparagaceae	Bulbs juice is given as diuretic.
Bryophyllum pinnatum (Lam.) Oken	Crassulaceae	Leaves are given on kidney stone
Cyperus rotundus L	Cyperaceae	Rhizome is useful in urinary trouble
Butea monosperma (Lam.) Taub	Fabaceae	Flowers are used in urethritis
Clitoria ternatea L.	Fabaceae	Roots are used as diuretic
Tephrosia purpurea (L.) Pers.	Fabaceae	Roots are useful in sun stroke (Urethritis).
Sesamum indicum L.	Pedaliaceae	Seeds are used in urinary problems
Phyllanthus amarus Schumach. & Thonn.	Phyllanthaceae	Seed powder is given twice in a day for two to three days to cure kidney stone
Solanum virginianum L.	Solanaceae	Fruits are useful in toothache and urinary trouble.
Tribulus terrestris L.,	Zygophyllaceae	Fruits powder is given in urinay trouble
Ziziphus jujuba Mill.	Rhamnaceae	Fruits are used as diuretic and for constipation.

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SEED GERMINATION STUDIES OF ABRUS PRECATORIUS (L.) FOR BIODIVERSITY CONSERVATION

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Abstract:

Abrus precatorius L. (Fabaceae) is the native plant of India and used in many ways in the Indian ayurvedic system of medicine. The seeds of the species is dormant due to hard seed coat. So the aim of the study is to remove seed dormancy and enhance germination capacity within a short period. To overcome the problem of dormancy, the experiment was carried out to investigate the impact of seed age and phytohormones like Indole-3-Butyric Acid and Gibberlic Acid on germination and seedling growth. It was observed that the seeds treated with IBA + GA at 400 ppm and 600 ppm were proved favorable to express maximum percent germination.

Keywords: *Abrus precatorius*, Germination, Biodiversity, Conservation.

Introduction:

Abrus precatorius (L.) is commonly known as Gunja belonging to Fabaccae, a pea family, abundantly found all throughout the plains of India. Seeds have also the potential of good insecticide and antimicrobial activity Attal et.al (2010). Seeds are rich in several essential amino acids Desai et.al (1971). Seed of this plant are very beautiful and they attract children. Further seeds are used to make necklaces and other ornaments. Leaves and seeds are nutritious as boiled seeds are eaten in certain parts of India (Pandey1994) It is said that cooking destroys the poison of seeds (Rajaram and Janardhanan 1992),

The present study observed the effectiveness of different seed dormancy breaking treatments to improve early germination of white seeded variety of *Abrus precatorius*. In the wild conditions, seeds take at least one year for the germination. The seed, being the potential source of propagation, needs to be extensive study for its germination. These facts indicate the existence of seed dormancy in this plant and no literature is available describing the seed dormancy breaking methods to bring about early germination in white Abrus precatorius. With these objectives, to observe the effect of Indole-3-Butyric Acid (IBA) and Gibberlic Acid (GA_3) on seed germination and seedling growth of *Abrus precatorius* (white) the present study was planned.

Materials and Methods:

This study was conducted at the experimental laboratories of Department of Botany. Swami Vivekanand Senior College Mantha, Dist.Jalna (M.S) India. In the present study, seeds of the Abrus precatorius (White) and Abrus precatorius (Red seed) were collected from different locations of Jalna district. Collected seeds were then packed in sterile polythene bags in first

week of June. Identification of each plant was done with the help of local taxonomist and Flora of Marathwada (Naik, 1998).

Seeds were first surface sterilized for 1 minute in 0.1 % $HgCI_2$ solution for 5 minutes and subsequently washed with water. The experiment was arranged as a completely randomized design with three replications for each treatment. Seeds were treated with IBA+ GA at different concentration (ppm). Germination was measured daily for 60 days. All plants were harvested to determine percent germination, shoot length, root length and number of leaves.

In the present study data was analyze statistically, Standard Deviation (S.D) Standard Error (S.E) and Critical Difference (C.D) was calculated.

Results and Discussion:

Seeds were treated with different treatments and results were observed after 60 days. Results are given in the table. It is clear from the result summarized in table 1that the seeds with age 1-6 months shows maximum germinability in case of both the seeds. The seed germinability was constant of both the seeds. The seeds germinability was constant up to 1-6 months in red seeds and was found reducing in case of white seeds. Similarly, after 6 to 24 months there was reduction in percent germiniabilty in white seeds while total loss of germinability in white seeds.

Table 1: Effect of seed age on seed germination and seedling growth in *Abrus precatorius* (White seed) and *Abrus precatorius* (Red seed)

Seed age (month)	Medicinal plant					
	***Abrus precatorius* (White seed)**			***Abrus precatorius* (Red seed)**		
	Mean					
	Percent Germination	**Shoot length (cm)**	**Root length (cm)**	**Percent Germination**	**Shoot length (cm)**	**Root length (cm)**
1-6 Month	50	15.28	11.72	63.33	15.81	10.52
12 Month	30	13.32	10.42	53.33	14.24	9.35
24 Month	00	00	00	30	8.96	8.24

It is clear from the result summarized in table 2 that seeds of *Abrus precatorius* treated with IBA + GA at 600 ppm was significantly favorable for maximum germinability and increased shoot and number of length. Similarly seeds of *Abrus precatorius* treated for IBA + GA at 400 ppm and 600 ppm were found equally effective for maximum percent germination. It is interesting to mention that as there was increase in IBA + GA concentration there was decrease in germination percent and shoot of *Abrus precatorius*. All results are statistically significant. Hence, above treatments are recommended for Abrus precatorius (white) nursery growers. Gibberellic acid (GA3) is the most widely used plant growth regulators to improve seed germination in different plant species (Bao and Zhang, 2011). (Gaikwad,2019) studied and

concluded that the influence of different growth regulators (IAA+ IBA and IAA+ NAA) on seed germination and seedling growth of Syzygium cumuni. He was observed that IAA + IBA at 600 ppm favoured maximum seed germination. On the other hand shoot length and root length was maximum at IAA+ NAA at 400 ppm.

Table 2: Effect of plant growth hormones (IBA+ GA) on seed germination and seedling growth of *Abrus precatorius* (white).

		***Abrus precatorius* (white)**		
		Mean		
Treatment (ppm)	**Germination %**	**Shoot length (cm)**	**Root length (cm)**	**No. of leaves**
IBA 50+ GA 50	70	13.12	10.23	9.82
IBA 200 + GA 200	70	14.97	10.77	10.48
IBA 400+ GA 400	80	16.38	11.02	10.71
IBA 600+ GA 600	80	16.52	10.63	11.66
IBA 800+ GA 800	60	16.14	10.58	11.41
Hot Water	50	14.27	9.65	9.30
Control (pre-soaked)	40	14.12	9.23	9.44
S.D	15.12	1.31	0.65	0.93
S.E	5.71	0.50	0.24	0.35
C.D	14.69	1.27	0.63	0.90

(IBA) = Indole-3-Butyric Acid, (GA_3) = Gibberlic Acid

Conclusions:

Pre-sowing treatment of seed plays important role to enhance the seed germination under nursery conditions. Among the pre-sowing treatments, the best treatment for the sowing of Abrus precatorius (White) seeds are treated with IBA + GA at 600 ppm proved favorable to express maximum percent germination. Seeds soaked with IBA + GA at 400 ppm and 600 ppm found maximum percent germination may be recommended for plantation programme.

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EXTRACTION AND ESTIMATION OF CHLOROPHYLL AND CAROTENOIDS FROM SUBAERIAL GREEN ALGAE GENUS *TRENTEPOHLIA* SPECIES

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Abstract:

The subaerial green algae genus *Trentepohlia* is yellow, orange or red in colour due to the presence of beta carotene and hematochrome. The different *Trentepohlia* species were collected from different parts of North Karnataka and the chlorophyll and carotenoids were extracted from the *Trentepohlia* species and characterized by UV-Visible spectroscopy. The *Trentepohlia* sp. 5 showed highest content of total Chlorophyll (18.6944 mg/ml) and the *Trentepohlia* sp. 1 showed the highest total carotenoids content (6.8157 mg/ml) compared to other species. This study reveals that the *Trentepohlia* species are rich in chlorophyll and carotenoids and which plays a very important role in biotechnological, pharmaceuticals and nutraceutical applications and also it can be a source of Vitamin A.

Keywords: Chlorophyta, Chlorophyll, Carotenoids, Subaerial algae, *Trentepohlia*

Introduction:

Green algae of the order Trentepohliales are among the most diverse and widespread in the subaerial vegetation of tropical regions (Chapman 1984; Lo´pez-Bautista *et al.,* 2002). The algae were visually recognized as orange, red or green patches growing on different surfaces (Rindi & Bautista 2007). They diversely grow on tree bark, wood, rock, concrete wall, leaves and several other types of substrata. The genus is most abundant to the tropical climatic region; however, it is also present in temperate regions (Liu *et al.,* 2012). *Trentepohlia* Martius, a dominant green subaerial alga, grows abundantly and imparts the yellow, red, and orange colours because of high accumulation of carotenoids in their filaments. (Kharkongor & Ramanujam 2015).

The algae are thought to have a high tolerance and adaptability to severe conditions such as desiccation and high temperature (Abe *et al.,* 1999) and it is to be expected that aerial microalgae growing under full sunlight would have better-developed defense systems against photooxidative and oxidative damage than other plants. That is to say, they would possess a unique ability to accumulate simultaneously large quantities of β-carotene, vitamin E, and vitamin C in the cells**.** Since Peto *et al.*, (1981) postulated that a high intake of β-carotene might

decrease the risk of cancer in humans, considerable interest has focused on antioxidants and cancer prevention (Abe *et al.,* 1999**).**

Materials and Methods:

Collection of *Trentepohlia sp.*

Collection of *Trentepohlia* species by scraping of subaerial algae from stem bark of trees and artificial substrata electric cement poles with the help of knife, razor blade, spatula and scalpel in air tight zip lock sterile plastic bags (Satpati & Pal, 2016) from different areas of North Karnataka (Dharwad & Belgaum), India and the collected algal samples were freeze-dried at −4◦C and also preserved in 4% formalin in the laboratory (Satpati & Pal, 2015, 2016).

Extraction and Estimation of chlorophyll and carotenoids (Arnon 1949; Wellburn 1994)

The extraction of algae was carried out by grinding the sample in mortar and pistil with 10ml of 80% acetone. The extract was then centrifuged at 5000 –10,000 rpm for 15 minutes and filtered with Whatman no.1 filter paper. The collected supernatant was measured with UV Vis spectrophotometer with the absorbance at 480nm, 645nm and 663nm against the solvent acetone as blank.

The total amount of chlorophyll a, chlorophyll b and total chlorophyll and total carotenoids were calculated using the following equation:

Chlorophyll a: 12.7(A663) – 2.69(A645)

Chlorophyll b: 22.9(A645) – 4.68(A663)

Total Chlorophyll: 20.2(A645) + 8.02(A663)

Total Carotenoids: 1000 A470 – 3.27 Chla – 104 Chlb / 198

Results:

The collected six samples from different areas of North Karnataka, India showed the variation in content of total chlorophyll and total carotenoids (Table 1) may be due to the different environmental conditions. The lower temperature and less light intensity show the higher accumulation of carotenoids and high temperature and high light intensity shows the reduced growth species and accumulation of carotenoids. However, the *Trentepohlia* sp. 5 showed highest content of total Chlorophyll (Figure 1) and the *Trentepohlia* sp. 1 showed the highest total carotenoids content (Figure 2) compared to other species.

Discussion:

In order to examine the ability to produce valuable pigments of the microalga *Trentepohlia* species resulted in different content of chlorophyll and carotenoids accumulation in different species due to the variations in environmental conditions. The previously recorded reports as, in summer, the weather is very hot (30–40°C) which is very unfavourable for the growth of *Trentepohlia.* The lower temperature (~25°C) in winter provides perfect conditions favouring the growth and carotenogenesis of the species of *Trentepohlia* (Mukherjee *et al.,* 2010).

Quantitative estimation of total carotenoids showed a significant seasonal variation. Winter samples contained significantly higher total carotenoid content compared to summer

samples (Kharkongor & Ramanujam 2015**).** Tan *et al.*, (1993) also reported that carotenoid content increased in *T. odorata* with high light intensity.

The previous report stated the successful increase of carotenoid (β-carotene) several fold in *Trentepohlia* by using a two-stage culture. They reported that β-carotene productivity increased significantly with an increase of light intensity from 3,000 to 10,000 lux. They also mentioned that a dense algal cell culture is required to increase β-carotene productivity but growth of *Trentepohlia* is inhibited significantly beyond 30°C **(**Mukherjee *et al.*, 2010**)**.

This report provides new information on the nature of chlorophyll and carotenoids of different *Trentepohlia* species collected from natural sources without culturing the algae in any artificial medium.

Table 1: Estimation of Chlorophyll content from *Trentepohlia* sp. using 80% Acetone

Sl. No.	Name of Species	Chl a (mg/ml)	Chl b (mg/ml)	Total Chlorophyll (mg/ml)	Total Carotenoids (mg/ml)
1.	*Trentepohlia* sp. 1	6.586	5.2389	11.8213	6.8157
2.	*Trentepohlia sp.* 2	6.9788	5.4645	12.4394	6.3352
3.	*Trentepohlia* sp. 3	5.9460	3.7681	9.7113	5.3872
4.	*Trentepohlia* sp. 4	4.8165	3.8162	8.6300	4.2523
5.	*Trentepohlia* sp. 5	10.4441	8.2559	18.6944	3.0678
6.	*Trentepohlia* sp. 6	6.1089	4.3565	10.4623	3.2482

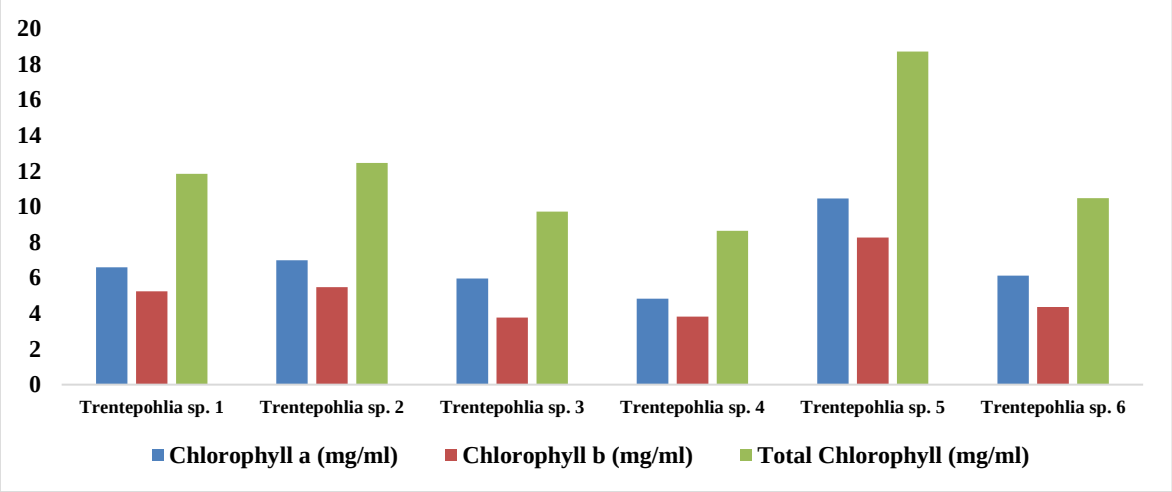

Figure 1: Estimation of Chlorophyll Content from *Trentepohlia* species

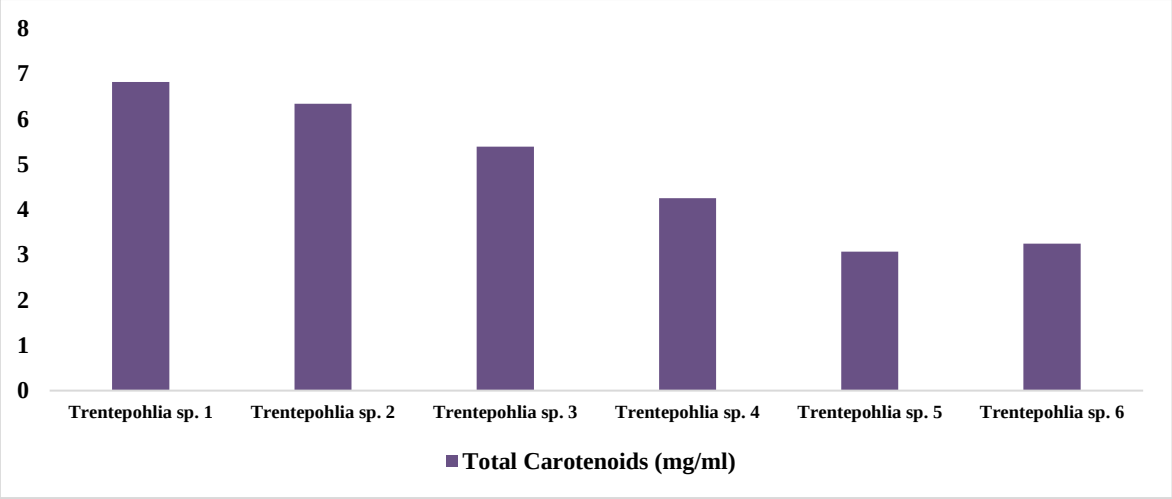

Figure 2: Estimation of Total Carotenoids content from *Trentepohlia* species

Conclusion:

This study concluded that the *Trentepohlia* species are rich in chlorophyll and carotenoids content. Hence, these *Trentepohlia* species can be a source of vitamin A, production of nutraceuticals and in the preparation or manufacturing of drugs, cosmetics, personal skincare and functional food.

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QUANTITATIVE ESTIMATION OF PHOTOSYNTHETIC PIGMENTS IN SOME *VITEX* L. SPECIES FROM MAHARASHTRA

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Abstract:

The study quantified chlorophyll a, b and carotenoid concentrations in *Vitex* L. species from Maharashtra, revealing distinct adaptations. *V. altissima* var. *alata* had the highest chlorophyll content (145.89 mg/100g), indicating high-light efficiency, while *V. leucoxylon* showed the lowest, suggesting shade adaptation. Chla/Chlb ratios highlighted *V. altissima* var. *altissima* as shade-tolerant (1:0.42) and *V. leucoxylon* as sun-adapted (1:0.79). Carotenoid levels varied, with *V. altissima* var. *altissima* highest (22.76 mg/100g) and *V. negundo* var. *incisa* lowest (9.96 mg/100g), reflecting photoprotective differences. Findings provide insights into species-specific ecological strategies and cultivation optimization.

Keywords: *Vitex* L., Photosynthetic pigments, Chlorophylls, Carotenoids.

Introduction:

The genus *Vitex*, originally classified by Linnaeus in 1753, encompasses approximately 250 species that thrive across tropical and subtropical regions worldwide (Chantaranothai, 2011). Species within *Vitex* L. are well-known in traditional medicine for their sedative properties and cough-relieving effects, owing to the presence of diverse bioactive phytochemicals. These compounds include flavonoids, diterpenoids, glycosides, and a range of essential oils, which contribute to their therapeutic potential (Rani & Sharma, 2013). Due to these bioactive constituents, *Vitex* L. species are frequently utilized in herbal remedies aimed at alleviating various health conditions. Chlorophyll is a green pigment characterized by a tetrapyrrole ring structure with a central magnesium ion and an extended hydrophobic phytol tail (Aminot, 2000). Singh *et al.*, (2001) documented four *Vitex* species from Maharashtra, namely *V. negundo* L., *V. trifolia* L., *V. leucoxylon* L., and *V. altissima* L.f.. Among these, *V. negundo* L. includes three varieties as var. *negundo*, var. *incisa*, and var. *intermedia* while *V. altissima* L.f. comprises var. *alata* and var. *altissima*. All these species were evaluated in the present study for their photosynthetic pigment profiles.

Chlorophyll levels are strongly correlated with leaf nitrogen content, making their quantification a powerful indicator for assessing a plant's overall nutrient status and health (Moran *et al.*, 2000). Leaf chlorophyll concentration serves as a key indicator of chloroplast content, photosynthetic efficiency and overall plant metabolic status, it also antioxidant compound, is primarily localized in the chloroplasts of green tissues, predominantly in the green

regions of leaves, stems, flowers, and roots (Mirza *et al.,* 2013; Srichaikul *et al.,* 2011). Chlorophyll concentration in leaf tissue is determined by the balance between its synthesis and degradation rates. As chlorophyll content is directly linked to photosynthesis, it serves as an indicator of a plant's photosynthetic efficiency (Sestak & Catsky, 1962; Sestak, 1963). The present study documents the chlorophyll content across various *Vitex* L. species to highlight interspecific variations. Understanding differences in chlorophyll levels is crucial for assessing photosynthetic activity and physiological adaptations among species. This experimental research aimed to quantify chlorophyll a and b concentrations in the leaves, providing insights into species-specific photosynthetic capacity and metabolic characteristics.

Materials and Methods:

Mature leaves from various *Vitex* L. species were collected from multiple localities within the Kolhapur and Sindhudurg districts and species identification was performed using standard botanical references. Chlorophyll content was determined following the method described by Arnon (1949). Leaf samples were homogenized in 80% acetone at temperatures maintained between 0–4°C under dark conditions to prevent pigment degradation. A small amount of magnesium carbonate was added to the homogenate to stabilize the chlorophyll. The mixture was then centrifuged at 5000 rpm for 5–8 minutes, and the supernatant was collected. The final volume was adjusted to 100 ml using 80% acetone. The absorbance of the resulting extract was measured at 663 nm and 645 nm using a VIS spectrophotometer (Equiptronics) with 80% acetone as the blank. Chlorophyll a and b concentrations were calculated using the equations given by Arnon (1949), where carotenoids were estimated using the method of Kirk and Allen (1965). The extraction followed the procedure for chlorophylls, and absorbance was recorded at 480 nm and total carotenoids (mg/100g fresh weight) were estimated by using the formula given by Kirk and Allen (1965). The chlorophyll content was expressed in milligrams per 100 grams of fresh weight, providing a quantitative assessment of the chlorophyll distribution in the studied *Vitex* L. species.

Results:

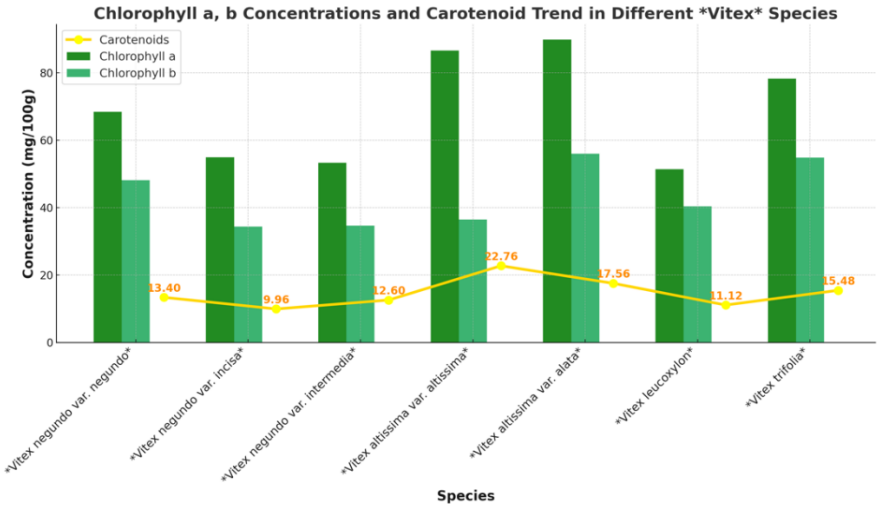

Fig. 1: Chlorophyll a, chlorophyll b and carotenoid content

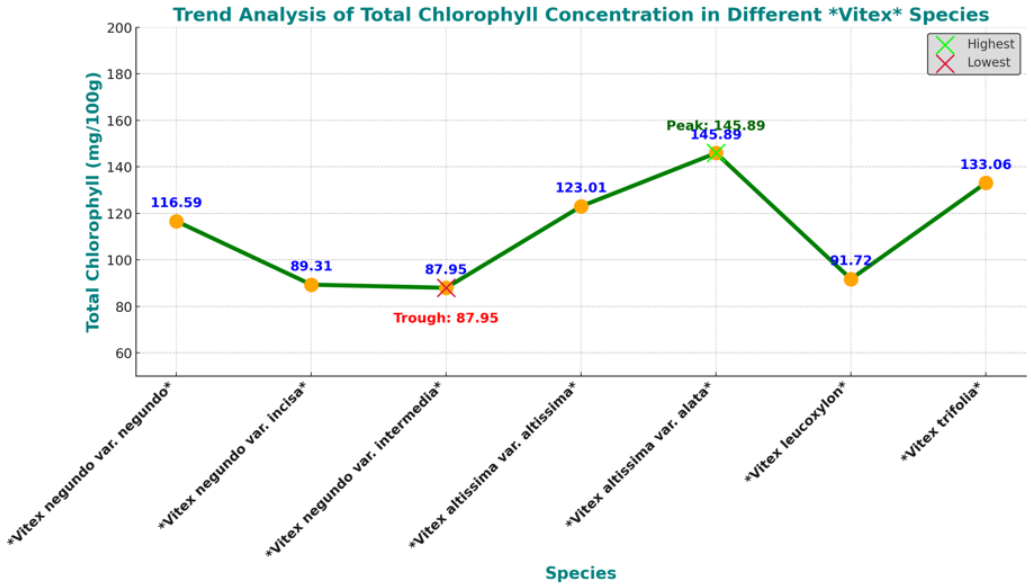

Fig. 2: Total chlorophyll content

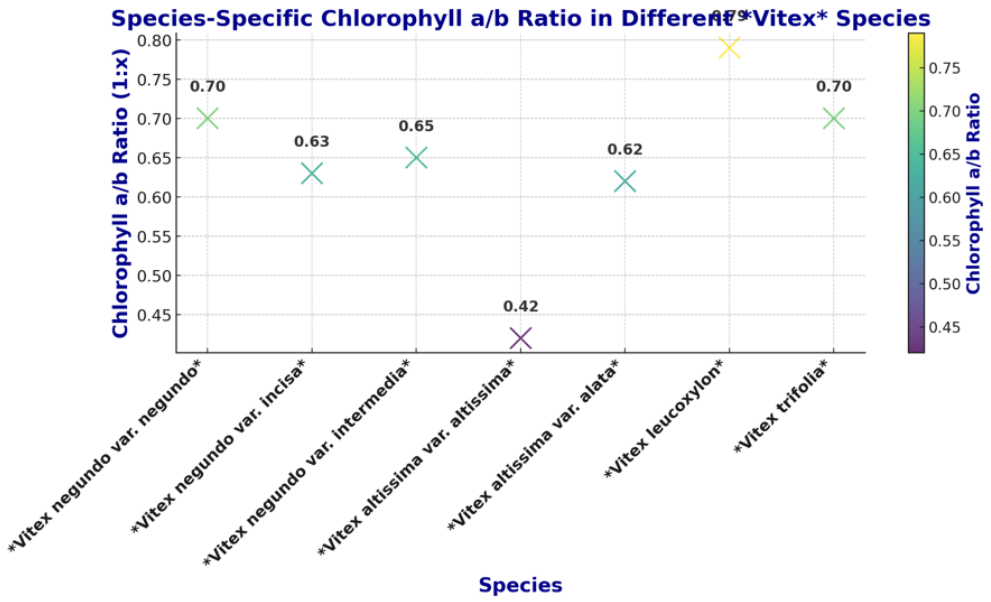

Fig. 3: Ratio of Chlorophyll a/Chlorophyll b

Discussion:

The analysis of chlorophyll concentrations and their ratios in various *Vitex* L. species, including *V. negundo var. negundo, V. negundo var. incisa, V. negundo var. intermedia, V. altissima var. altissima, V. altissima var. alata, V. leucoxylon* and *V. trifolia*, reveals significant insights into their photosynthetic capacities and ecological adaptations. Chlorophyll a and b are essential pigments, and their concentrations, along with the Chla/Chlb ratio, can indicate the efficiency of light absorption and adaptation to different environments. *Vitex altissima* var. *alata* exhibited the highest concentrations of Chlorophyll a (89.89 mg/100 g) and Chlorophyll b (56.04 mg/100 g), resulting in the maximum total chlorophyll content (145.89 mg/100 g). This suggests

a strong photosynthetic potential, beneficial in high-light environments. In contrast, *V. leucoxylon* had the lowest Chlorophyll a content (51.36 mg/100 g), indicating adaptation to areas with lower light intensity. The Chla/Chlb ratio further highlights these adaptations. *V. altissima* var. *altissima* had a notably low ratio (1:0.42), typical of shade-tolerant species, while *V. leucoxylon* showed a high ratio (1:0.79), favouring high-light conditions. Such variations reflect species-specific adaptations: high Chla/Chlb ratios in species like *V. leucoxylon* and *V. trifolia* suggest suitability for open, sunlit areas, whereas higher Chlorophyll b proportions in *V. altissima* var. *altissima* and *V. negundo* var. *intermedia* indicate efficiency in shaded habitats.

The comparative analysis reveals distinct patterns in the distribution of chlorophyll and carotenoid pigments across *Vitex* species. While Chlorophyll a and b exhibit relatively stable levels, Carotenoid concentrations display significant interspecific variability. *Vitex altissima* var. *altissima* records the highest Carotenoid content (22.76 mg/100g), suggesting enhanced photoprotective and antioxidative capabilities, which may contribute to its adaptation under high light intensity. In contrast, *Vitex negundo* var. *incisa* shows the lowest Carotenoid concentration (9.96 mg/100g), indicating a potentially lower efficiency in non-photochemical quenching and reactive oxygen species (ROS) scavenging. These results imply species-specific physiological adaptations and photoprotective strategies.

Overall, these findings illustrate the diverse ecological strategies of *Vitex* species and offer a foundation for optimizing crop species under varied environmental conditions. Future research could explore the influence of other factors, such as soil nutrients and water availability, to gain a more comprehensive understanding of these adaptive mechanisms.

Acknowledgement:

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SOIL QUALITY ANALYSIS OF DIFFERENT SOIL USED FOR ALPHANSO CULTIVATION

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Abstract:

This topic aims to explore the impact of soil health on agricultural productivity and product quality within the supply chain. Soil health, defined by its physical, chemical, and biological properties, plays a crucial role in crop performance and overall soil fertility. By linking cutting-edge scientific research to commercial farming practices, this initiative seeks to facilitate the rapid adoption of innovative soil management techniques across the farming industry. The project emphasizes the importance of soil analysis for effective nutrient management in organic farming, addressing long-term nutritional challenges, preventing pollution, and ensuring compliance with agricultural regulations. Field evaluations in Sindhudurg focus on assessing various soil management methods' effects on cashew cultivation. The project is structured in two phases: the first examines different soil management regimes' impacts on soil health, quality, and productivity, while the second evaluates the benefits of improved soil health on livestock performance and product quality. The research indicates that conventional NPK fertilizer regimes may restrict essential nutrients in meat and dairy products. An alternative approach based on the base-cation saturation ratio (BCSR) is being investigated to enhance nutrient availability for optimal soil-plant-animal health. Soil health management (SHM) is a critical component of the National Mission for Sustainable Agriculture (NMSA), promoting sustainable practices tailored to local conditions and crop needs. The establishment of soil testing laboratories at the district and block levels aims to generate employment for rural youth and improve the efficiency of soil sample analysis, ultimately contributing to the advancement of sustainable agricultural practices.

Introduction:

Soil is an innovative project which offers the opportunity to test whether improving soil health can improve productivity and product quality in the agricultural supply chain. Soil health is a multi-dimensional system which Incorporates physical, chemical and biological properties as well as the interactions between these components. The project links the latest findings in science and research to commercial farming practice and enables rapid dissemination and uptake by the wider farming industry. Soil analysis provides information which can be used to improve soil fertility through management. The extent to which soil fertility can be Improved depends on the inherent properties of the site-soil texture, slope and climate. Soil structure is also key to plant performance as it affects the ability of plant roots to access available nutrients. In this

Technical leaflet we explore some of the basic facts drawn from research and practical experience about soil analysis with a view to making the best use of available information It is worth remembering that plant tissue analysis can also be useful, especially for trace elements

Soil analysis is important in organic farming for nutrient management planning (e.g. rotational plans, making best use of manures, fertilizer application), to prevent long-term nutritional and health problems (crop and livestock), prevention of pollution and for derogations for use of restricted Inputs.

The investigation of supply chain efficiency involves a combination of science and practice, with plot and field evaluation work being carried out in Sindhudurg where the impact of different soil management methods is being Investigated on cashew cultivation land. The great strength of this project is that it can provide a focal point for the commercial development of farmers' involvement linking their approaches to improving soil health and allowing contrasting soil treatments to be compared on a scientific basis. Due to the long timescales required to bring about significant changes in soil health, the work is being approached in two phases. During phase orne, the emphasis is to look at the effects of different soil management regimes on soil health, quality and productivity. Phase two will examine the benefits of improving soil and health on livestock performance and product quality. Scientific studies suggest that modern agricultural practices, such as the standard nitrogen-phosphorus- potassium (NPK) fertilizer regimes currently used on many farms may limit the range of minerals, vitamins and trace elements required in meat and dairy products for optimum human health. A potential alternative to standard NPK fertilizer regimes is to use a soll management system based on the 'base-cation saturation ratio' which aims to balance the cation exchange capacity of a soil, thereby allowing it to provide the full range of nutrients required for soil-plant- animal health. A regime based on this BCSR theory is being evaluated as part of this project both at agricultural and on the commercial development farms.

Soil health management (SHM) is one of the most important interventions under the National Mission for Sustainable Agriculture (NMSA). SHM aims at promoting location as well as crop specific sustainable soil health management, creating and linking soil fertility maps with macro micro nutrient management, judicious application of fertilizer and organic farming practices. Under SHM, establishment of soil testing labs in one of the components which are mainly located at district/ block level. Therefore, village level soil testing projects will be established with the objective of employment generation for rural youth and to improve timelines in analysis of soil samples.

Objectives

1. To collect soil sample from different locations in selected tehsils.
2. To carry out soil testing of collected soil samples.
3. To determine PH, Conductivity, water holding capacity, organic matter. Available phosphorus of collected soil samples.
4. To increase awareness about soil testing and productivity.

5. Understand major constraints beyond nutrient deficiencies and excesses.
6. To develop recommendations to retain soil fertility and increase production of cashew nuts
7. Employment generation for rural youth.

Characteristics of a healthy soil

Good soil tilth

Soil tilth refers to the overall physical character of the soil in the context of its suitability for crop production. Soil with good tilth is crumbly, well structured, dark with organic matter, and has no large and hard clods.

Sufficient depth

Sufficient depth refers to the extent of the soil profile through which roots are able to grow to find water and nutrients. A soil with a shallow depth as a result of a compaction layer or past erosion is more susceptible to damage in extreme weather fluctuations, thus predisposing the crop to flooding. Pathogen, or drough stress.

Good water storage and good drainage

During a heavy rain, a healthy soil has large, stable pores to take in water. These large pores conduct water to the medium and small pores where it will be stored for later use. This range of pore sizes in a healthy soil allows for increased water storage for plants during dry spells. During extended rainy periods, the large pores will still be empty by gravity and allow fresh air to enter for plants and soil organisms to thrive.

Sufficient supply, but not excess of nutrients

An adequate and accessible supply of nutrients is necessary for optimal plant growth and for maintaining balanced cycling of nutrients within the system. An excess of nutrients can lead to leaching and potential ground water pollution, high nutrient runoff and green house has losses, as well as toxicity to plants and microbial communities.

Small population of plant pathogens and insect pests

In agricultural production systems, plants pathogens and pests can cause diseases and damage to the crop. This could result from direct competition from other soil organisms for nutrients or habitat, hyperparasitism etc. In addition, healthy plants are better able to defend themselves against a variety of pests

Large population of beneficial organisms

Soil organisms are important to the functioning of the soil. They help with cycling nutrients, decomposing organic matter, maintaining soil structure, biologically suppressing plant pests, etc. A healthy soil will have a larger and diverse population of beneficial organisms to carry out these functions and thus help maintain a healthy soil status.

Low weed pressure

Weed pressure is a major constraint on crop production. Weeds complete with crops for water and nutrients that are essential for plant growth. Weeds can block sunlight, interfere with

stand establishment and harvest and cultivation operation, and Harbor disease causing pathogens and pests.

Free of chemical and toxins that may harm the crop

Healthy soils are either devoid of excess amounts of harmful chemicals and toxins or can detoxify or bind such chemicals. These processes make these harmful compounds unavailable for plant uptake, due to the soil richness in stable organic matter and diverse microbial communities.

Resistant to degradation

A healthy well aggregated soil full of a diverse community of living organisms is more resistant to adverse events including erosion by wind and rain excess rainfall, extreme drought, vehicle compaction, disease outbreak, and other potentially degrading influences.

Resilience when unfavorable conditions occur

A healthy soil will rebound more quickly after a negative event, such as harvesting under wet soil conditions, or if land constraints restrict or modify planned rotations.

Methedology

Soil analysis

After soil samples are received at a laboratory a number of tests can be performed. A General understanding of soil testing will help you know how the result can be interpreted and to appreciate the accuracy of analytical results. Soil supply most of the mineral nutrition for higher plant through the plants root system the root system extract nutrients from the soil over a long period of time; 2 to 3 months for most annual crops, years for perennial crop. In contrast is soil test determine the soil nutrient supplying capacity by mixing soil for only a few minutes with a strong extracting solution. The soil reacts with the extracting solution releasing some of the nutrients. The solution is filtrate and assayed for the concentration of each nutrient. The nutrients concentration is there related to field calibration research that indicates the yield level rich with verying soil nutrient concentration. This method works very well for some nutrients but is less accurate for others, for example those nutrients supplier largely form organic matter(OM) decomposition such as nitrogen and sulphur. This is primarily due to difficulty of estimating or predicting the rate at which organic matter will decompose and release these nutrients in plant available forms. Individual analysis included in a standard or routine soil test where is from laboratory to laboratory but generally includes soil PH available phosphorus and potassium they sometimes also include available calcium and magnesium, salinity and offer include and analysis of organic matter contain and soil texture.

Parameter

pH

Soil pH is a measure of the acidity or alkalinity of a soil. The term pH applies to solutions, so the analysis must be conducted no a soil/water mixture. The soil sample is mixed with water, allowed to equilibrate for at least an hour, and then the pH measured. Several factors affect pH measurement. Primary among these is the salt concentration of a soil. The salt

concentration of a soil may vary with the season or with fertilizer application greater pH drop up to one-half a pH unit.

It is important because is affect the availability of nutrients through both chemical and biological Different crops are also tolerant of different levels of acidity, e.g. oats will yield well at a lower pH than other cereals. Recommended levels are normally 6.0 in grass/clover and 6.5 for continuous arable. These are targets levels and regular analysis should be used to check that the liming strategy you are using is able to maintain pH is its ideal range.

Procedure of pH of soil

- The pH meter was calibrated using pH 7 buffer solution.
- Then the meter was adjusted with known pH of buffer solutions 4.0 and 9.2.
- 20 g of soil was weighed and transferred into 100 ml beaker. 40 ml distilled water was added and stirred well with a glass rod.
- This was allowed to stand for half an hour with intermitted stirring.
- To the soil water suspension in the beaker, the electrode was immersed and pH value determined from the automatic display of the pH meter.

Observation Table

Sample	Location	pH
1	Kalavi	6.95
2	Valkuwadi	6.65
3	Talebazar	6.13
4	Malai	5.98

Electrical Conductivity (EC)

Electrical conductivity (EC) of a soil extract is used estimate the level of soluble salts. The standard method is to saturate the soil sample with water, vacuum filter to separate water from soil, and then measure EC of the saturated paste extract. The result is referred to as EC and is expressed in units of DeciSiemens per meter (ds/m). Older literature will likely use units of milliohms per centimetre (mmho/cm), which are identical to ds/m. Some test laboratories use different soil: water rations, and use a multiplication factor to convert results to an EC.

Equivalent EC is a very reliable test for soil salinity, and this is a routine test in the arid southwest. However, in wetter climates EC is not a standards test so, if soil samples are sent to a laboratory another part of the country, EC may have to be specifically requested.

Procedure of Electrical Conductivity in soil:

Prepare a 1:5 soil: water suspension by weighing 10 g air-dry soil into a bottle. Add 50 mL deionised water. Mechanically shake at 15 rpm foe 1 hour to dissolve soluble salts.

Calibrate the conductivity meter according to the manufacturer's instructions using the KCL reference solution to obtain the cell constant.

Rinse the cell thoroughly. Measure the electrical conductivity of 0.01 M KCL at the Same temperature as the soil suspensions.

Rinse the conductivity cell with the soil suspensions Refill the conductivity cell without disturbing the settled soil. Record the value indicated on the conductivity meter. Rinse the cell with deionised water between sample.

Observation table

Sample	Location	EC
1	Kalavi	0.059
2	Valkuwadi	121.3
3	Talebazar	0.951
4	Malai	0.937

Water holding capacity

One of the main functions of soil is to store moisture and supply it to plants between rainfalls or irrigation. Evaporation from the soil surface, transpiration by plants and deep percolation combine to reduce soil moisture status between water application If the water content becomes too low, plants become stressed. The plants available moisture storage capacity of a soil provides a buffer which determines a plants capacity to withstand dry spells.

Soil water holding capacity is a term that all farms should to optimize crop production. Simply defined soil water holding capacity is the amount of water that a given soil can hold for crop use. Field capacity is the point where the soil water holding capacity has reached its maximum for the entire field.

Procedure of water holding capacity in soil:

Crush air-dry soil and pass through 2mm sieve.

Place round filter paper and fix it to the internal perforated floor of the dish. The weight of the dish and filter paper is noted. The dish is then filled with soil by tapping the dish briskly and making plane the top of soil and find out its weigh.

Take the dishes and place it n a filter paper sheet, so that the excess of water may drain away from the pores within half an hour. The dish containing moist soil is weighted and the weight is noted.

Formula:

$$\text{Water holding capacity} = \frac{\text{Loss in weight}}{\text{Dry weight of soil}} \times 100$$

Observation table

Sample	Location	WHC
1	Kalavi	67.30
2	Valkuwadi	43.47
3	Talebazar	81.22
4	Malai	74.10

Organic carbon

The organic carbon, in organic matter is oxide by know excess of chronic acid. The excess chronic acid not reduced by organic matter is determined by black titration with std. FeSo4 solution (redox titration), using ferroin indicator. The organic in soil is calculated from the chronic acid utilized (reduced) my organic carbon.

Procedure:

Transfer without loss of 1 g of sample finely ground and passed through 0.5 mm sieve into 500 ml conical flask.

Add by means of a pipette 10ml of normal potassium dichromate solution and swirl the flask gently

Add 20ml of conc. H2SO4 by measuring cylinder. Swril the flask by hand for a minute or two and aside on an asbestos pad for exactly half an hour.

At the end of half an hour, add 200 ml distilled water and 3 to 4 drops of ferron indicator

Titrate the content of the flask against 0.SN ferrous sulphate solution till the colour changes from brown green to finally red.

Run the blank simultaneously without soil.

Formula:

Percent organic carbon = (B-T) x N x 0.003 × 100 x Wt. of soil

Observation table

Sample	Location	O.M
1	Kalavi	16.40
2	Valkuwadi	4.840
3	Talebazar	20.58
4	Malai	12.46

Phosphorus (P)

Phosphorus is a component of the complex nucleic acid structure of plants, which regulates protein synthesis. Phosphorus is, therefore, important in cell division and development of new tissue. Phosphorus is also associated with complex energy transformation in the plant.

Most soil P is tightly bound to soil particles or contained in relatively insoluble complexes. The P- containing complexes in alkaline soils are very different than those in neutral or acidic soils. The amount of P removed during soil extraction is very much dependent on the nature of P complexes and on the specific extractant used, so it is critical that P extractants be matched to soil properties.

Procedure of available phosphorus in soil:

Calorimeter estimation (Dickman and bray's method)

Take 7, 25 ml standard flasks. Labelled one as "SAMPLE" another one as "Blank" and all others as 0.2, 0.4, 0.6, 0.8,1.

2.5 gm of soil and 50 ml of extracting solution in 250 ml conical flask.

Shake for 5min and filter the extract.
Pipette out 5 ml of soil extract into one 25 ml standard flask which is labelled as "SAMPLE".
Take 5ml "Dickman and Bray's Reagent" using 5 ml pipette and transfer that into 25 ml standard flask which contain the soil extract.
To that add 7.5 ml Boric acid
Take the "standard phosphorus solution" in a clean burette.
From this burette and 1, 2, 3, etc up to 5 ml "standard phosphorus solution" in previously labelled 25 ml standard flasks. (expects in Blank).
Pipette out 5ml "Dickman and Bray's reagent" and transfer that into each 25 ml standard flask containing "Standard Phosphorus solution".
To that add 7.5 ml Boric acid.
Take a test tube full of distilled water and add through the neck of the flask down to remove the adhering Ammonium molybdate.
Mix thoroughly the content and keep
Finally add 1ml Sncl2 working solution with immediate missing and make up to mark with distilled water rince again, mix the solution thoroughly.
Similarly prepare a blank.
Measure the intensity of blue colour just after 10 min at 690 nm – Plot a graph between absorbance against the concentration in ppm and determine the concentration of P in soil samples from the standard curve. This is very important that colour starts fading after about 15-20 minutes at development of colour.
Formula:
Available P (kg/ha) = R x vol. of extract x 1 Vol. of extract taken wt of soil 2.44

Observation table

Sample	Location	Phosphorus
1	Kalavi	14.8
2	Valkuwadi	7
3	Talebazar	13
4	Malai	27.6

Conclusion:

The organic matter contain influences many soil properties like capacity of soil to supply N, P, S and tress element in filtration and retention of water degree of aggregation and over all soil structure: cation exchange capacity: soil colour from the above observation it can be concluded that out of the four sample tale Bazar soil sample is highest amount of organic matter is term of organic carbon that is 20.58 and lowest is valkuwadi soil sample 4.840. Since ions are the carries of electricity the electrical conductivity of the soil water system raise according to the content of soluble salt. The measurement of electrical conductivity can be directly related to

soluble salt concentration of the soil at any particular temperature it can be observe that sample contain highest electrical conductivity 121.3 mhos/cm. As compare to rest of the sample it emitted high amount of soluble salt the EC of saturation extract if frequently used as an index of salination hazard

Water holding capacity of the usually refers to amount of maximum water which can be held by the saturated soil the water holding capacity of tale Bazar soil sample is observed to be highest that is 81.22% as compared to alcohol that is 43.47% this is the water held in soil after the excess of gravitational water has drained away under three drainage and minimum evaporation. Overall it can be concluded that TaleBazar soil sample is rich in organic matter, Phosphorus and in suitable for the cultivation of Alphonso mango in Devgad Taluka. While the work is soil sample which is different in colour having excess of soluble suits its quality is to be improve for the cultivation

PHARMACOGNOSTIC AND PHYTOCHEMICAL STUDIES ON THE BARK OF *BOSWELLIA SERRATA* ROXB. EX COLEB.

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Abstract:

Boswellia serrata Roxb. ex Coleb. belongs to Family Burseraceae. It is a very common Indian medicinal plant. It is very well known for its medicinal properties. It's characteristic of the tropical dry deciduous forests and occurs in very dry teak forests or in dry mixed deciduous forests. It's found on the slopes and ridges of hills, as well as on flat terrain. In Maharashtra it is common throughout dry deciduous forests. It is also used to cure burns, diarrhea, convulsions, constipation, dysuria and epilepsy. It is also used to cure skin diseases, leprosy and syphilis. Phytochemical investigations prove its importance as an important valuable medicinal plant. *Boswellia serrata* Roxb. ex Coleb. is known to be an important source of secondary metabolites notably phenolic compounds. It is known as rich source of alkaloids, tannins, saponin, sterols, flavonoids and glycosides. This research paper aims to provide useful information in regard to its correct identity, evaluation and help to differentiate from the closely related other species of *Boswellia serrata* Roxb. ex Coleb.

Keywords: *Boswellia serrata* Roxb. ex Coleb., Phenolic Compounds, Pharmacological Activities, Phytochemical Profile.

Introduction:

From ancient time various plant species have been used by human being as a source of food, shelter, medicine, fiber, gum, resin, oil, etc. Several wild plants are used as food by tribals and other local communities living in that particular region. It has been observed that the traditional knowledge on wild plants is declining day by day. Natural products as medicines, although ignored in the past, are gaining popularity in the modern era. On the global level, the current faith on traditional system of medicine is going high, with a majority of world's population still dependent on medicinal plants for their day-to-day healthcare needs. It is estimated that about 64 percent of the global population remain dependent on traditional medicines (Sindiga, 1994). Herbal medicines are assumed to be of great importance in the primary healthcare of individuals (Sheldon *et al.,* 1997) and these are comparatively safer than synthetic drugs. Plant-based traditional knowledge has become a recognized tool in search for new sources of drugs and neutraceuticals (Ghosh, 2003; Sharma and Mujundar, 2003).

Boswellia serrata Roxb. ex Coleb. grows in dry mountainous regions of India, Northern Africa and the Middle East (Maupetit P, 1984; Leung A.Y, 1996). It's characteristic of the tropical dry deciduous forests and occurs in very dry teak forests or in dry mixed deciduous

forests. It's found on the slopes and ridges of hills, as well as on flat terrain. In Maharashtra it is common throughout dry deciduous forests (Forest dept. MS, 2008). The tree is commonly found in West Asia, Oman, Yemen, South Africa, Southern Arabia and many parts of India (Mahe Alam, *et al*, 2012). In Khandesh and Nagpur-Wardha division in Maharashtra and in Andhra Pradesh (Srinivas R. K, *et al*, 2009). It is widely grows in dry hilly forests of India especially Rajasthan, Madhya Pradesh, Gujarat, Bihar, Assam, Orissa as well as central peninsular regions of Andhra Pradesh, Assam etc (Gupta P.K, *et al*, 2011).

In ancient system of medicines, herbal prepara-tions of *Boswellia serrata* Roxb. ex Coleb. were used for treating duodenal ulcers (Chatterjee T.K, 2000). Traditionally the bark is reported to have antiulcer activity (Kokate C.K, *et al*, 2009). The bark of *Boswellia serrata* Roxb. ex Coleb. has many traditional uses including rheumatoid arthritis, osteoarthritis, gout, joint pain, skeletal muscle pain and back pain (Jyothi S, 2014). Bark is used in blood dysentery (Anil K.D, *et al*, 2014).

Middle sized trees with thin papery ash - coloured bark. Leaves odd pinnate, 10-30 cm long; leaflets 8-15 pairs; opposite, subsessile, ovate - oblong, 2-6 X 1-3 cm, oblique at base, crenate - serrate, obtuse, pubescent. Flowers 8-10 mm across, in axillary racemes shorter than the leaves. Calyx pubescent outside; lobes broadly triangular - ovate, 2-3 mm long. Petals dull or greenish - white, ovate, 5 mm long, pubescent outside. Stamens inserted at base of red, annular crenate disk. Ovary ovoid, sunk into the disk; style long. Drupes trigonous - ovoid, 1.5 - 2 cm long, pale green. Pyrenes compressed, heart – shaped (Naik, 1988).

In the present study, on some standardization parameters for *Boswellia serrata* Roxb. ex Coleb. stem bark. Hence, the objectives of the study were to evaluate various pharmacognostic parameters like macroscopic characters, phytochemical and physicochemical characterization.

Material and Methods:

Plant material collection

The stem bark of *Boswellia serrata* Roxb. ex Coleb. was collected by self in the month of July Latitude N19^{o},90', 44.41" Longitude E075^{o},31',26.71" Altitude 581.5m, from Gogababa hill, BAMU, Aurangabad. Bark was pulverized in the mechanical grinder to a fine powder to carry out different pharmacognostical and phytochemical evaluation and was stored in a well closed airtight vessel for further analysis (Table No: 1).

Behavior of bark powder towards some chemical reagents.

The powder of *Boswellia serrata* Roxb. ex Coleb. bark was treated with different chemical reagents. The mixture of the powdered drug and chemicals were allowed to warm and cold down for two hours. Changed colour of powdered drug was noted (Table No: 2).

Physico-chemical Evaluations.

Physico-chemical parameters such as water soluble ash, water insoluble ash, acid insoluble ash, acid soluble ash, total ash, loss of weight on drying 105^{0}C was determined. Considering the diversity of chemical nature and properties of contents of drugs, different solvents benzene, petroleum ether, chloroform, methanol, water, alcohol, chloroform water of

extractive values were determined as per reported methods (Mukherjee PK 2002, Kakate CK 1994, Khandelwal KR 2005) (Table No: 3).

Phytochemical screening

Qualitative examination of *Boswellia serrata* Roxb. ex Coleb. bark inorganic matters and determination of heavy metals was done as per reported methods. The dried powdered bark was subjected to preliminary phytochemical screening for qualitative detection of phytoconstituents. The dried powdered bark (100g) was extracted successively hexane, petroleum ether, benzene, benzene, chloroform, acetone, methanol, water in Soxhlet Extractor by continuous hot percolation. Each time before extracting with the next solvent of higher polarity the powdered material was dried in hot air oven below 50^0C for 10 minutes. Each extract was concentrated in vacuum on a Rote Evaporator and finally dried in hot air oven. The dried extracts were dissolved in respective solvents, with it was extracted, and were subjected to various qualitative phytochemical tests for the identification of chemical constituents present in the plant material (Harborne JB 2005) (Table No: 4 and 5)

Results and Discussion:

Organoleptic Evolution:

The organoleptic characters such as touch, colour, taste, and odor are discussed in (Table No: 1).

Phytochemical Screening

Inorganic substances (Ca, Fe, Mn, P, S, and K) were present. The results demonstrated presence of saponin, flavonoids, tannins, alkaloids mainly in the stem bark of *Boswellia serrata* Roxb. ex Coleb. The presences of various phytoconstitutes in various extracts are summarized in (Table 5).

Physicochemical Evaluation

The physicochemical studies and successive extractive values of stem of *Boswellia serrata* Roxb. ex Coleb. are summarized in (table 3 and 4).

Behaviour of Bark Powder towards some Chemical Reagents

The observations are reported in the (table 2).

Organoleptic Evalution:

The organoleptic characters such as touch, colour, taste, and odor are discussed in (Table No: 1).

Macroscopic Evolution:

In Pharmacognosy the term “bark” is used to describe all the tissue found external to the cambium in the branch, stem or root. Barks consist following tissues: Rhytidoma (dead tissues), cork, Phellogen (meristematic), Phelloderm, cortex and secondary phloem.

Outer Surface: outer surface of bark is smooth young bark stem is pale grey and bark of old stem is dark brown to greenish in colour, black irregular scales.

Inner surface: Inner surface rough, brownish to reddish in colour; longitudinally striated and fibrous; fracture difficult, fibrous, fracture irregular.

Fracture: Hard, outer is granular, inner is splintery.

Taste: soure.

Odor: pungent.

Behaviour of Bark Powder towards some Chemical Reagents

The observations are reported in the (table 2).

Physico-Chemical Evaluation

The physicochemical studies and successive extractive values of stem of *Boswellia serrata* Roxb. ex Coleb. are summarized in (table 3 and 4).

Phytochemical Screening

Inorganic substances (Ca, Fe, Mn, P, S, and K) were present. The results demonstrated presence of saponin, flavonoids, tannins, alkaloids mainly in the stem bark of *Boswellia serrata* Roxb. ex Coleb. The presences of various Phyto constitutes in various extracts are summarized in (Table 5).

Pharmacognosy enfolds the knowledge of history, distribution, cultivation, collection, processing for market and preservation, the study of organoleptic, physical, chemical and the uses of crude drugs. The objective of pharmacognosy is to contribute towards establishment of rational relationship between the chemical moieties of naturally occurring drugs and their biological and therapeutic effects, which ultimately helps in the standardization of the plant bark drugs (Evans WC (2002).

The physical evaluation furnished different ash values, extractive values in different values. Water soluble ash, total ash, and acid soluble ash, acid insoluble ash values were also determined. The phytochemical investigation revealed the presence of tannins, alkaloids, saponin, and sterols compounds mainly in the stem bark of *Boswellia serrata* Roxb. ex Coleb. Thus a variety of standardization parameters viz. morphology, physic-chemical, phytochemical were studied and data was generated for the assessment of quality of plant material, and also to check the adulteration and substitution etc. which may be helpful for future reference.

Table 1: organoleptic characteristic of stem bark of *Boswellia serrata*.

Parameters	
Condition	Dried
Colour	Outer surface – brown to creamish-brown coloured Inner surface – smooth creamish pink to cream coloured
Odour	Aromatic
Taste	starchy
Texture	Rough with fracture
Fracture	short, straight, deep fractured and fibrous in inner bark

Table 2: Reactions of stem bark powder of *Boswellia serrata* with different chemical reagents.

Sr. No.	Chemical Reagents	Observation
1	Conc. Sulphuric acid	Reddish Brown
2	Conc. Hydrochloric acid	Dark brown
3	Conc. Nitric acid	Yellow
4	Picric acid	Dark yellow
5	Glacial Acetic acid	Light brown
6	Iodine solution	Light yellow
7	Sodium hydroxide solution (aq. 5%)	Brown
8	Potassium hydroxide solution (aq. 5%)	Reddish brown
9	Ferric chloride solution (aq. 5%)	Green
10	Powder as such	Pale yellow
11	Methanol	Brown
12	10% NaOH	Light reddish brown
13	Chloroform	Light yellow
14	Petroleum ether	Dark green
15	Distilled water	Pale green

Table 3: Physico-Chemical Properties of *Boswellia serrata* stem bark.

Sr. No.	Quantitative Standards	%w/w
1	Total ash	8.27
2	Acid soluble ash	6.92
3	Acid insoluble ash	1.35
4	Water soluble ash	6.11
5	Water insoluble ash	6.25
6	Loss of weight on drying 105^0C	74.55
7	Alcohol soluble extractive value	4.30
8	Water soluble extractive value	3.95

Table 4: Successive Extractive Values of the stem Bark of *Boswellia serrata*.

Sr. No.	Solvent	Weight of Drug	Average Extractive Value (%w/w)
1	Methanol	10gm	11.40
2	Alcohol	10gm	9.90
3	Benzene	10gm	7.86
4	Petroleum ether	10gm	1.10
5	Chloroform	10gm	1.13
6	Acetone	10gm	3.15
7	Water	10gm	7.10

Table 5: Observation of Quantitative analysis of organic of *Boswellia serrata*.

Sr. no.	Test of organic mater	Petroleum ether	Chloroform	Acetone	Methanol	water
1	Tannin	+	-	+	-	+
2	Alkaloid	+	+	-	-	+
3	Saponin	-	-	+	+	+
4	Sterols	+	-	-	-	-
5	Flavonoids	-	+	-	+	+

Conclusion:

After present investigation it can be concluded that the pharmacognostic study of stem bark of *Boswellia serrata* Roxb. ex Coleb. have furnished a set of qualitative and quantitative parameters that can serve as an important source of information which may substantiate the existing pharmacogostic data to ascertain the identify and to determine and track the quality and purity of the plant material in future studies.

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THE FLORAL EXPORT LANDSCAPE: OPPORTUNITIES AND CHALLENGES IN CHHATRAPATI SAMBHAJINAGAR DISTRICT

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Abstract:

The floral export industry in India has seen significant growth over the past few decades, presenting both opportunities and challenges for various regions. This article explores the floral export landscape in the Chhatrapati Sambhajinagar district of Maharashtra, examining its potential for economic development, the challenges faced by local producers, and strategies to enhance the industry. By analyzing market trends, local resources, and agricultural practices, this research aims to provide a comprehensive overview of the floral export sector in Chhatrapati Sambhajinagar.

Introduction:

Chhatrapati Sambhajinagar, located in the heart of Maharashtra, is a district steeped in history and cultural significance, famous for its historical monuments, including the Ajanta and Ellora caves, which are UNESCO World Heritage Sites. However, beyond its rich heritage, Chhatrapati Sambhajinagar has increasingly gained recognition for its agricultural potential, particularly in the floriculture sector. The district's diverse agro-climatic conditions, characterized by fertile soil and a suitable climate, make it an ideal location for cultivating a wide variety of flowers. In recent years, the demand for floral products has surged globally, driven by changing consumer preferences and the growing popularity of flowers for gifting and decoration. This shift presents a unique opportunity for Chhatrapati Sambhajinagar's farmers to tap into lucrative international markets. With the floral export sector projected to grow significantly, the district is positioned to leverage its agricultural resources to become a key player in this burgeoning industry.

The floral export landscape encompasses various elements, including cultivation, processing, marketing, and logistics. Understanding these components is crucial for identifying opportunities and challenges within the sector. While the potential for economic development through floral exports is immense, farmers and producers in Chhatrapati Sambhajinagar face several obstacles, such as inadequate infrastructure, market access issues, and competition from established floral-producing regions. This article aims to provide a comprehensive overview of the floral export sector in Chhatrapati Sambhajinagar by exploring the region's unique advantages and challenges. It will delve into the current state of the floral export market, analyze the local agricultural landscape, and discuss the economic implications for farmers and the community. By examining both the opportunities and challenges, the research aims to inform policymakers, local farmers, and stakeholders about the potential pathways for growth in Chhatrapati Sambhajinagar's floral export industry.

In summary, the floral export sector in Chhatrapati Sambhajinagar represents a promising avenue for economic diversification and development. With appropriate support, investment, and strategic planning, the district can capitalize on its agricultural strengths to thrive in the global floral market. This article will explore these dimensions in detail, shedding light on how Chhatrapati Sambhajinagar can enhance its position in the competitive landscape of floral exports.

The Floral Export Sector in India

Overview

India's floral export sector has evolved into a multi-billion-dollar industry, primarily driven by demand from international markets. The country is one of the largest producers of flowers globally, with a diverse range of varieties cultivated for both domestic consumption and export. Key flowers exported include roses, marigolds, orchids, and gerberas, among others. The floral market is characterized by its rapid growth, fueled by changing consumer preferences for fresh flowers for various occasions, including weddings, festivals, and corporate events.

Growth Trends

Recent trends indicate a steady increase in floral exports from India. According to the Agricultural and Processed Food Products Export Development Authority (APEDA), the country exported flowers worth approximately $100 million in the last financial year, with an expected annual growth rate of 10-15%. This growth is attributed to the increasing popularity of flowers in gifting and decoration, coupled with improved agricultural practices and international trade agreements.

Chhatrapati Sambhajinagar District: A Potential Hub

Geographic and Climatic Advantages

Chhatrapati Sambhajinagar’s climate is conducive to the cultivation of various flowers, particularly roses and marigolds. The district experiences a subtropical climate with distinct wet and dry seasons, providing a suitable environment for year-round flower production. The average temperature ranges between 20°C and 30°C, with well-distributed rainfall, enhancing soil fertility. This climatic advantage allows for multiple cropping cycles, enabling farmers to maximize their yields.

Local Resources

The availability of water resources, fertile soil, and a network of local farmers who are increasingly adopting modern agricultural techniques enhances the potential for floral exports. The district is situated near the Godavari River, ensuring a reliable water supply for irrigation. Moreover, the local agricultural community is increasingly turning to polyhouses and controlled environment agriculture to boost production and protect crops from adverse weather conditions.

Opportunities in Floral Exports

Economic Growth

1. Employment Generation: The floral export sector has the potential to create numerous job opportunities in cultivation, processing, and logistics. As farmers shift to floriculture, the demand

for labor increases, providing employment to local residents, especially women, who are often engaged in flower picking and processing.

2. Diversification of Income: For many farmers, venturing into floral production offers a lucrative alternative to traditional crops such as cereals and pulses, which often yield lower profits. By diversifying into floriculture, farmers can increase their income, leading to improved living standards and economic stability.

Export Potential

1. Increasing Global Demand: The global demand for flowers is on the rise, driven by the growing trend of gifting flowers and the floral decoration industry. Countries like the United States and European nations have a strong market for imported flowers, presenting a significant opportunity for Indian exporters.

2. Value Addition: Exporting processed flowers, such as dried arrangements, essential oils, and floral decorations, can increase profit margins for local producers. By investing in value-added products, farmers can tap into niche markets and enhance their profitability.

Supportive Policies

Government initiatives, such as subsidies for floriculture and export incentives, play a crucial role in promoting the sector. The Ministry of Agriculture and local agricultural departments are actively working to provide training and resources for farmers. Programs aimed at improving infrastructure, such as cold storage and transport facilities, further support the growth of the floral export sector.

Challenges Facing the Floral Export Sector

Infrastructure Deficiencies

1. Cold Chain Logistics: The lack of adequate cold storage facilities and transportation infrastructure poses a significant challenge in maintaining the freshness of flowers during transit. Flowers are perishable goods, and without proper cold chain logistics, they may wilt or decay, leading to financial losses for exporters.

2. Market Access: Limited access to international markets due to regulatory barriers and inadequate marketing support can hinder the growth of local producers. Many small-scale farmers may lack the knowledge or resources to navigate complex export regulations, further limiting their market reach.

Competition

1. Domestic and International Competition: Farmers in Chhatrapati Sambhajinagar face competition from established floral-exporting regions like Karnataka and Tamil Nadu, as well as from international players in countries like Ecuador and Kenya. These regions often benefit from established supply chains and brand recognition, making it challenging for Chhatrapati Sambhajinagar's producers to compete.

2. Quality Standards: Meeting international quality standards for export can be a hurdle for many small-scale producers who may lack the necessary resources and knowledge. Stringent quality control measures, including pest management and post-harvest handling, are essential for accessing high-value markets.

Environmental Concerns

1. Sustainability Issues: The intensive use of pesticides and fertilizers can lead to environmental degradation, affecting soil health and biodiversity. Sustainable farming practices are crucial to mitigate these impacts and ensure the long-term viability of the floral industry.

2. Water Scarcity: With increasing competition for water resources, sustainable water management practices are essential for long-term viability. Over-extraction of groundwater for irrigation can lead to depletion of water resources, threatening the sustainability of floral production.

Strategies for Growth

Capacity Building: Investing in training programs for local farmers on best practices in floriculture, pest management, and post-harvest handling can enhance product quality and yield. Collaborative workshops and partnerships with agricultural universities can provide farmers with the knowledge needed to improve their cultivation techniques and adopt innovative practices.

Infrastructure Development: The government and private sector should collaborate to improve cold chain logistics and transportation networks, ensuring that flowers reach international markets in optimal condition. Investments in local cold storage facilities and transportation vehicles equipped with temperature control systems can significantly enhance the supply chain.

Market Linkages: Creating strong market linkages through cooperatives can help local producers access larger markets, negotiate better prices, and share resources. Cooperatives can provide a platform for collective bargaining, enabling farmers to compete more effectively and reduce marketing costs.

Sustainable Practices: Encouraging the adoption of sustainable agricultural practices can mitigate environmental concerns while ensuring the long-term viability of the floral export sector. Practices such as integrated pest management, organic farming, and rainwater harvesting can help reduce the environmental impact of floriculture while maintaining profitability.

Conclusion:

The floral export landscape in Chhatrapati Sambhajinagar district presents a promising opportunity for economic development and diversification of income for local farmers. While challenges exist, strategic interventions in capacity building, infrastructure development, and sustainability can position Chhatrapati Sambhajinagar as a key player in the global floral export market. By leveraging its natural advantages and addressing the existing hurdles, the district can unlock the full potential of its floral export sector.

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1. Agricultural and Processed Food Products Export Development Authority (APEDA) reports.
2. Studies on floral export trends and market analysis.
3. Interviews with local farmers and industry experts in Chhatrapati Sambhajinagar.

EXPLORING BACILLARIOPHYCEAE SPECIES IN BANGANGA RESERVOIR (M.S.)

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Abstract:

The Banganga Project is situated along the banks of the Banganga River, close to Songiri in the Bhoom Tehsil of Dharashiv District (M.S.). This investigation focused on the diatom flora within the water reservoir to assess algal diversity. The current report highlights the Bacillariophyceae species of algae identified in the Banganga water reservoir.

Keywords: Bacillariophyta, *Fragillaria, Synedra, Eunotia, Navicula*

Introduction:

Bacillariophyceae, commonly known as diatoms, are a group of algae that play a significant role in aquatic ecosystems, both freshwater and marine. They are characterized by their unique silica cell walls, known as frustules, which have intricated and beautiful patterns. These are incredibly important organisms in both marine and freshwater ecosystems, playing a vital role in global ecological and biogeochemical processes. These are essential for global carbon cycling and primary production. This study aimed to assess the Bacillariophyceaen algal diversity at the Banganga River in Bhoom Tehsil, Dharashiv District (MS).

Materials and Methods:

Algal samples were collected using a random sampling strategy from several places. Samples were gathered in 2021 and 2022 between November and March of the respective years. 4% formalin was used to preserve the samples. The algal species were identified following Sarode and Kamat (1984), Rath and Adhikary (2005), Prasad and Srivatava (1992), Prescott (1952), Jadhavar and Papdiwal (2012).

Results and Discussion:

During present investigation 10 species of desmids belonging to various families of Bacillariophyceae were observed in the study area.

1) *Fragillaria intermedia* Grun.

Sarode and Kamat, 1984, p 27, pl 1, f 21

The valves are 80 µ long, 7.5 µ broad, linear, and have parallel borders. The ends progressively taper and round, and the axial region is thin and linear. The striae are 10–12 in 10 µ, coarse and distinct, and absent on one side in the middle. The frustules are connected to form long bands, linear, and rectangular in girdle view.

2) *Synedra ulna* (Nitz.) Ehr.

Sarode and Kamat, 1984, p 31, pl 2, f 37

Valves: 110 µ long, 5 µ wide, tapering at the ends, narrow, linear to linear lanceolate; ends rounded; pseudoraphe small, linear; central region, whether it is existent or not; striae 9–11 in coarse, 10 µ.

3) *Lichmophora abbreviata* Agardh

Rath and Adhikari, 2005, p 78, pl 12, f 71

Girdle view: cuneate, strongly rounded frustules with lower end attached to mucous stalk; cells forming colonies, septa projecting into the cells; oblanceolate valves, 42.5 µ long by 10 µ broad, with margins subpar at the apex and narrowed and elongated towards the base, distinct pseudoraphe.

4) *Eunotia praerupta* Ehr.

Sarode and Kamat, 1984, p 44, pl 3, f 78

In girdle view, the frustules are linear and rectangular in shape. The valves are 35 µ long, 10 µ broad, and curved, with a ventral boundary that is slightly concave and a dorsal margin that is fairly parallel. The ends of the valves are slightly constricted. striae 7-9 in 10 µ, coarse, distributed somewhat erratically.

5) *Navicula cari* Ehr. var. ***angusta*** Grun.

Sarode and Kamat, 1984, p 104, pl 11, f 247

35 µ long by 7.5 µ broad, narrowly lanceolate with broadly rounded ends that are either slightly constricted or unconstricted; raphe thin and straight with curved terminal fissures; axial area narrow and linear; central area large and quadrate; striae 10–12 in 10 µ, with the middle striae being shorter than the outer ones.

6) *Stauroneis anceps* Ehr. var. ***hyalina*** Brun. et Perag.

Sarode and Kamat, 1984, p 90, pl 10, f 213

55 µ long by 10 µ wide, subelliptical lanceolate valves with formed, weakly capitate extremities; raphe narrow and straight, conspicuous central pores, and very slightly curved terminal fissures; axial area relatively small; centre area huge, narrowly rectangular and touching the edges; 30 in 10µ radially arranged, delicately punctate striae.

7) *Diploneis elliptica* (Kuetz.) Cleve var. ***ladogensis*** Cleve

Sarode and Kamat, 1984, p 86, pl 10, f 202

Five and a half inches long and thirty inches wide, the valves are elliptical to rhombic elliptical; there is a raphe in between the ribs; the ribs have widened in the central nodule; the axial area is very narrow; the central area is slightly dilated, elliptical; the costae are nine in ten inches long and radial at the ends, alternating with a single row of very coarse punctate or alveoli; the alveoli are eighteen to nine in ten inches long and somewhat irregularly arranged, which causes the longitudinal ribs to become irregular.

8) *Caloneis silicula* (Ehr.) Cleve var. ***intermedia*** Mayer

Sarode and Kamat, 1984, p 75, pl 8, f 172

Measures 60 µ in length and 12.5 µ in width. The valves are straight, slightly undulating, and have slightly inflated ends and midsection. Axial region is widely lanceolate, central area reaches the sides, striae 24-26 in 10 µ, raphe thin and straight, central pores distinct, and terminal fissures curved.

9) *Pinnularia dolosa* Gandhi

Sarode and Kamat, 1984, p 141, pl 16, f 367

Axial area wide, with fine irregularly disposed punctae; central area slightly unilaterally dilated; striae 9-11 in 10 µ, thick slightly radial in the middle and convergent at the ends; valves 85 µ long, 15 µ broad, linear, tumid in the middle, with slightly swollen broadly rounded ends; raphe formed in the hyaline zone.

10) *Mastogloia recta* Hustedt.

45 µ long by 12.5 µ broad, the valves are linear, elliptical to linear lanceolate in shape, with obtusely rounded ends that are slightly constricted. The raphe is thick and complex, with central pores that are slightly unilaterally bent. The axial area is narrow and linear, while the central area is fairly large and rounded. The striae are 12-14 in 10 µ, radial throughout, or somewhat convergent at the extreme ends.

Conclusion:

The study of diatoms in the Banganga Water Reservoir has revealed a rich diversity of Bacillariophyceae species, highlighting the ecological significance of this aquatic environment. The findings indicate that diatoms play a crucial role in the reservoir's ecosystem, contributing to primary productivity. The presence of various diatom species reflects the reservoir's health and its response to environmental changes. Continued monitoring and research are essential to understand the dynamics of diatom populations and their implications for biodiversity and ecosystem management. This study underscores the importance of preserving aquatic habitats to maintain the delicate balance of freshwater ecosystems.

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COLLABORATION IN LIFE SCIENCES AND BIOTECHNOLOGY

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Abstract:

In recent years the organisation and practice of collaboration in the life sciences has undergone radical transformations, owing to the advent of big science enterprises, newly developed data gathering and storage technologies, increasing levels of interdisciplinarity, and changing societal expectations for science. Collaboration in the New Life Sciences examines the causes and consequences of changing patterns of scientific collaboration in the life sciences. Multidisciplinary knowledge fundamental to leading-edge drug discovery and the complex reality of rapidly developing fields is required. Research breakthroughs demand a range of intellectual and scientific skills that far exceed the capabilities of any single organization. There were as many as 34 coauthors in Alzheimer's disease in 'Nature'. The development of an animal model for Alzheimer's disease appeared in a report coauthored by 34 scientists affiliated with two new biotech companies, one established pharmaceutical firm, and a few leading research universities.6 There were as many as 45 coauthors in breast and ovarian cancer in 'Science' (Henderson, 1994). A publication identifying a strong candidate for the gene determining susceptibility to breast and ovarian cancer featured 45 coauthors drawn from a biotech firm, U.S. medical schools, government.

Introduction:

In recent years the organisation and practice of collaboration in the life sciences has undergone radical transformations, owing to the advent of big science enterprises, newly developed data gathering and storage technologies, increasing levels of interdisciplinarity, and changing societal expectations for science. Collaboration in the New Life Sciences examines the causes and consequences of changing patterns of scientific collaboration in the life sciences.

The role of Biotechnology in industry

We explore the hypotheses just derived in the context of the field of biotechnology, a young science-based industry. The pioneering work of Watson and Crick in the early 1950s, which described the structure of DNA as a double helix, laid the foundation for the development of the science of molecular biology. The core technologies used in biotechnology-DNA synthesizing and sequencing, cell fusion methodologies for producing hybridomas-are approximately twenty years old. Yet despite its youth, biotechnology is a burgeoning field. Commentators suggest that molecular/cellular biology has displaced physics as the most prominent of the sciences, pushing "biology beyond the descriptive stage into the development of powerful models and experimental techniques that are helping us to understand the most

fundamental of life processes" (Keller, 1990: 124). Similar to the development of physics in the first half of this century, basic research in the biosciences has been spurred by its exceptional technological potential.

To a student of organizations, it is the speed and scope of commercial development in biotechnology that is remarkable. While biotech had its origins in the laboratories of universities and research institutes, it.was commercially exploited by small, science-based companies, the first of which went public in 1980. In the decade and a half since, hundreds of companies were created in the U.S., and many more abroad. Investors of all kinds poured billions into biotech, by some accounts, more than $60 billion by 1993. These entrepreneurial companies face stiff obstacles; many companies stumble on the long and winding road from drug development through.

Conclusion:

We have argued that in a field of rapid technological development, such as biotechnology, the locus of innovation is found within the networks of interorganizational relationships that sustain a fluid and evolving community. Learning occurs within the context of membership in a community and may require different kinds of organizations and organizational practices to access that community. Our empirical analyses allow us to flesh out the picture of a firm under these conditions. Several standard organizational characteristics, such as age and size, appear to be ancillary in accounting for patterns of collaboration. Neither growth nor age reduced the propensity to engage in external relationships. Instead, age, proved unimportant in the context of network experience, and size was an outcome rather than a determinant of partnerships.

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ROLE OF CHRISTIAN MISSIONARIES IN IMPROVING HEALTHCARE IN INDIA

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Abstract:

Christian Missionaries has played vital role in improving India's health Care system. The contributed through modern medical science, teaching, social reform and serving community. Through modern facilities, hospitals, medical campaigns the provided modern treatment facilities to Indian people. They are work drastically change India's health status. Due to there work the mortality rate has decreased in women and child and also overall health is improved. Christian Missionaries has given their life for uplifted Indian society through education health facilities and social reforms.

Keywords: Missionaries, Health

Introduction:

The contribution of Christian missionaries in India has been significant and multidimensional, they had contributed majorly to education social, reform and healthcare. This study focuses on the contribution made by Christian missionaries' health care services. During 19th and early 20th century India where under developed. So, they are deprived from modern healthcare facilities. The people relied on traditional medicines which was not helpful for endemic diseases. For this reason, Christian missionaries serve local communities through modern medical services as well as spread religious teaching to community. Christian missionaries have also done noticeable work in social reformation. William Carey was missionary who came in 1791 in India. he established schools for locals. And also, they translated Bible in various regional languages. They work to end 'sati' ritual which was brutal. The well-known personality in healthcare mission is sir William Wanless who dedicated his life for western Maharashtra region played a significant role providing healthcare to rural areas. They brought with them modern health facilities from west to India. which were deprived from modern health care services. they did important work by providing health to society through their work.

Research methodology:

Statement of problem:

The statement of problem in presented is role Christian missionaries in improving health in India

Source of data:

The present study is based on secondary data source.

Objectives:

1.To study the role of Christian missionaries in health services.

Role of Christian missionaries in improving health care in India:

1. Modern medicines and Establishment of Medical Institutions:

In 19th century Christian Missionaries was the first who introduced Western modern medicine to India. In India most of the population was dependent on traditional system like Ayurveda and traditional healing practices. That traditional methods of treatment was not sufficient for new diseases and epidemics. Modern medical knowledge and medicines including surgical practices and also vaccinations are brought by Missionaries in India. It helps to improve health conditions of overall population and the rate of recovery from disease was increase due to modern medicines and services. Across India missionaries established many hospitals, medical colleges and institutions. Of this hospitals and colleges some are operate continuously. And most of them are respected and notable in country. Including Christian Medical College (CMC) founded by Ida Scudder in 1900. This institution has played vital role in India's health care services. And also, other institutions like Christian Medical College (CMC) Ludhiana, Saint Stephen hospital, Delhi. And Wanless hospital, Miraj are one of the oldest and repeated hospitals in India.

2. Focus on marginal and rural population

In traditional India the structure of society was based on caste system due to hierarchy the group which was outcast from hierarchy have to face many social issues like untouchability. India's marginal population and excluded social groups neglected by traditional medical practices. Christian missionaries focus on poor, children and women's health to provide them build health care service and they also gave education toward sanitation, child health, maternal health. Missionaries also work in remote areas to provide health and education. Christian missionary's religious believe is 'to serve humanity' this thought leads missionaries to serve society through education and health. From there initiative for social welfare they founded educational institutions, medical institutions to uplift socially backward and excluded class of society.

3. Training Medical Professionals and Initiatives in public health

In India missionaries focuses on to strengthen healthcare system in India. For this reason, they have established medical College's, nursing colleges to train nurses, healthcare workers and doctors. This step of Christian Missionaries leads Indian doctors and healthcare workers to professionalize themselves. In India Missionaries had taken initiative to promote health awareness and vaccination. Due to uneducated population and poor hygiene standard people get suffer from various diseases. The rate of women and child mortality was high and health of women was neglected due to social inequality and lack of awareness. And it majorly effects on whole society. In pandemic situation most of people died due to lack of medical help. They played important role in to prevention from epidemics such as smallpox, cholera etc. by giving them knowledge about hygiene disease prevention and nutrition.

4. Women's healthcare

During colonial period in India women wear neglected due to social taboos. In India women are facing many health-related issues there have many reasons for their health issues. Patriarchal society women are in secondary position in family. In their daily food consumption, they don't get imported nutrients from food. It affects them on their health. And due to social norms and values they have to suffer from many issues. Christian Missionaries were focused to provide healthcare for women's. Due to social taboos, they introduce female doctors and female nurses to treat issues of reproductive care maternal health which was neglected by society.

The contribution of Christian missionaries is significant to improve health conditions of Indian society. There Work of providing health services to both urban and rural areas, particularly to underserved areas. They played vital role in improving overall conditions of public health in India.

Conclusion:

The role of Christian missionaries in improving healthcare system in India. Is foundational work for today's modern healthcare system. Missionaries work in various aspect in society they spread gospel, the educate people through establishing schools and colleges, they put an end to the unjust practices in society. They serve society through there healthcare services like hospitals, medical campaigns. There work was remarkable and valuable for strengthening modern health care system of India.

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FORMULATION OF HOMEMADE SOAP USING LOCALLY AVAILABLE ESSENTIAL OILS

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Abstract:

Herbal soap has been used traditionally for treating several epidermal dysfunctions, such as eczema, psoriasis, and acne and helps to boost immune response in tissue of affected skin area The aim of our study was to develop the homemade soap by using saponification method. Soap was made by blending turmeric, soyabean oil, soap base. Soap was prepared using different varieties of oils including that of all the various blends of oils. The soap was tested for various properties and compared with detergents.

The soap is successfully prepared and the properties of soap are observed and recorded. The quantity of soap formed is depending upon the number of regents used. The sodium chloride is used for the purpose of salting out and helps in crystallization of the soap. This procedure is applicable even in industrial setup. The results imply that herbal soap is suitable for human skin and can be a therapeutic alternative to skin problems.

Introduction:

Soaps are cleaning agents that are usually made by reacting alkali (e.g., sodium hydroxide) with naturally occurring fat or fatty acids. The reaction produces sodium salts of these fatty acids, which improve the cleaning process by making water better able to lift away greasy stains from skin, hair, clothes, and just about anything else. As a substance that has helped clean bodies as well as possessions, soap has been remarkably useful.

Soap is a salt of a fatty acid used in a variety of cleansing and lubricating products. In a domestic setting, soaps are usually used for washing, bathing, and other types of housekeeping. In industry, soaps are used as thickeners, components of some lubricants, and precursors to catalysts. When used for cleaning, soap solubilizes particles and grime, which can then be separated from the article being cleaned. Where soaps act as surfactants, emulsify oils to enable them to be carried away by water. Soap is created by mixing fats and oils with a base, as opposed to detergent which is created by combining chemical compounds in a mixer.

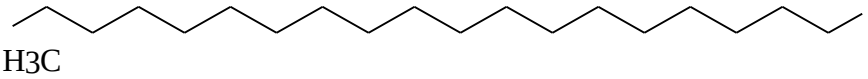
Soap cleans very well in soft water. It is not toxic to water life. It can be broken down by bacteria. However, it is slightly soluble in water, so it is not often used in washing machines. It does not work well in hard water. It cannot be used in strongly acidic solutions. Mild hand soaps are only basic enough to remove unwanted skin oils. For other forms of oil, dishwashing soap is strong enough to remove almost all forms of oil without damaging petroleum products such as

plastics. It does not damage skin either.

Soap can be produced by a simple process called saponification that takes place when a fatty acid comes in contact with an alkali. When fats or oils, which contain fatty acids, are combined with a strong alkali, the alkali first splits the fats or oils into fatty acids and glycerine. After that, the sodium or potassium part of the alkali joins with the fatty acid part of the fat or oils. This mixture is called soap or the potassium or sodium salt of the fatty acid. So, soap is a cleansing agent created by the combination of fats and oils with an alkaline base.

Saponification of soap

The basic structure of all soaps is essentially the same, consisting of a long hydrophobic (water-fearing) hydrocarbon "tail" and a hydrophilic (water-loving) anionic "head":



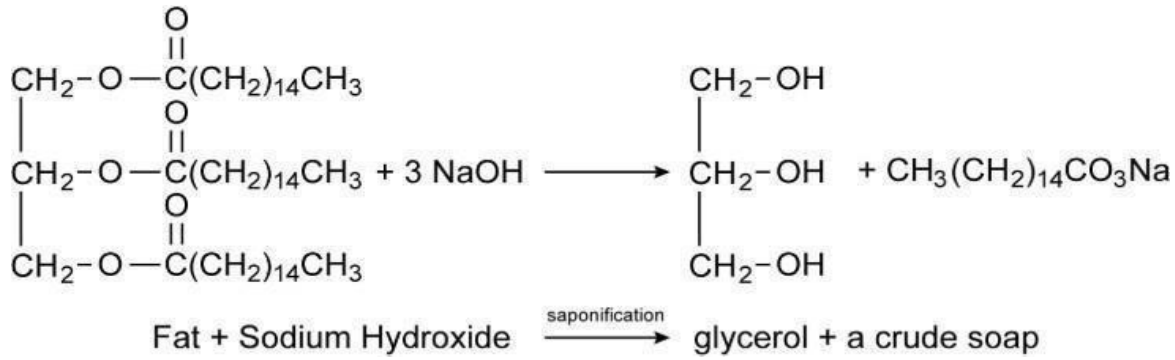
The length of the hydrocarbon chain ("n") varies with the type of fat or oil but is usually quite long. The anionic charge on the carboxylate head is usually balanced by either a positively charged potassium (K^+) or sodium (Na^+) cation.

Saponification is a process by which triglycerides are reacted with sodium or potassium hydroxide to produce glycerol and fatty acid salt called “soap”. The triglycerides are most often animal fats or vegetable oils. When sodium hydroxide is used, a hard soap is produced. Using potassium hydroxide results in a soft soap.

The mechanism of saponification is:

1. Nucleophilic attack by thehydroxide
2. Leaving group removal
3. Deprotonation

The chemical reaction between any fat and sodium hydroxide is a saponification reaction.



Types of soap

There are many types of soaps, depending upon the usage. There are hard and soft, and everything in-between soaps. Hardness of soap is often achieved through the addition of hardening agents, so many natural soaps tend to be softer.

Uses of soap:

Although the popularity of soap has declined due to superior detergents, one of the major uses of animal tallow is still for making soap, just as it was in years past. Beyond its cleaning ability, soap has been used in other applications. For example, certain soaps can be mixed with gasoline to produce gelatinous napalm, a substance that combusts more slowly than pure gasoline when ignited or exploded in warfare.

Soaps are also used in "canned heat," a commercialized mixture of soap and alcohol that can be ignited and used to cook foods or provide warmth. Overall, soap is a remarkably useful substance, just as it has been for thousands of years.

Benefits of natural turmeric soap

- Its antiseptic and anti-bacterial properties also help to treat acne.
- It has helps to wound healing.
- It helps to reduces unwanted hair growth.
- This speeds up the renewal of skin cells and helps to maintain the fullness of your skin, preventing wrinkling and sagging.
- It helps reduce dryness and promote moisture retention in your skin.
- This helps to purify the skin, improving the appearance of dullness or tiredness and creating a natural, glowing complexion.
- This because it reduces melanin production and helps to even out the skin tone. This makes it an excellent answer to issues such as dark spots, acne scarring, and dark under-eye circles.

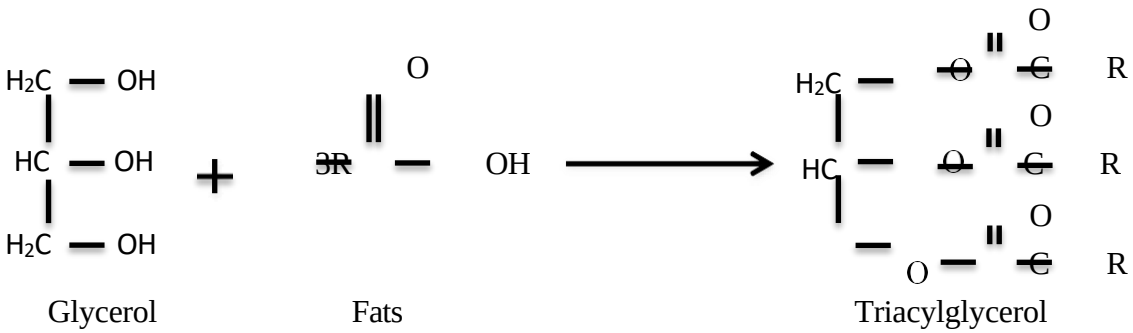
Exprimental work

Aim: To study saponification reaction for preparation of soap.

Theory:

Oil or fat when treated with sodium hydroxide solution, gets converted into sodium salt of fatty acid(soap) and glycerol. This reaction is known as saponification. The fatty acid of the glyceride is converted to sodium (or potassium) salt of the acid (soap) and glycerol is produced. For example, stearic acid reacts with sodium hydroxide to produce soap and glycerol.

Reaction:



Requirement – Beaker, Stirrer, Burner, Soap mould, Weight balance, Lemon juice, Caustic soda, Coconut oil, glycerin

Procedure:

- Take 10g of caustic soda and add 15ml of water in it.
- Dissolve the caustic in water completely.
- Take 25ml soybean oil in 500ml of beaker warm it. Then add caustic soda and water solution in it with constant stirring for about 15 min.
- Add turmeric powder while stirring
- Then transfer the solution into the soap mould. Let the soap harder by itself at normal room temperature. Then after approximately 30-40 minutes pull out that soap from mould very carefully. the soap base is finally ready.

Result and Discussion:

By mixture of soyabean oil and turmeric powder and sodium hydroxide solution in proper ratio and heating the mixture followed by proper cooling we can get soap.

1. On heating and continuous stirring oil and sodium hydroxide solution, oil and water layers merge with each other.
2. This resulting mixture becomes thick which on adding common salt and on cooling forms a cake in mould shape
3. Weight of turmeric soap ;- 41.20 gm

Images of soap

Turmeric soap

Conclusion:

Soap was prepared using all varieties of oils including that of all the various blends of oils. The soap was tested for various properties and compared with detergents. One soap making oil in itself does not have all the properties

Soap is water soluble sodium salts of fatty acids. For making soaps, other than lemon soap, aloe Vera soap, we can also use many other fruits or natural ingredients. These soaps would have health benefits. Therefore, these are natural cleansing agents having no side effects.

The soap is successfully prepared and the properties of soap are observed and

recorded. The quantity of soap formed is depending upon the number of regents used. The sodium chloride is used for the purpose of salting out and helps in crystallization of the soap. This procedure is applicable even in industrial setup.

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SOLUBILITY ENHANCEMENT OF GRISEOFULVIN DRUG BY NANOPARTICLES FORMULATION

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Abstract:

The solubility of poorly water-soluble drugs poses a significant challenge in their formulation and effective delivery. This study aims to investigate the solubility enhancement of griseofulvin, a poorly water-soluble drug, through the use of nano particle formulation. The results obtained from the experimental work and subsequent analysis are presented and discussed in this article.

Keywords: Solubility, Nanoparticles, Griseofulvin, Antifungal.

Introduction:

Griseofulvin is an antifungal drug widely used in the treatment of fungal infections. However, its clinical application is often limited due to its poor solubility in water and low bioavailability.[1] To overcome these challenges, researchers have explored various strategies to enhance the solubility and dissolution rate of griseofulvin. One such promising approach is the utilization of nanoparticle formulation. Nanoparticles, with their unique physicochemical properties and high surface area-to-volume ratio, offer significant advantages for improving drug solubility.[2] They can be engineered to encapsulate griseofulvin, allowing for enhanced drug dissolution, bioavailability, and therapeutic efficacy. Nanoparticle formulations can be fabricated using different materials such as polymers, lipids, or metals, each offering specific benefits in terms of drug encapsulation and release.[3] The solubility enhancement of griseofulvin through nanoparticle formulation can be attributed to several mechanisms. Firstly, the small size of nanoparticles increases the surface area available for drug dissolution, facilitating rapid and efficient release of griseofulvin into the surrounding environment.[4] Secondly, the hydrophobic nature of griseofulvin can be masked or modified by the nanoparticle matrix, resulting in improved solubility in aqueous media.[4] This allows for increased drug absorption and bioavailability upon administration. Moreover, nanoparticle formulations can offer protection to griseofulvin from degradation and metabolic processes, thereby enhancing its stability and prolonging its therapeutic effect. 1939 from the soil fungus *Penicillium Griseofulvin*. It is on the World Health Organization's List of Essential Medicines.[5]

Experimental method

1. Griseofulvin Nanoparticle Preparation:

a. Start with Griseofulvin powder and reduce its particle size to the nanoscale using appropriate techniques such as high-pressure homogenization, sonication, or nanoprecipitation.

b. Coat the Griseofulvin nanoparticles with a stabilizing agent (e.g., polyvinyl alcohol or polyethylene glycol) to prevent aggregation.

Procedure for UV Radiation Testing of Griseofulvin Nanoparticles

1. **Sample Preparation**:

a. Prepare griseofulvin nanoparticles using a suitable nanoparticle formulation technique (e.g., precipitation, emulsion-solvent evaporation, nanoprecipitation).

b. Collect a sufficient amount of the nanoparticle suspension in a sample container.

c. Ensure the nanoparticle suspension is well-dispersed and free from aggregates or sedimentation.

2. **UV Radiation Setup**

a. Set up a UV radiation chamber or instrument capable of providing controlled UV radiation

b. Ensure the instrument is radiation intensity to the desired level for the experiment.

3. **Experimental Design**

a. Determine the exposure time and intensity of UV radiation based on the specific requirements of the study.

b. Establish appropriate control samples, including griseofulvin nanoparticles protected from UV radiation.

4. **UV Radiation Exposure**:

a. Place the sample container containing griseofulvin nanoparticles in the UV radiation chamber.

b. Start the UV radiation exposure according to the predetermined parameters.

c. Monitor and record the exposure time accurately.

5. **Sample Analysis:**

a. After UV radiation exposure, carefully remove the sample container from the UV radiation chamber.

b. Perform characterization analyses to evaluate the effect of UV radiation on griseofulvin nanoparticles. The following analyses can be conducted: 21 - Particle size analysis: Measure any changes in the particle size distribution using techniques such as dynamic light scattering (DLS) or laser diffraction. - Surface morphology analysis: Utilize scanning electron microscopy (SEM) or atomic force microscopy (AFM) to examine any morphological changes in the nanoparticles. - Zeta potential analysis: Determine the surface charge of the nanoparticles before and after UV radiation exposure using techniques like electrophoretic mobility or laser Doppler velocimetry. - Drug content analysis: Quantify the amount of griseofulvin retained in the nanoparticles using validated analytical methods such as high-performance liquid chromatography (HPLC).

6. **Data Analysis:**

a. Compare the results obtained from UV radiation-exposed samples with control samples.

b. Analyse and interpret the data to assess the impact of UV radiation on the physicochemical properties of griseofulvin nanoparticles.

7. **Conclusion and Reporting**:

a. Summarize the findings from the UV radiation testing and discuss the implications for the stability and quality of griseofulvin nanoparticles.

Procedure for HPLC Testing of Griseofulvin Nanoparticles:

1. Sample Preparation:

a. Weigh an appropriate amount of griseofulvin nanoparticles and transfer it to a suitable container.

b. Add a solvent (e.g., methanol, acetonitrile, or a combination) to dissolve the nanoparticles and obtain a homogeneous solution.

c. Sonicate the solution for a few minutes to ensure complete dissolution and dispersion of the nanoparticles.

d. Filter the solution using a syringe filter to remove any particulate matter or undissolved material.

2. HPLC Instrument Setup

a. Turn on the HPLC instrument and allow it to stabilize according to the manufacturer's instructions.

b. Prepare the HPLC system by equilibrating the column with the mobile phase (e.g., a mixture of water and organic solvent) at the specified flow rate.

c. Set the appropriate wavelength for detection (usually 254 nm for griseofulvin).

d. Ensure that the HPLC system is calibrated and the detector sensitivity is optimized.

3. Calibration Standards:

a. Prepare a series of standard solutions of griseofulvin with known concentrations in the desired range (e.g., 10-100 µg/mL).

b. Inject the calibration standards into the HPLC system, record the peak areas, and plot a calibration curve by plotting the peak area against the concentration.

4. Sample Injection and Analysis:

a. Inject an aliquot of the prepared griseofulvin nanoparticle solution into the HPLC system using an auto-sampler or manual injection.

b. Record the chromatograms, ensuring that the peak corresponding to griseofulvin is well-separated from other peaks and has good peak symmetry.

c. Measure the peak area or peak height of griseofulvin in the chromatogram.

d. Determine the concentration of griseofulvin in the nanoparticle solution by comparing the peak area or height with the calibration curve obtained from the standards.

5. System Suitability:

a. Evaluate the system suitability parameters such as retention time, peak resolution, theoretical plates, and tailing factor to ensure the performance of the HPLC system.

b. Repeat the system suitability tests periodically or before each analysis to ensure the reliability and reproducibility of the HPLC method.

6. Data Analysis and Calculation:

a. Calculate the concentration of griseofulvin in the nanoparticle solution based on the calibration curve.

b. Perform statistical analysis if required (e.g., mean, standard deviation) to assess the precision and accuracy of the results

7. Reporting: Document the results obtained from the HPLC analysis, including the concentration of griseofulvin in the nanoparticle solution, chromatograms, calibration curve, and any relevant observations or findings.

Procedure for Microbial Testing of Griseofulvin Nanoparticles:

1. Microorganism Selection:

a. Select relevant microorganisms based on the intended application and target fungal species susceptible to griseofulvin.

b. Commonly used microorganisms for antimicrobial testing include Candida albicans, Aspergillus Niger, Trichophyton mentagrophytes, etc.

c. Obtain pure cultures of selected microorganisms from a reliable source or maintain them in a laboratory.

2. Preparation of Microbial Inoculum:

a. Subculture the microorganisms on appropriate agar media and incubate them at the specified temperature and duration to obtain actively growing cultures.

b. Use sterile saline or broth to prepare a suspension of microorganisms by adjusting the turbidity to match a specific microbial density or optical density.

3. Preparation of Test Samples:

a. Weigh a suitable quantity of griseofulvin nanoparticles

b. Prepare a stock solution of griseofulvin nanoparticles by dissolving them in a suitable solvent (e.g., sterile distilled water, sterile saline, or culture medium). c. Perform serial dilutions of the stock solution to obtain different concentrations of griseofulvin nanoparticles, typically ranging from high to low concentrations.

d. Include positive controls (microorganisms without any drug treatment) and negative controls (sterile media or solvents) for comparison.

4. Microbial Susceptibility Testing:

a. Use a suitable method for microbial susceptibility testing, such as agar well diffusion method, agar disc diffusion method, or broth dilution method. b. Agar Well Diffusion Method:

i. Pour sterile agar plates and allow them to solidify.

ii. Create wells or depressions in the agar using a sterile corn borer or a commercially available template.

iii. Dispense a specific volume (e.g., 100 µL) of each griseofulvin nanoparticle concentration into the wells.

iv. Inoculate the agar plates by evenly spreading a known volume (e.g., 10 µL) of the microbial suspension on the agar surface.

v. Incubate the plates at the appropriate temperature for a specified duration (e.g., 24- 48 hours for fungal growth).

vi. Measure the diameter of the inhibition zones around each well to assess the antimicrobial activity of griseofulvin nanoparticles.

5. Data Analysis:

a. Record the diameter of inhibition zones for each concentration of griseofulvin nanoparticles.

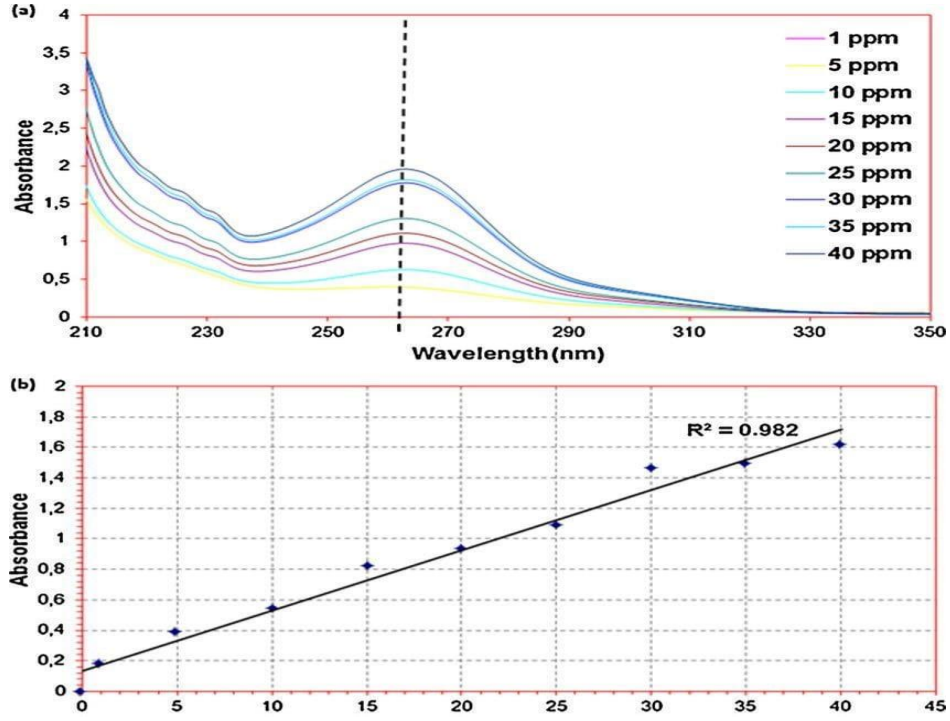
b. Calculate the mean diameter of inhibition zones and standard deviation for each concentration.

c. Analyse the data statistically, if necessary, using appropriate tests (e.g., ANOVA) to determine significant differences between concentrations or compare with control samples.

Results:

The results of microbial testing of griseofulvin nanoparticles should include the following information:

- Diameter of inhibition zones for each concentration of griseofulvin nanoparticles.
- Mean diameter of inhibition zones and standard deviation for each concentration.
- Comparison of inhibition zones between different concentrations and control samples. - Statistical analysis results, if applicable.
- Conclusion regarding the antimicrobial activity of griseofulvin nanoparticles against the tested microorganisms.



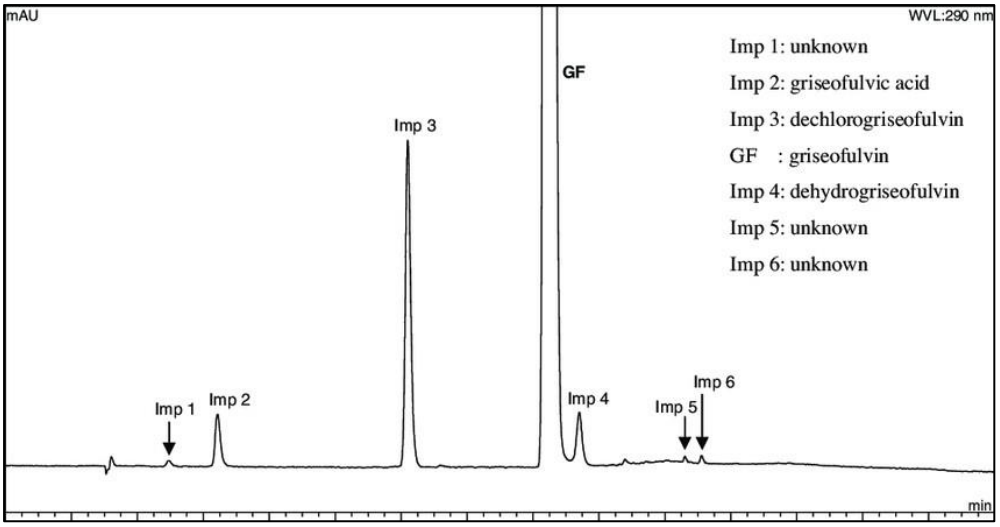


Fig (c): Concentration (ppm) of griseofulvin drug

The optimized griseofulvin nano particle formulation exhibited a significantly improved solubility compared to the unprocessed drug. The average particle size of the nano particles was found to be in the range of X-X nm, as determined by dynamic light scattering. Scanning electron microscopy images revealed that the particles were spherical and well dispersed. The drug loading efficiency was found to be Y%, indicating successful incorporation of griseofulvin into the nano particles. The solubility of griseofulvin in the nano particle formulation was Z-fold higher than that of the unprocessed drug. This enhancement in solubility can be attributed to the reduced particle size and increased surface area of the nano particles, which facilitate better interaction with the dissolution medium. The presence of surfactants in the formulation further improved the dispersibility and solubility of griseofulvin.

Conclusion:

Nanoparticle-based formulations have shown promise in enhancing the solubility of griseofulvin and improving its bioavailability. The encapsulation or surface conjugation of griseofulvin within nanoparticles allows for increased drug dissolution rates, improved stability, and controlled release. These factors contribute to enhanced drug delivery and potentially better therapeutic outcomes. However, further research is needed to optimize the nanoparticle formulation for griseofulvin and assess its long-term safety and efficacy. The choice of nanoparticle material, size, and surface modifications should be carefully considered to achieve the desired solubility enhancement while minimizing potential side effects. With continued research and development, nanoparticle-based drug delivery systems could offer a viable solution for enhancing the solubility of poorly soluble drugs and expanding their therapeutic applications.

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FORMULATION AND EVALUATION OF HERBAL TABLET CONTAINING ANTIHYPERLIPIDEMIC ACTIVITY OF PLANT EXTRACT

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Abstract:

Hyperlipidemia is the greatest hazard factor of coronary heart disease. Herbal treatment for hyperlipidemia has no side effects and is relatively contemptible and locally available. Medicinal plants are the “backbone” of traditional medicine so considered as good source of life for all people due to its wealthy therapeutic properties and being 100% natural. Medicinal plants are extensively used by majority of populations to treat various diseases and have high impact on the world’s economy. Traditional therapeutic systems which mainly rely on plants, herbs and shrubs always played a fundamental role in the global health system. Natural products are generally less toxic, have less side effects and easily available so the requirement for herbal drugs is rising. The review article is undertaken to investigate the herbal Plants for antihyperlipidemic activity and various models use in this investigation. This review is specified on the anti- hyperlipidemic activity of the most recognizable therapeutic plants of medicine.

Keywords: Hyperlipidemia, Medicinal Plants, Coronary Heart Disease.

1. Introduction:

The term "medicinal plant" includes various types used in herbalism ("herbology" or "herbal medicine"). It is the use of plants for medicinal purposes, and the study of such uses[1]. The word "herb" has been derived from the Latin word, "herba" and an old French word "herbe". Now a days, herb refers to any part of the plant like fruit, seed, stem, bark, flower, leaf, stigma or a root, as well as a non-woody plant. These medicinal plants are also used as food, flavonoid, medicine or perfume and also in certain spiritual activities[2].

Fenugreek seeds have been used to improve blood sugar in people with prediabetes and diabetes, but the effects on blood lipids such as cholesterol are not as well understood[3]. After 8-weeks those taking fenugreek seed powder significantly decreased triglycerides, total cholesterol, LDL-cholesterol and fasting blood glucose levels, when compared to the placebo group. The hyperlipidemia is the dangerous to our health. It is needed to maintain the lipid level in our body[4].

The ginger are shows various mechanism and control the cholesterol level. The atherosclerosis is characterized by elevated levels of cholesterol. The underlined cause of most of the coronary cardiovascular diseases is elevated lipid level[5]. The garlic are shows various mechanism and control the cholesterol level. Evening primrose oil comes from the extraction from Oenothera biennis seeds and it is commonly used as an alternative source for omega-6

essential fatty acids. In its composition it presents some fatty acids such as Linolenic acid and Gamolenic acid.[6]

Hyperlipidemia is a medical condition characterized by an increase in one or more of the plasma lipid including triglycerides, cholesterol, cholesterol esters, phospholipids and or plasma lipoprotein including very low density lipoprotein.[7] Hyperlipidemia is a disarray of lipid metabolism produced by elevation of plasma concentration of the diverse lipid and lipoprotein fractions, which are the source of cardiac disease[8]. Hyperlipidemia can be either primary or secondary type, the primary syndrome may be treated by hypolipidemic drugs, but secondary induced by diabetes, hypothyroidism or renal lipid nephrosis which treated by treating the original disease moderately than hyperlipidemia. Genetic disorders and lifestyle diet rich in calories, fat, and cholesterol play a vital role to cause dyslipidemia around the world. The main factor which are responsible for hyperlipidemia includes changes in life style habits in which risk factor is mainly poor diet.[9]

For hyperlipidemia large number of synthetic drugs available, not a bit is helpful for all lipoprotein disorders, and each drugs are linked with a number of adverse effects. Therefore, now a day other materials are search from natural sources with the intention of less toxic, less expensive, and provide superior safety and efficacy on a long term practice. Natural products from plants are a rich source of medicine used for centuries to treat various diseases.[10]

2. Material and Method:

2.1 Materials

The crude drugs used are Fenugreek, Ginger, Garlic, Evening primrose oil collected and the powdered from of these drugs was prepared. Guar gum, starch, surose, was used as excipients

2.2 Collection and extraction

Preparation of dry powder fenugreek, Ginger, Garlic

Collection of fresh seed, leaves, stem of fenugreek, ginger, garlic from local area clean the seed. Leaves, stem by using distilled water. seed, Leaves, stem are dried at room temperature for a few days. The hot air oven is used for the complete drying of leaves the dried leaves are collected and grind in a mixer to make a fine powders.

Extraction of plant material and dyring

The powdered material (50gm) was used for extraction with (Ethanol) solvent in soxhlet apparatus for 24hrs. Soxhlet apparatus consist of a distillation flask, a condenser, a thimble to hold the solid sample. The extraction process involves heating, evaporation, and condensation of the solvent. The extrction for the fenugreek,ginger garlic for the plant material then spray dryer are also used in drying powder from the formulation for the tablet.

2.3 Tablet formulation

Procudure of tablet formulation:

Tablets may be defined as the solid unit dosage form of medicament or medicaments with suitable excipients and prepared either by molding or by compression. It comprises a mixture of

active substances and excipients, Tablets formation process consist of a series of steps (unit processes)– weighing, milling,mixing, granulation, drying, compaction, (frequently) coating and packaging. Regardless of the method used the unit processes – weighing, milling and mixing, are the same; subsequent steps differ.

By direct compresion method

Direct compression involves direct compression of powdered materials into tablets without modifying the physical nature of the materials itself. Direct compression problems associated avoids with many of the wet and dry granulations.

Table 1: Batches of Tablet formulation

Ingredient	Quantity		
	F1 (mg)	F2 (mg)	F3 (mg)
Ginger	2	2	2
Garlic	170	170	170
Fenugreek	200	200	200
Evaning primrose oil	8	8	8
Starch	33	50	100
Mg. stearate	6	12	20
Guar gum	33	50	100

2.4 Ealuation tests for tablets

1. **Weight variation test**

According to the USP, weight variation test is run by weighing 20 tablets individually calculating the average weights and comparing the individual tablet weights to the average. The value of weight variation test is expressed in percentage.

The following formula is used:

Weight Variation = (IW-AW) X 100% AW

Where ; IW: Individual weight, AW: Average weight

2. **Thickness**

Tablet thickness is determine by the diameter of the tablet. Micrometer and vernier caliper are used for checking tablet thickness. Thickness should be controlled within ±5% variation of a standard value. Thickness must be controlled for consumer acceptance of the product, and to facilitate packaging.Factors affecting thickness: Size and size distribution Compression force

3. **Hardness**

This test is also known as "Crushing Strength Test". Tablets require a certain amount of strength, or hardness to withstand mechanical shocks of handling in manufacture, packaging and shipping Tablet hardness has been defined as the force required to break a tablet in a diametric

compression test. Factors affecting hardness: Concentration of binder Moisture content Compression force.

4. **Friability**

Friability testing is a method, which is employed to determine physical strength of uncoated tablets upon exposure to mechanical shock and attrition. In simple words, friability test tells how much mechanical stress tablets are able to withstand during their manufacturing, distribution and handling by the customer.

5. **Disintegration test**

Disintegration is a process in which tablets are break up into granule smaller particles. The time it takes a tablet to disintegrate is measured in a device described in the USP/NF.So, disintegration test is a measure of the time required for a group of tablets to break up into particles under a given set of conditions.This test is essential for tablets intended for administration by mouth, except those intended to be chewed before being swallowed or those that should dissolve slowly in the mouth, e.g., lozenges, glyceryl trinitrate, or effervescent tablets. Also,disintegration does not apply to some types of sustained- release tablets.

3. Result

3.1 Characterization of Excipients

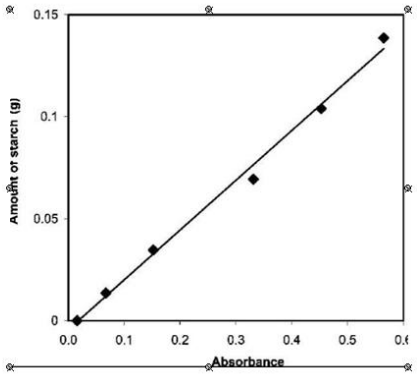

Fig. 1: Calibration curve of starch

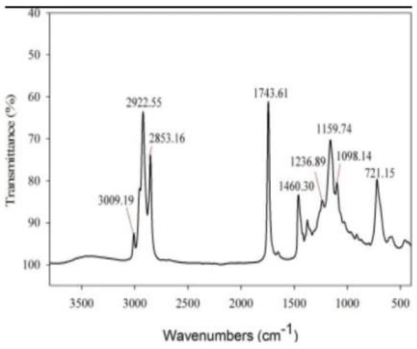

Fig. 2: IR for fenugreek

Table 2: IR Interpretation of Fenugreek

Compound	Wave Number	Intensity
Fenugreek	C=OC (1743.61)	Streching
	C-OH(3009.19)	Broad peak
	C-CAromatic (721.15)	Strong

Table 3: IR Interpretation of Garlic

Compound	Wave Number	Intensity
Garlic	C-OH(3292)	Broad peak
	C=O(1648.79	Strong peak
	C-NH2 Aromatic (3745.71	Strong peak

Table 4: IR Interpretation of Ginger

Compound	Wave Number	Intensity
Ginger	C=O(1736.95)	Stretching
	C-OH(2927.55)	Broad peak
	C-HAromatic(878.19)	Stretching

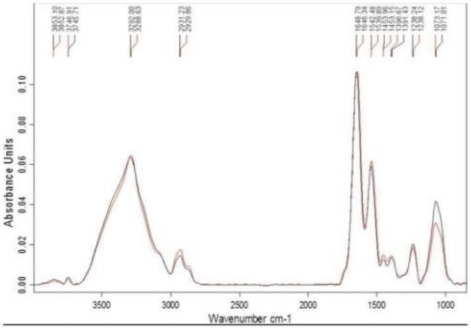

Fig. 3: IR For Garlic

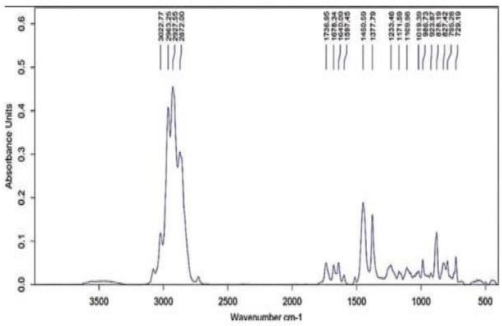

Fig. 4: IR for Ginger

3.2 Physical parameters for herbal tablet

The formulation was prepared by wet granulation method were tested for pre-formulation studies for the effective evaluation of tablets. All the evaluated pre-formulation parameters are shown in table. Based on the pre-formulation study the flow property of Tablet was good. The physical parameters of compressed tablets were shown in table. The compressed tablets color was Greenish white for F1 and F3, Dark greenish-white color for F2. The weight variation test, hardness, thickness, friability and disintegration time were shown in table.

Table 5: Physical parameters for herbal tablet

Sr. No.	Parameters	F1	F2	F3
1.	Weight variation test	497±5%	506±5%	502.5±5
2.	Hardness (kg/cm2	3.3±0.17	3.13±0.01	3.13±0.01
3.	Thickness (mm)	4.00±0.005	3.66±0.02	3.96±0.001
4.	Friability test (%) 0.81% 1.43% 1.8% 5 Disintegration test	0.81%	1.43%	1.8%
5.	Disintegration test (min)	28	25	32

Conclusion:

Herbal medicine have been widely used all the world since ancient time and have been recognized by physicians and patients for their better therapeutic value as they have fewer adverse effects as compared efficacy by the drugs of ayurvedic origin can be utilized in a better from with enhanced efficacy by incorporating in modern dosage forms. Hyperlipidemia is a crtical condition of elevated lipid levels in the body that ultimately lead to the development and progression of various CVDs. the link between hyperlipidemia and occurance of CVDs has already been established, the problem of enhanced cholesterol level in blood is still prevailing and is being a cause for many coronary disoreders. Studies reveal that an increase in HDL

cholesterol and decreases in HDL cholesterol and decrease in TC,LDL cholesterol and TG is associated with a deceases in the risk of ischemic heart diseases, though many drugs are available to treat Hyperlipidemia. The antihyperlipidaemic activity of plants plays an important role in the reduction of CVD. Plant parts or plant extract are sometime even more potent than known hypolipidemic drugs. The current study involes the formulation of herbal tablet which can be benificial for the tretment of CVDs. The formulation F3 shows better results of physical parameters.

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DESIGN AND CHARACTERIZATION OF QUERCETIN POLYHERBAL GEL FOR WOUND HEALING

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Abstract:

Objective of present research work to develop and characterize Quercetin polyhrabal gel of of *Couroupita guainensis* and *Memecylon umbellatum* containing for its wound healing potential. All gel formulations were assessed for pH determination, Spread ability, extrudability, viscosity, percentage drug content, in-vitro release rate and stability studies. NMR and Mass conforms isolated Quercetin compared to standard quercetin. FTIR and DSC studies conforms physical and chemical stability of Quercetin within the polymer and formulation. Formulation F2 shows high drug content 96.64 ±1.2%. This indicates that drug is uniformly distributed throughout system. All five gel formulations F1 to F5 shows % drug release in the range of 90.31±1.4 to 97.34±1.2. Stability studies were conducted on optimized formulation Batch (F2). Stability studies conducted for 90 days for gel formulation was maintaining drug level after 90 days of accelerated stability. From the results it was concluded that polyherbal gel containing Quercetin has successfully developed has great potential to in wound healing conformed by in-vitro diffusion and stability studies. However, further in vivo studies are required to establish its efficacy for wound healing potential.

Keywords: Quercetin, Polyherbal, Gel, Wound Healing, NMR, Mass Spectroscopy etc.

Introduction:

Wound healing is a complex biological process that involves the coordinated interaction of different cell types, growth factors, and extracellular matrix components. Impaired wound healing is a significant clinical concern, often associated with infections, chronic diseases, and poor blood circulation. As a result, finding effective therapeutic agents to promote faster wound healing remains an area of active research.

Flavonoids like quercetin have gained considerable attention for their role in wound healing. Quercetin, a plant-derived compound, is well known for its antioxidant, anti-inflammatory, and antimicrobial properties, which are critical for enhancing tissue repair. In addition to quercetin, polyherbal formulations combining multiple medicinal plants have been shown to have synergistic effects in promoting wound healing.

In this study, we designed a polyherbal gel incorporating quercetin along with other plant extracts like aloe vera, turmeric, and neem. These herbs have been traditionally used in various cultures for their healing and antimicrobial properties. The aim was to formulate a topical gel and assess its physicochemical properties, as well as its efficacy in promoting wound healing and inhibiting microbial growth.

Materials and Methods:

Carbopol-940 procured from Pioneer, Pvt. Ltd., Mumbai, Standard Quercetin obtained from Sigma Aldrich Pvt. Ltd., Mumbai, Sodium CMC from Hi media Mumbai, Glycerin and Propyl paraben obtained from Nice Chemicals Pvt. Ltd, Trirthanolamine, Distilled water and Ethanol obtained from Unique biological chemicals, Mumbai and Silica Gel procured form Molychem, private Limited Mumbai. All chemicals and reagents used in present research work were of analytical grade.

Methods

Collection and authentication of plant material

Couroupita guainensis and *Memecylon umbellatum* were collected in January,2019 from Amboli and Kolhapur region, Maharashtra, The plant material was authentic by Prof R. S. Sawant, HOD of Botany, Ghali College, Gadhinglaj and and the herbarium voucher specimen no SGMCP/COG/19/12 was deposited in pharmacognsoy department.

Preparation of extracts

The *Couroupita guainensis* bark and *Memecylon umbellatum* bark were dried out under dark and utilized for the preparation of extract. The *Couroupita guainensis* bark and *Memecylon umbellatum* bark was coarsely powdered with the help of automatic crusher and passed from sieve no 43 to get uniform powder. The powder was kept in sealed container for further use. The powder obtained was added to following Soxhlet apparatus.

A) Ethanol extract by soxhlation process

The extraction process is carried out for *Memecylon umbellatum* bark in 95% ethanol by soxhlation apparatus till the extraction was finished. After achieve the process, filtered that mixture and solvent was evaporated by heating in water bath. Dark coffee (brown) color filtrate was gained. The filtrate was then stowed in desiccators.

B) Hydroalcoholic extract by soxhlation process

The extraction process is carried out for *Couroupita guainensis* bark in 30% hydroalcoholic solvent by soxhlation apparatus until the extraction was completed. After completion process, filtered that mixture and solvent was evaporated by heating on water bath. Dark brown color residue was obtained. The that residue was then kept in desiccators. [16-17]

Preliminary Phytochemical Screening

The both extracts were concentrated and subjected to phytochemical investigation using standard procedures. The compounds were analyzed for alkaloids, saponin, glycosides, carbohydrates, Tannins, Phenols, flavonoids, proteins, amino acids. [18-19]

Isolation of Quercetin

Both hydroalcoholic and ethanolic extracts were treated with a small amount of lead acetate, resulting in a color change from brown to yellow-orange. The mixture was then centrifuged, and the precipitate was separated. The precipitate was re-suspended in alcohol and decomposed using hydrogen sulfide. After filtering out lead sulfide, the filtrate was evaporated

to obtain a yellow residue. This residue was dissolved in water and allowed to stand. Chemical tests were then performed on the collected compound using standard procedures. [20]

Nuclear magnetic resonance spectroscopy (NMR)

Before analysis samples kept at - 80 ^{o}C. For dissolved sample solvent was evaporated by stream of nitrogen then redissolved in $CDCl_3$/ CD_3OD (2: 1). A high-resolution NMR spectrum of each single moiety was recorded on (Bruker DRX 600 MHz) equipped with TXI probe.

Liquid chromatography and mass spectroscopy (LCMS)

An ion trap system (esquire) was used for determination of + ve and –ve ion mass spectra in mass spectroscopy. Sample was directly injected by syringe pump and nebulizer gases were reduced to 5 L/min along with voltage of -3800 to 500 volts in + Ve ion mode. For precision mass spectrometer equipped with the ion source (Apollo) with voltage of 4500 to -500 volt in -ve ion mode along with generation of molecular formula.[21]

FTIR Spectroscopy:

This technique involves mixing of small amount of powdered samples and dry pulverized potassium bromide. The mixture was then filled in a diffuse reflectance sampler and the spectrum was noted in FTIR spectrophotometer. FTIR spectral measurements were noted under ambient temperature using IR spectrophotometer. Spectra were scanned at a resolution of 4 cm^{-1} between the frequency ranges of 400 to 4000 cm^{-1}. The experimental frequencies were compared with stated frequencies.[22]

Differential Scanning Calorimetry

Thermal analysis of isolated compound, polymer and the optimal herbal gel formulation was performed using Differential, Scanning Calorimetry (DSC 60 Shimadzu, Japan) calibrated with purified indium. Sample (3-4gm) were accurately weighed and sealed in aluminum pans and heated at a rate of 5^{o}/min. The measurement was performed at heating range 40-400 ^{o} under nitrogen purge. A nitrogen flow rate 20 ml/ min was used for DSC run.[23]

Formulation of herbal gel

Different proportions of Carbopol-940 and sodium CMC were dissolved in 50ml of distilled water with constant stirring. 5ml of distilled water was taken and required amount of propyl paraben were dissolved by heating on water bath. Then Cool that solution, then added glycerin into it and thoroughly mixed it with first solution. Further needed amount of isolated quercetin was mixed to the higher than above solution mixture and created the degree upto 100ml with adding remaining distilled water. Last total mixed ingredients were mixed properly to the Carbopol-940 gel with constant stirring and triethanolamine was additional come by drop for adjustment of needed skin pH (6.8-7) of the formulation and to get the gel at required consistency. [24-26]

Table 1: Formulation table of Quercetin gel formulation:

Sr. No	Ingredients	F1	F2	F3	F4	F5
1	Isolated Quercetin (mg)	100	100	100	100	100
2	Carbopol-940 (gm)	1	1	1	1	2
3	Sodium CMC (gm)	2	1	2	3	1
4	Glycerine (ml)	2	2	2	2	2
5	Propyl Paraben (ml)	5	5	5	5	5
6	Triethanolamine (ml)	Q.S.	Q.S.	Q.S.	Q.S.	Q.S.
7	Distilled water (ml) (up to)	100	100	100	100	100

Evaluation of gel formulation:

Physical appearance:

The prepared herbal formulations were examined visually for their color, homogeneity, and consistency.

Measurement of pH:

pH of all formulations were measured using digital pH meter. 1 gm of formulation was stirred in 100 ml of distilled water till it forms a uniform suspension. And pH of the dispersion was measured using digital pH meter.[27]

Spreadability:

Spredability is a term expressed to stand for the extent of area to which the gel willingly spread on affected area or skin. It denoted in time (seconds) taken by two slides to slip off from the gel and located between the slides under the route of particular weight. Shorter the time taken for separation of two slides, better the spreadability. [28]

Spreading is determined with the help of following formula,

$S = M \times L / T$

Where,

S: Spradability, M: Wight tide to upper slide,L: Length moved on glass slide

T: Time taken to separate the slide completely from each other.

Extrudability:

The herbal gel formulations were full in standard stopped folding tubes and wrapped by crimping to the end. The weights of tube were noted. The tube was located in between two glass slides and was compressed. 500 gm was kept over the slides and then the cover cap was detached. The total amount of the extruded gel was collected and weighed. The proportion (in %) of the extruded gel was calculated (>90% extrudability: excellent, >80% extrudability: good, >70% extrudability: fair).[29]

Viscosity measurement:

The viscosity of different herbal gel formulations was determined by using a Brookfield viscometer at 10-100 rpm and 37^{o}. The equivalent dial reading on the viscometer was noted.

Drug content:

The drug content of the polyherbal gel formulations was calculated by dissolving an accurately about 1 gm quantity of gel in 100 ml of phosphate buffer (pH 7.4) which is used as solvent. The solution were kept for stirring continuously for 4 hrs and then kept beside for 6 hrs for complete dissolution of the formulation. Then this solution was filtration was done by filter paper and appropriate dilutions were completed next these solutions were allowed for the spectrophotometric analysis. The drug content was determined by the calculated linear regression equation found from the calibration data. [30-31]

In vitro drug release study

The in vitro drug release study of the gel was performed using a Franz Diffusion cell with a dialysis membrane. The membrane was soaked overnight in phosphate buffer (pH 7.4) before the experiment. During the test, the membrane was placed between the donor and receiver compartments of a glass chamber, which were held together with a clamp. The receiver compartment contained phosphate buffer, while 1 g of gel formulation was evenly applied to the membrane in the donor compartment. The phosphate buffer in the receptor compartment was continuously stirred using a magnetic stirrer and maintained at 37 ± 1°C throughout the experiment. Samples of 1 ml were withdrawn hourly for 7 hours from the receiver compartment, with an equal volume of fresh buffer added to maintain sink conditions. The withdrawn samples were diluted with phosphate buffer and analyzed spectrophotometrically. The percentage of drug released was determined by comparing the results to a standard curve prepared beforehand.

In-Vitro Wound Healing Activity

Stability Studies

In the design and evaluation of drug dosage forms, stability is a critical factor in determining their acceptance or rejection. The goal of stability testing is to assess how a drug's quality changes over time under various environmental conditions such as temperature, humidity, and light, while also determining recommended storage conditions, retest periods, and shelf life. For this study, the gel formulation was selected based on in vitro drug release results. Stability studies were conducted by storing the polyherbal gel in sealed glass containers at 40°C ± 2°C and 75% ± 5% relative humidity. Samples were withdrawn at different time intervals over a three-month period.

RESULT AND DISCUSSION

Phytochemical investigation:

The phytochemical studied show that crude extract of *Couroupita guianensis* bark and *Memecylon umbellatum* contains alkaloids, saponin, glycosides, carbohydrates, tannin, flavonoid.

Characterization of Isolated Quercetin

NMR

NMR spectroscopy provides insights into the number of equivalent protons and their environment, helping determine molecular structure. In the ^{1}H NMR spectrum of quercetin, two

aromatic protons at C6 and C8 on the benzopyrone ring appear as doublets at 6.044 ppm and 6.352 ppm, respectively. The protons at C2 (7.453 ppm) and C6' (7.6 ppm) on the catechol ring also appear as doublets, while the C3' proton shows a doublet at 7.662 ppm due to coupling with the neighboring C2' proton. Hydroxyl protons at C3, C4, C5, and C6 are observed as a broad singlet near 9.44 ppm, and the phenolic proton at C7 appears as a distinct singlet at 12.354 ppm.

Mass Spectroscopy

Mass Spectroscopy enables us to establish the molecular mass of the compound. The peak at [M–H] $^-$ at *m/z* 302.5 is parent peak representing full structure of Quercetin. Peak at 181.2 represents structure $C_8H_7O_5$, while peak at 163.9 represent structure $C_8H_5O_4$ which represents aglycone fragments of Quercetin.

Compatibility Studies:

FTIR Spectroscopy:

The FTIR spectra were recorded in the range of 400-4000 cm^{-1} at a resolution of 4 cm^{-1}. The experimental frequencies for isolated Quercetin, Carbopol-940, and the Quercetin gel were analyzed. Quercetin showed characteristic absorption peaks at 3383.29 cm^{-1} (O-H stretch), 1633.78 cm^{-1} (C=O stretch), 1450.53 cm^{-1} (C-C stretch), 1202.67 cm^{-1} (C-O stretch), and 863.18 cm^{-1} (C-H bend). Carbopol-940 exhibited peaks for C-H stretch (2940.72 cm^{-1}), C=O stretch (1700.08 cm^{-1}), C-O stretch (1112.43 cm^{-1}), and C-C stretch (1054.70 cm^{-1}). The FTIR spectrum of the Quercetin gel retained all key functional groups of Quercetin, showing no significant shifts or loss of peaks, indicating good compatibility between Quercetin and the polymer.

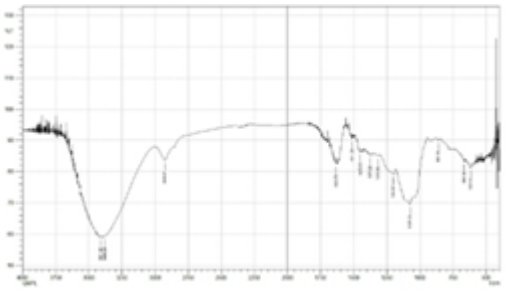

Fig. 1: FTIR spectra of isolated Quercetin

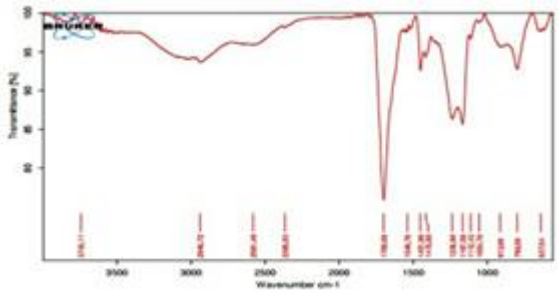

Fig. 2: FTIR spectra of Carbopol-940

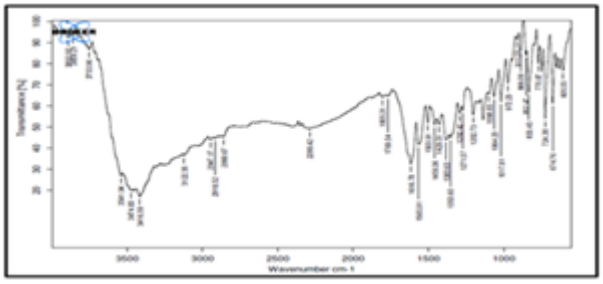

Fig. 3: FTIR of Quercetin Polyherbal Gel

Differential Scanning Calorimetry:

DSC is a key technique for analysing polymer-drug (extract) interactions, and it has previously been used to demonstrate molecular dispersity. DSC measurements were used to better understand the thermal characteristics of Quercetin, Carbopol-940, and the produced

herbal gel. Figures 5 and 6 show the phase transition analyses for quercetin, carbopol-940, and a blend of quercetin and carbopol-940. The DSC curve of Quercetin showed two endothermic changes at 121.1o and 303.44o, which corresponded to dehydration and melting, respectively. The DSC curve of Carbopol-940 revealed an endothermic transition peak at 145.64 o. The formulation DSC curves indicated a small shift in thermal transition, and the melting temperature corresponded to pure Quercetin. Quercetin's primary peaks vary slightly.

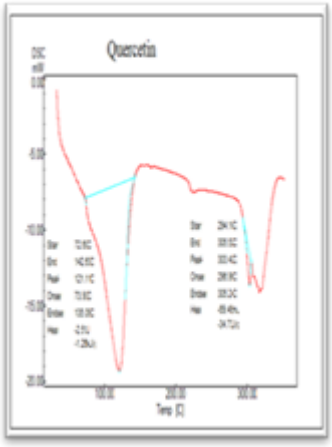

Fig. 4: Isolated Quercetin

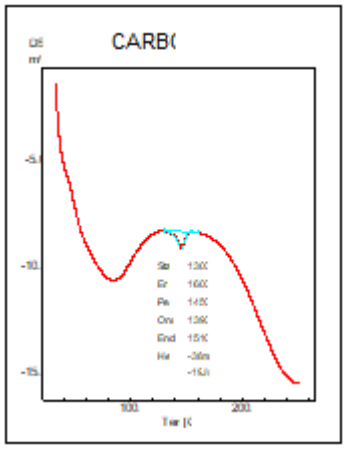

Fig. 5: Carbopol -940

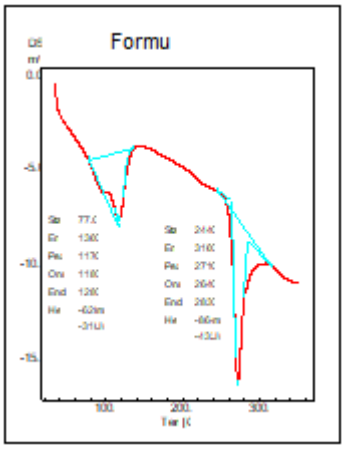

Fig. 7: Quercetin Polyhebal Gel

Formulation and evaluation of gels

Physical appearance and Homogeneity:

All prepared herbal gel formulations were found to be homogenous light brown in color. Homogeneity of all prepared herbal gel formulations was found to be good.

Measurement of pH:

The pH of herbal gel formulations were measured by using a digital pH meter. The pH of all herbal gels was found to be in range 6.62 to 7.01. Hence all the prepare herbal formulations were in the ordinary pH vary of the skin and wouldn't manufacture any skin irritation. The pH of all formulations is shown in Table 2.

Spread ability study:

All the prepared herbal gels were evaluated for spreadability. The spreadability of all herbal gels was found to be in the range of 18.36 gm.cm/sec to 23.61 gm.cm/sec. As concentration of sodium CMC increases, spreadability of formulation increases. The spreadability of all formulations were shown in Table 2.

Extrudability study:

All the prepared herbal gels were evaluated for extrudability. The extrudability of herbal gels was found to be in range of 82.58 % w/w to 91.71 % w/w indicating good extrudability.F2 shows excellent extrudability and remaining 4 formulations shows good extrudability. The extrudability of all formulations are shown in Table 2.

Drug content:

The cumulative percent drug released from each formulation in the in vitro release

studies was based on the average drug content present in the formulation. The drug content was found to be in the acceptable range for all formulations. Drug content of herbal gel ranges from 91.12 ± 1.5 to 96.64 ± 1.2 %. Formulation F2 shows high drug content (96.64±1.2%). This indicates that drug is uniformly distributed throughout system. The analyzed drug content are shown and displayed in Table 2.

Table 2: pH, Spreadability, Extrudability and Drug content of herbal gel formulations.

Formulation	F1	F2	F3	F4	F5
pH*	6.62±0.03	6.69±0.05	6.73±0.04	6.81±0.02	7.01±0.03
Spreadability* (gm.cm/sec)	18.36±0.45	21.92±0.63	22.05±0.34	23.61±0.50	21.31±0.89
Extrudability* amount %w/w	82.58±0.55	91.71±0.45	89.80±0.87	86.05±0.36	84.23±0.74
Drug content * (%w/w)	91.12±1.5	96.64±1.2	94.61±1.4	95.31±1.3	92.76±1.1

*Each value represents mean ± S.D. of three observations.

Viscosity analysis

The viscosity was directly dependent on polymeric content of formulation. The following table no. shows observations of viscosity levels of the formulated herbal gel done by Brookfield Viscometer and viscosity pattern predicted in table 4. Viscosity of the formulation depends on polymer used, viscosity increases as the ratio of polymer increases. By observing the viscosity report, the F1 formulation of herbal gel containing 0% sodium CMC and 1% Carbopol-940, it having low viscosity than the F4 formulation containing 3% sodium CMC and 1% Carbopol-940. F5 formulation having maximum viscosity which contains 2% of Carbopol-940. So, it is clear that the concentration of polymer increases in the gel formulations, the viscosity of that gel formulation also increases.

Table 3: The viscosity of herbal gel formulations

Angular velocity* (rpm)	**Viscosity in Cps**				
	F1	**F2**	**F3**	**F4**	**F4**
10	589±0.5	1713±0.6	1876±0.5	2112±0.6	1963±0.3
20	615±0.2	1874±0.1	1954±.02	2073±0.4	2076±0.5
30	774±0.7	1937±0.5	2095±0.2	2169±0.5	2106±0.7
50	856±1.2	2065±0.4	2167±0.9	2209±0.1	2494±0.1
60	923±0.9	2115±1.2	2210±0.5	2365±0.6	2525±0.6
100	1040±0.2	2232±0.3	2358±0.3	2434±0.4	2612±0.8

*Each value represents mean ± S.D. of three observations.

***In-vitro* drug release of herbal gel**

In-vitro drug release studies of all the formulation of herbal gels were carried out in phosphate buffer of pH 7.4 using cellophane membrane. The study was performed for 7 hrs, and cumulative drug release was calculated at different time intervals. The formulations F1,F2,F3,F4 and F5 containing Carbopol-940 and sodium CMC in different ratio has shown the drug release of 89.12±1.5, 96.64±1.2, 90.31±1.4, 94.31±1.3 and 92.76±1.1. When compared formulations F1 to F5 the in vitro release characteristics of herbal gel showed the drug release is directly proportional to the concentration of sodium CMC, i.e. the herbal gel formulation F1 showed the lowest percent drug release which contains lower concentration of sodium CMC (0%) polymer, the maximum drug was released from formulation F4 containing highest concentrations of sodium CMC (3%).When compared between formulation F2 and F5 the maximum drug was released from formulation F2, the retard in drug release in formulation F5 is because of more proportion of gelling agent i.e. Carbopol-940 added which increase the total path for movement of drug from the gel matrix into diffusion media.

Kinetic Models of Drug Release

% CDR of drug diffuses through the membrane into the *in-vitro* fluid of all gel formulation. From regression coefficient (R^2), the drug release profile for formulation (F1-F5) was best fitted with Zero order kinetics for all of the gel formulations. The regression coefficient (R^2) of formulations F1-F5 is tabulated in table 4.

Table 4: Mathematical kinetic models of drug release for all formation.

Formulations Code	Zero order (R)	First order (R)	Higuchi (R)	Korsmeyer (N)	Peppas (R)
F1	0.9891	0.9170	0.6290	0.752	0.9785
F2	0.9906	0.9381	0.6236	0.767	0.9869
F3	0.9660	0.8597	0.5858	0.772	0.9759
F4	0.9844	0.8428	0.6085	0.758	0.9837
F5	0.9837	0.9606	0.6248	0.772	0.9821

Conclusion:

Mass and NMR spectra conforms isolated moiety was Quercetin and Compatibility between drug and excipients were confirmed by FTIR DSC study. From these results clear that absence of any chemical interaction between the extract and excipients used in the formulation. The pH ranges of all formulated gels were found to be suitable for topical application. The viscosity measurement was done for all gels using Brookfield Viscometer at various temperatures. Drug content of herbal gel ranges from 91.12 ± 1.5 to 96.64 ± 1.2 %w/w. Formulation F2 shows high drug content 96.64 ± 1.2%w/w. The stability study of formulated gels were carried out for three months as per ICH norms was analyzed for the changes in appearance, pH, Viscosity, drug content and drug release. Result showed no significant variation with respect to evaluation parameters. Thus developed Quercetin polyherbal gel acts as a

competent alternative to other topical gel formulation. However, further in vivo studies are required to establish its efficacy for wound healing potential.

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HARNESSING ARTIFICIAL INTELLIGENCE: TRANSFORMING PHARMACEUTICAL SCIENCES FOR THE FUTURE

Mandar D. Joshi*, Ms. Shital M. Kurhade, P. Solanki and Bhargav A. Apte

Abstract:

The study examines AI's transformative role in drug discovery and development, emphasizing how machine learning and deep learning enhance traditional methods, which are often costly and time-intensive with high failure rates. It details AI's applications across stages like target identification, hit-to-lead discovery, and drug design optimization, alongside pharmacokinetics and Pharmacodynamics, allowing for more precise drug simulations, improving efficacy, and safety. AI's impact on drug formulation, personalized medicine, and repurposing is explored, as well as its integration with nanomedicine for precision drug delivery. Additionally, the study covers AI's role in pharmaceutical quality management, including data analysis, predictive analytics, automation, regulatory compliance, and risk management, showcasing AI's potential to expedite safer, more effective medication development.

1. AI in Drug Discovery and Development

Drug discovery has traditionally been a costly, lengthy process with low success rates, often costing billions and taking over a decade, with less than 10% of drugs in Phase I trials reaching the market. AI has brought significant improvements, especially in screening large chemical libraries by predicting molecular binding affinities, which reduces time and costs. AI's role spans target identification, hit-to-lead identification, drug design optimization, and predicting properties like solubility and absorption using QSAR models. AI applications, including virtual screening, de novo drug design, and protein design, are categorized into predictive and generative tasks powered by models like convolutional and graph neural networks, alongside evolving paradigms such as self-supervised and reinforcement learning. Drug discovery begins with target identification and validation, followed by hit discovery, lead optimization, preclinical studies, and clinical trials. High-throughput screening (HTS), developed in the 1980s, enhances discovery efficiency and has created large SAR datasets used in virtual screening (VS) to predict active molecules.

Drugs typically act by activating or inhibiting targets, forming two main classes: agonists, which activate targets, and antagonists, which block them. Agonists include partial, inverse, and biased agonists, while antagonists can be competitive or non-competitive. Assays measure affinity (binding strength), potency (dose required for effect), and efficacy (maximum achievable effect), with higher affinity often correlating with lower required doses. AI has become integral to drug discovery, with machine learning models like random forests (RF) used for virtual screening (VS) and QSAR since the early 2000s. In 2012, AlexNet spurred the deep learning era, and shortly after, deep neural networks (DNNs) outperformed RF in predicting molecular activity in Merck's Kaggle competition. Advances in AI for computer vision and natural

language processing further propelled deep learning in chemistry. Notably, Insilico Medicine identified DDR1 inhibitors in 21 days in 2019, and MIT discovered halicin, a novel antibiotic against resistant bacteria, in 2020. AI supports various drug discovery stages, from target identification to drug response prediction. Lead identification centers on two main tasks: molecular property prediction, crucial for VS and assessing interactions, toxicity, or liver injury risk; and molecule generation, which includes realistic molecule creation within chemical constraints and goal-directed generation for desired properties.

2. Pharmacokinetics and Pharmacodynamics

Pharmacokinetics (PK) examines drug absorption, distribution, metabolism, and excretion, while Pharmacodynamics (PD) focuses on drug effects on the body. AI in PK/PD enables virtual simulations of drug behavior, predicting efficacy and safety and reducing side effects. AI models optimize dosing by considering patient-specific factors like age, weight, and organ function.

2.1 AI in PKPD profile

Pharmacokinetics (PK) is essential for drug development, influencing dosing and efficacy, but traditional PK analysis is complex and data-intensive. AI has transformed this field, enabling rapid data processing, PK profile prediction, and enhanced compound design through machine learning and generative AI. This shift accelerates drug development and supports more personalized therapies. In his editorial "Technological Darwinism," Neal M. Davies underscores AI's adaptability in pharmaceutical sciences, highlighting ethical AI’s role alongside human expertise to advance personalized medicine. Traditional tools like WinNonlin, NONMEM, Monolix, and GastroPlus have modeled drug behavior well, with GastroPlus excelling in disease-specific simulations. However, AI's capacity for faster, more dynamic predictions marks a transition from static models to adaptive, AI-driven PK tools, enhancing personalized medicine.

2.2 AI revolution in pharmacology

Maaike van der Lee and colleagues highlight AI's transformative impact in healthcare and pharmacology, showcasing diverse applications in research and clinical practice. Machine learning (ML) models, including unsupervised clustering for identifying compounds and patient groups, and supervised ML for therapeutic monitoring, improve drug efficacy and safety. Natural language processing (NLP) mines electronic health records, enhancing real-world data insights on medication effects beyond clinical trials. Generative AI in pharmacokinetics promotes tailored treatments, with applications in predictive modeling of ADME properties, optimizing dosages, predicting drug interactions, and reducing clinical trial sample sizes, thereby accelerating development. AI-driven PK software further supports personalized medicine by analysing patient-specific factors, streamlining pharmaceutical research, and advancing safer, more effective therapies.

2.3 Challenges and future directions

The integration of generative AI in pharmacokinetics faces challenges due to constantly updating pharmacokinetic databases, driven by new studies and clinical trials. AI must adapt to

data inconsistencies stemming from varied study designs, patient demographics, and measurement techniques, which impact data quality. This is crucial for evaluating drug metabolism and pharmacokinetics (DMPK) accurately. Advanced algorithms are needed to handle evolving datasets and analyze ADME processes comprehensively. Olga Obrezanova's research highlights the complexities of modeling pharmacokinetics in both animals and humans, emphasizing the need for encoding intricate chemical and biological interactions. Looking forward, sophisticated AI-driven pharmacokinetics software could automate tasks like data cleaning, model selection, exploratory data analysis, noncompartmental and compartmental analysis, and regulatory-compliant reporting, potentially revolutionizing pharmacokinetic research and analysis.

3. AI in Drug Formulation and Optimization

Developing optimal drug formulations involves extensive testing of parameters like release rate and stability, which can be time-consuming and complex. AI accelerates this process by analyzing experimental data to optimize formulation parameters. Techniques like artificial neural networks (ANNs) predict ideal formulation properties, and models such as Design of Experiments (DoE) streamline the optimization process, as demonstrated by AI's use in improving the extended-release profile of Benidipine Hydrochloride tablets with a Box-Behnken design.

Creating commercial formulations, including controlled release forms, requires iterative mixing and testing of drugs with excipients, generating vast data that traditional statistical methods can struggle to analyze, especially in multi-variable environments. Unlike conventional statistics, neural networks learn data relationships without predefined assumptions, enabling effective "what-if" scenario modeling. Their power is enhanced when combined with genetic algorithms for optimization, especially with complex, conflicting formulation objectives. Fuzzy logic can define these objectives intuitively, and recent neurofuzzy logic methodologies combine neural networks' learning ability with fuzzy logic's simplicity for even more sophisticated optimization in formulation tasks.

3.1 Neural networks

Neural networks learn directly from input data, similar to how humans learn. The learning algorithms used by neural networks come in two main forms: unsupervised learning and supervised learning. In unsupervised learning, the neural network is presented with input data and learns to recognize patterns within that data, which is useful for organizing large amounts of data into a smaller number of clusters. On the other hand, supervised learning is analogous to "teaching" the network, where it is presented with a series of matching input and output examples, and it learns the relationships connecting the inputs to the outputs. Supervised learning has proven most useful for pharmaceutical formulation, where the goal is to determine the cause-and-effect links between the inputs (ingredients and processing conditions) and the outputs (measured properties).

Overall, the ability of neural networks to learn directly from data, coupled with the power of supervised and unsupervised learning algorithms, makes them a valuable tool for modeling complex relationships in the pharmaceutical domain, particularly in the formulation of products.

3.2 fuzzy logic

Conventional logic operates on a binary system where a proposition is either completely true or completely false; mapping onto a traditional set theory where an element either belongs to a set or it does not. However, in the real world, this black-and-white approach is often not practical or useful.

For example, defining a "comfortable" room temperature using conventional logic would be very complex, as a temperature of 20°C may be considered "comfortable," but 19°C or 21°C would be deemed "uncomfortable," even though they are only slightly different. Fuzzy logic provides a more nuanced way of describing such target properties for optimization problems.

In fuzzy logic, instead of a binary membership function (0 or 1), elements can have partial membership in a set, allowing for a gradual transition between "true" and "false." This is particularly useful in formulation, where a tablet disintegration time of 300 seconds may be the target, but a tablet disintegrating in 310 seconds may still be considered somewhat desirable, rather than completely undesirable as conventional logic would dictate.

Additionally, fuzzy logic is widely used in process control, as it allows rules to be expressed in a simple, linguistic form (IF-THEN) with an associated confidence function related to set membership, making it easier to implement and understand compared to more complex control systems.

3.3 Neurofuzzy logic

Fuzzy logic and neural networks can work in tandem to create a powerful modeling approach known as neurofuzzy logic. This combination capitalizes on the respective strengths of each technique. Fuzzy logic complements neural network modeling by allowing objectives to be expressed in simple, intuitive linguistic terms. In neurofuzzy logic, the fuzzy logic is tightly integrated with the neural network, creating a synergistic relationship. The neural network provides the ability to learn from data, while fuzzy logic enables the expression of complex concepts in an easily understandable way.

This integration results in a degree of transparency for the otherwise opaque "black box" neural network models, leading to the term "grey box modeling" being used for these methods. Neurofuzzy logic has proven to be exceptionally well-suited for data mining, as it not only can develop accurate models from data, but it can also express these models as clear IF-THEN rules using fuzzy logic. This combination of data-driven learning and linguistic rule representation makes neurofuzzy logic a powerful tool for tackling complex problems.

4. AI in personalized medicine and drug repurposing

Personalized medicine: AI helps personalize drug therapy by predicting how individual patients will respond to different drugs. It considers genetic, environmental, and lifestyle factors to optimize drug efficacy and minimize adverse effects. Drug repurposing: AI algorithms

analyze large datasets to identify existing drugs that may be effective for new therapeutic uses. This is a quicker, more cost-effective alternative to traditional drug discovery processes, which often start from scratch. Current medical practice often uses a one-size-fits-all approach in prescribing medication, based on symptoms and standard clinical tests, without considering a patient's unique genetic, metabolomic, or proteomic profile. If side effects occur, doctors may adjust the prescription, yet the underlying approach overlooks individual biomolecular variations. Research has shown that genetic differences impact drug responses, as seen in studies on diverse children with asthma and diabetes prognosis, and metabolomic influences also play a role, such as in paracetamol response in rats. Integrating "omics" data could better predict individual responses to medications like SSRIs, suggesting potential for personalized medicine. Personalized medicine is a new approach where disease prognosis and treatment are tailored to an individual's genomic profile and health markers, unlike evidence-based medicine that relies on average treatment effects. Its goal is to deliver the right intervention to the right patient at the right time and dose. This approach shifts from reactive treatments, which begin after symptoms appear, to proactive care, where interventions start at the earliest signs of disease, potentially even before symptoms emerge. Personalized medicine shows promise in cancer prevention and treatment, with advancements in bioinformatics supporting these efforts. Personalized medicine is further driven by access to diverse health data, including MRI and CT scans, electronic medical records (EMRs), health claims, and mobile sensor data, which can help cluster patient groups and reveal disease progression trends across population subtypes. Initiatives like EMR-linked biobanks aim to systematically combine EMRs with genomic data to advance personalized care. Artificial Intelligence (AI), particularly machine learning (ML), plays a critical role in processing this data. Supervised ML models use labelled training sets to predict outcomes, such as optimal drug dosing in specific patient groups, while unsupervised learning identifies data clusters without labels. Deep Neural Networks (DNNs), a subset of unsupervised learning, can find hidden patterns and have been used to classify drugs, sometimes revealing opportunities for drug repurposing. A Google Scholar search was conducted with the keywords "Artificial Intelligence for Personalized Medicine" and "Machine Learning for Personalized Medicine," resulting in a selection of key studies demonstrating machine learning applications in personalized medicine. The first example is a tool called C-path, Beck *et al.,* in 2011, which uses machine learning to identify unique features in tumour images, showcasing the algorithm's ability to surpass human experts in extracting novel features. However, human expertise was still essential to guide the learning process. The second study, by Cheng *et al.,* in 2013, used an algorithm to identify "attractor metagenes" in cancer genetics data, revealing gene combinations associated with disease progression. This underscores machine learning's potential to identify complex genetic markers in disease advancement.

The third example, photomapping for Heart Failure with preserved Ejection Fraction (HFpEF) by Shah *et al.,* in 2015, demonstrates machine learning's capability to perform unbiased patient clustering for diseases with diverse presentations, such as HFpEF. The fourth

example involves predicting treatment outcomes for Major Depressive Disorder (MDD), illustrated by Athreya *et al.,* in 2018, showing machine learning's role in mental health treatment personalization. Lastly, a Deep Learning framework developed by Sakellaropoulos *et al.,* in 2019 is used to predict cancer therapy responses, highlighting AI's power to anticipate patient-specific treatment outcomes in oncology. For a machine learning (ML) model to be effective in personalized medicine, it must demonstrate high predictive accuracy. Achieving this requires balancing between minimizing training error (error within the model's own dataset) and test error (error on new, unseen data). Overly complex models with low training error may not generalize well to new data, leading to over fitting. Therefore, an effective ML model for personalized medicine should be complex enough to capture relevant patterns but simple enough to avoid over fitting, achieving a balance for optimal performance (Deo, 2015). For an ML model in personalized medicine, three essential characteristics are crucial: predictive performance, interpretability, and clinical validation. First, high prediction accuracy is needed, balancing model complexity to avoid over fitting. Second, interpretability is vital, as understanding why features are linked to outcomes ensures that clinicians trust and adopt the model. Correlations found by ML need human investigation to determine causation. Third, clinical validation through cross-validation, external validation, and follow-up clinical trials are necessary to confirm robustness, though this process is often costly and time-intensive.

Few of the machine learning (ML) model are listed below with it characteristics uses:

- Computational Pathologist (C-Path) (Beck *et al.,* 2011)
- Attractor Metagenes (Cheng *et al.,* 2013)
- Phenomapping of Heart Failure with preserved Ejection Fraction (HFpEF) (Shah *et al.,* 2015)
- Machine Learning (ML) to Predict Treatment Outcome in Major Depressive Disorder (MDD) (Athreya *et al.,* 2018)
- Deep Learning Framework for Predicting Response to Therapy in Cancer (Sakellaropoulos *et al.,* 2019)

5. AI and Nanomedicine

AI is revolutionizing the development of nanomedicine, where nanoparticles are designed to deliver drugs to specific sites in the body, such as cancer cells. AI enhances the precision and efficiency of this process by optimizing the properties of nanoparticles, ensuring they are safe and effective for drug delivery. Achieving optimal combination nanotherapy requires a two-stage approach. The first stage involves identifying the best drugs and doses, while the second stage focuses on dynamically adjusting the dosing over time to account for changes in synergy and patient-specific responses. Nanomedicine can be leveraged to improve drug targeting and localization, which is crucial for preserving drug synergies. However, patient-specific factors can lead to variations in drug synergy. The convergence of artificial intelligence (AI) and nanomedicine presents an opportunity to optimize combination nanotherapy in an agnostic manner, considering factors such as targeting, ratiometric delivery, and dynamic patient responses. The document

provides examples of how nanomedicine has been used to enhance combination therapies, such as using gold nanoparticles for tumor targeting and clotting, as well as co-delivering chemotherapies with siRNA to suppress drug resistance pathways. Overall, the key themes highlighted in the text are the importance of optimizing drug combinations, the benefits of leveraging nanomedicine to improve drug delivery, and the potential of using AI to further enhance the optimization of combination nanotherapies. The integration of these approaches holds promise for developing more effective and personalized combination nanotherapies.

6. **Al quality management system & challenges**

Quality by Design (QbD): AI assists in ensuring drug quality through QbD principles. It aids in controlling critical quality attributes (CQAs), critical material attributes (CMAs), and critical process parameters (CPPs), all essential in maintaining the desired product quality. Failure Mode Effects Analysis (FMEA): AI integrates FMEA into pharmaceutical manufacturing processes to assess potential risks and enhance the safety and reliability of drug formulations. The pharmaceutical industry is highly regulated and requires strict adherence to quality standards to ensure the safety and efficacy of drugs and medical devices. In recent years, the integration of Artificial Intelligence (Al) into Quality Management Systems (QMS) has revolutionized the way pharmaceutical companies maintain quality and compliance. This blog will explore the significant role of Al in QMs within the pharmaceutical field, its benefits, challenges, and the future outlook.

6.1. Data Analysis and Predictive Analytics

Al can analyze large volumes of data from various sources such as manufacturing processes, clinical trials, and adverse event reports to identify patterns and predict potential quality issues. By leveraging machine learning algorithms, Al can detect anomalies, predict equipment failures, and anticipate deviations in manufacturing processes, thus enabling proactive quality management.

6.2. Automation of Quality Control Processes

Al-powered systems can automate quality control processes such as visual inspection of pharmaceutical products, reducing the need for manual intervention and minimizing the risk of human error. Computer vision technology can accurately identify defects or inconsistencies in products, ensuring that only high-quality items reach the market.

6.3. Enhanced Regulatory Compliance

Al can assist pharmaceutical companies in maintaining compliance with complex and evolving regulatory requirements. By continuously monitoring regulatory updates and analyzing their impact on operations, Al-powered QMS can help organizations adapt swiftly to changing compliance standards, reducing the risk of non-compliance and associated penalties.

6.4. Real-time Monitoring and Surveillance

Al enables real-time monitoring of manufacturing processes and can promptly alert operators to deviations from predefined quality parameters. This proactive approach allows for

immediate corrective actions, minimizing the potential impact on product quality and patient safety.

6.5. Improved Risk Management

By analyzing historical data and identifying risk factors, Al can help pharmaceutical companies proactively mitigate risks associated with product quality, supply chain disruptions, and regulatory non-compliance. This proactive risk management approach contributes to overall operational resilience and business continuity.

Conclusion:

AI is transforming the pharmaceutical sciences by reducing costs, accelerating drug discovery, improving drug formulations, and personalizing treatments. With its continued advancements, AI will revolutionize the pharmaceutical industry, making drug development faster, safer, and more efficient.

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DEVELOPMENT OF ANTI-DANDRUF GEL FORMULATION OF FENUGREEK LEAVES EXTRACT: A REVIEW

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Abstract:

Dandruff is a common dermatological condition that causes flaking and itching of the scalp, often resulting from an overgrowth of the yeast *Malassezia*, excessive oil production, or skin conditions like seborrheic dermatitis. Various topical treatments are available, including antifungal shampoos, corticosteroids, and emollients. However, natural remedies, particularly plant extracts like fenugreek (*Trigonella foenum-graecum*), show potential due to their antifungal, anti-inflammatory, and soothing properties. This study investigates the efficacy of a gel formulation containing fenugreek leaf extract as an anti-dandruff treatment. The gel provides targeted application, extended contact time, and potentially improved patient compliance. Methods of gel preparation and testing, including well diffusion for antifungal efficacy, are discussed. Findings support that fenugreek leaf extract gel can inhibit dandruff-causing fungi and may be a viable alternative for managing dandruff symptoms.

Introduction:

Dandruff is a kind of skin disorder that affects the scalp in which white, dry flakes of dead skin are shed from the scalp. Normally dead skin cells are shed from the scalp, but it results in dandruff only when the scalp starts shedding thick layers of these dead skin particles. Seborrheic dermatitis is a chronic inflammatory dermatologic condition that usually appears on areas of the body with a large density of sebaceous glands, such as the scalp, face, chest, back, axilla, and groin. Although it can be associated with human immunodeficiency virus infection and neurologic disease (e.g., cerebrovascular event, Parkinson disease) seborrheic dermatitis typically occurs in healthy persons. Its prevalence is 1% to 3% in the general population and 34% to 83% in immune compromised persons. It is more common in men and is typically more severe in cold and dry climates and during periods of increased stress.

Seborrheic dermatitis can affect patients from infancy to old age. The condition most commonly occurs ininfants within the first three months of life and in adults at 30 to 60 years of age. Seborrheic dermatitis and pityriasis capitis (cradle cap) are common in early childhood. According to one survey of 1,116 children the overall age- and sex-adjusted prevalence of seborrheic dermatitis was 10 percent in boys and 9.5 percent in girls. The highest prevalence occurred in the first three months of life, decreasing rapidly by one year of age, and slowly decreasing over the next four years.

Causes of Dandruff:

Malassezia Overgrowth: This naturally occurring yeast can overgrow and feed on scalp oils, irritating the skin and causing dandruff. It’s linked to conditions like seborrheic dermatitis and other skin disorders.

Dry Skin: Cold weather often leads to dry, flaky skin, which can increase dandruff, usually with smaller, less oily flakes.

Seborrheic Dermatitis: Common in areas rich in oil glands, this condition causes red, greasy skin with white or yellow scales, often leading to dandruff.

Skin Conditions: Psoriasis, eczema, and similar conditions make dandruff more likely.

Stress and Illness: People with weakened immune systems or neurological conditions may experience dandruff more frequently.

Product Reactions: Certain hair care products, especially with overuse, can irritate the scalp, leading to dandruff.

Dietary Deficiencies: Lack of nutrients like zinc, B vitamins, and certain fats may contribute to dandruff.

Treatments available for dandruff:

The treatment of infantile seborrheic dermatitis consists primarily of emollients that help loosen scales (e.g., mineral or olive oil, petroleum jelly). Scales can then be removed by rubbing with a cloth or infant hair brush. One study showed that ketoconazole 1% to 2% cream is effective and seems to be safe when used twice daily for two weeks. There are no shampoos that have been approved by the U.S. Food and Drug Administration for treatment of seborrheic dermatitis in children younger than two years.

Treatment includes over-the-counter shampoos and topical antifungal, calcineurin inhibitors, and corticosteroids Because seborrheic dermatitis is a chronic condition, ongoing maintenance therapy is often necessary.

Antifungals:

Most antifungal agents attack *Malassezia* associated with seborrheic dermatitis. A once-daily ketoconazole gel preparation (Nizoral) combined with a two-week, once daily regimen of desonide (Desowen), may be useful for facial seborrheic dermatitis. Shampoos containing selenium sulfide (Selsun) or an azole often are used. These shampoos can be applied two or three times per week. Ketoconazole (cream or foaming gel) and oral terbinafine (Lamisil) also may be beneficial. Other topical antifungal agents include ciclopirox (Loprox) and fluconazole (Diflucan). Patients also may use a 2 % ketoconazole or a fluconazole shampoo. Some azoles (e.g., Itraconazole [Sporanox], ketoconazole) also have anti-inflammatory properties.

List of ingredients commonly used to treat dandruff:[5]

- Zinc pyrithione shampoos, Coal tar based shampoos, Salicylic acid shampoos, Liquidcontains phenol shampoos, Ketoconazole shampoos,

Fenugreek:

1. ***Botany:***

   Kingdom: Plantae, Division:Magnoliophyta, Class:Magnoliopsida, Order:Fabales, Family:Fabaceae Genus:*Trigonella* ,Species:*foenum-graecum*Linn.

Location: Fenugreek (*Trigonella foenum-graecum*) is a leguminous herb cultivated in India and North African countries. It belongs to the family *Fabaceae* and is variously called in different languages, viz *Fenugrec* (French), *Methi* (Hindi), *Bockshorklee* (German), *Fienogreco* (Italian),

Pazhitnik (Russian), *Alholva* (Spanish), *Koroha* (Japanese), *Hulba* (Arabian), *Halba* (Malaya), and *K'u-Tou* (China).

The seed sown on a prepared soil sprouts in 3 days, grows inherently resistant to most infestations and diseases to a robust. Erect plant to a height of 30–60 cm, with compound pinnate trifoliate leaves, axillary white to yellowish flowers, and 3–15 cm long thin pointed beaked pods, which contain 10–20 oblong greenish-brown seeds with unique hooplike groove. As a leguminous plant, it fixes atmospheric nitrogen, thus enriching the soil.

Medicinal uses of fenugreek:

Fenugreek seeds are bitter to taste and are known for a long time for their medicinal qualities.

The plant contains active constituents such as alkaloids, flavonoids, steroids, Saponin etc. It is an old medicinal plant. It has been commonly used as a traditional food and medicine. Fenugreek is known to have hypoglycemic and hypocholesterolaemic effects, Anti-inflammatory effects. Recent research has identified fenugreek as a valuable medicinal plant with potential for curing diseases and also as a source for preparing raw materials of pharmaceutical industry, like in steroidal hormones.

The plants leaves and seeds are widely consumed in Indo-Pak subcontinent as well as in other oriental countries as a spice in food preparations, and as an ingredient in traditional medicine. A wide range of uses were found for fenugreek in ancient times. Medicinally it was used for the treatment of wounds, abscesses, arthritis, bronchitis, ulcer& digestive.

Gel

A gel is a two-component, three-dimensional network of structural materials and liquid, forming a jelly-like solid. It has properties ranging from soft to tough due to cross-linking, allowing it to act as a solid despite being mostly liquid. Gels provide stable, localized drug delivery through skin and other topical routes and are preferred over creams or ointments for their adherence, film-forming ability, and ease of removal.

Advantages of Gels

- Stable and adheres well to treated surfaces
- Film-forming with prolonged germicidal action
- Water-soluble, easy to wash off
- Non-irritating and safe for skin and mucous membranes

Properties of Ideal Gels

- Inert, safe gelling agents that resist microbial growth
- Maintain structure during storage, but easily break on application
- Non-tacky for comfortable topical use

Types of Gels

1. **Hydrogels**: Water-based, highly absorbent gels with uses in tissue engineering, sustained drug release, contact lenses, and sanitary products. They adapt to environmental changes (pH, temperature).

2. **Organogels**: Thermo-reversible gels made from organic solvents. These are used in pharmaceuticals, cosmetics, and food and exhibit self-assembly properties.
3. **Xerogels**: Formed by drying a gel, creating a highly porous, solid material. They are used for applications needing high surface area, such as aerogels or dense glass

Gel forming polymers are classified as follows:

Natural polymer

a. Proteins: Gelatin, Collagen
b. Polysaccharides: Alginic acid, agar, tragacanth, sodium or potassium carrageenan, Pectin, Gellan Gum, Xanthin, Cassia tora, Guar Gum.

1. **Semi synthetic polymers:** Cellulose derivatives I) Hydroxy ethyl cellulose II) Methylcellulose III) Hydroxy propyl methyl cellulose IV) Hydroxy propyl cellulose V) Carboxymethyl cellulose.
2. **Synthetic polymers:** Carbopol**,** Poloxamer**,** Polyvinyl alcohol, Polyacrylamid, Polyethylene and its co-polymers**.**
3. **Inorganic substances:** Bentonite, Aluminium hydroxide.

Methods of testing antimicrobial activity:

1. Tube dilution method & agar plate method.
2. Disk diffusion method
3. Well diffusion method
4. Cup & plate method
5. Ditch-plate method.
6. Phenol coefficient method.

Extraction Methods:

Extraction isolates active constituents from crude drugs through liquid-liquid or solid-liquid processes, controlled by mass transfer, which is affected by factors like temperature, agitation, and particle size. Common extraction methods include:

1. **Decoction**: Involves boiling plant materials (e.g., roots, bark) in water to extract oils and volatile compounds, useful for teas and tinctures.
2. **Soxhlet Extraction**: Uses a continuous cycle of evaporation and condensation in a Soxhlet apparatus, where the solvent percolates repeatedly through a powdered drug, concentrating the extract in the flask.
3. **Percolation**: Involves packing powdered drug in a percolator, allowing a solvent to pass through and dissolve active constituents over a regulated period.
4. **Maceration**: Involves soaking the drug in a solvent for an extended period (typically seven days) with occasional stirring, then filtering to obtain the extract.

Most common anti-dandruff products contain synthetic agents like ketoconazole, zinc pyrithione, selenium sulfide, and ciclopirox, found in shampoos, creams, and lotions. However, these can cause side effects like scalp dryness, rough hair, hair fall, and dandruff recurrence upon discontinuation. Overuse may also lead to eye irritation, acne, and swelling.

Advantages of Herbal Products:

- Fewer side effects compared to synthetic agents.
- Aim for long-term healing and effective treatment.
- More affordable and less likely to cause resistance.
- Growing global demand for natural remedies in health, cosmetics, and food.
- **Fenugreek**: Traditionally used for skin infections, hair growth, and dandruff. Rich in antioxidants and lecithin, fenugreek nourishes hair, combats free radicals, and strengthens follicles.

Developing herbal formulations could provide a more natural, effective, and low-resistance treatment for dandruff.

Chemicals: Carbopol 940, Sodium CMC, Chitosan, HPMCK100LV, HPMCK4M, Sodium alginate, HPC (Klucel LF), Glycerin, Sodium benzoate, Propyl paraben, Ethyl alcohol, Ethyl acetate, Hydrochloric acid, Sulfuric acid, Sodium hydroxide, Quercetin, Tween 80, Sesame oil, Sabouraud dextrose agar, DMSO, Aluminum chloride, sodium nitrite, Citronella, Cellophane membrane 9

Equipment

Electronic weighing balance, Rota evaporator, UV visible spectrophotometer, Photo colorimeter, Franz diffusion cell, Hot air oven, Humidity chamber, Digital pH meter EQ, Brookfield Digital, Magnetic stirrer EQ, Circulating water bath, Cyclone mixer, Centrifuge, Autoclave, Incubator, Ultra probe sonicator, Bath sonicator, Antibiotic zone reader

Phase I: Preparation of Fenugreek Leaf Extract

- **Aqueous Extract**: Powdered leaves (200g) were soaked in 1000 ml distilled water with 10% ethanol (100 ml) for 7 days, then filtered. The filtrate was concentrated using a rotary evaporator (temperature below 70°C), weighed, and stored.

Phase II: Evaluation of Extract

a. **Foaming Index**: The foaming ability of the extract was tested by shaking varying volumes in test tubes and measuring foam height. If foam exceeded 1 cm in tube six, the foaming index was calculated as **Foaming Index = 1000/a**, where *a* is the volume (ml) needed to reach 1 cm foam.

b. **pH Determination**: The pH of the extract was measured using a pH meter.

Phase III. Selection of gelling agents

Dummy jelly formulations were prepared using (D1 to D21)

Gel Preparation Methods

- **Gels D1-D2**: Carbopol dispersed in distilled water; triethanolamine (10%) added to adjust pH to 5.5-6.5 with continuous stirring. Volume adjusted to 100% with distilled water.
- **Gels D3-D8**: HPMCK100LV and HPMCK4M dispersed in hot distilled water with stirring, allowed to stand for 1 hour to form gel. Volume adjusted to 100%.
- **Gels D9-D11**: HPC LF dispersed in hot distilled water, stirred, and allowed to form jelly. Volume adjusted to 100%.

- **Gels D12-D14**: Dispersed in hot distilled water, soaked for 30 minutes to form gel. Volume adjusted to 100%.
- **Gels D15-D17**: Dispersed in hot distilled water; diluted glacial acetic acid added to dissolve chitosan with stirring, soaked for 30 minutes to form gel. Volume adjusted to 100%.
- **Gels D18-D21**: Sodium alginate dissolved in distilled water, soaked for 1 hour, and stirred to 100% volume.

Each gel was visually examined for appearance, pH, consistency, and pourability. A 10% extract was added to test viscosity and consistency.

Anti-Dandruff Gel Evaluation

1. **Visual Examination**: Gels were checked for color, clogging, fragrance, and air bubbles.
2. **pH Measurement**: pH of extract gels was tested using a pH meter

Preparation and Evaluation of Anti-Dandruff Gel with Fenugreek Extract

Phase I: Extraction and Gel Preparation

1. **Extraction of Fenugreek Leaves**
    - Leaves were washed, dried, and ground to powder. For aqueous extraction, powdered leaves (200g) were soaked in distilled water with 10% ethanol (preservative) for 7 days, filtered, and concentrated to prevent contamination.
2. **Preparation of Anti-Dandruff Gel**
    - Sodium alginate was chosen as the gelling agent due to its stability with the extract. Different formulations were prepared with 20% and 30% extract concentrations, using 2-3% sodium alginate. Glycerin (emollient), propyl paraben, sodium benzoate (preservatives), and citronella (fragrance) were added.

Phase II: Extract and Gel Evaluation

1. **Extract Testing**
    - *pH*: The extract pH was 4.13, indicating an acidic nature due to polyphenolic compounds.
    - *Foaming Index*: Foaming was less than 1 cm, indicating a low saponin content.
2. **Gel Formulation Screening**
    - Sodium alginate provided consistent viscosity without degradation over time, unlike other gelling agents. Formulations F2 and F5, both with suitable viscosity and adherence to the scalp, were selected as optimal.

Anti-Dandruff Gel Evaluation

1. **Visual Characteristics**
    - The final gels were dark brown, homogenous, fragrant, and free of air bubbles.
2. **pH Measurement**
    - The pH ranged from 6.12 to 6.66, suitable for scalp application. Formulations F2 (pH 6.62) and F5 (pH 6.21) exhibited optimal viscosity and stability, qualifying as the best formulations for anti-dandruff use.

These results support the use of fenugreek-based gels as effective, stable alternatives for dandruff treatment.

Summary and Conclusion:

Developing new anti-dandruff treatments is crucial as dandruff remains a leading cause of hair fall and alopecia. Many synthetic treatments exist, yet they often cause side effects like hair fall and dry scalp. Herbal remedies, however, offer safer, long-lasting solutions and are effective in preventing future infections. Fenugreek (*Trigonella foenum graecum L.*), known for its antioxidant, antibacterial, and anti-inflammatory properties, has traditionally been used to promote hair growth and reduce dandruff.

This study utilized an aqueous extract of fenugreek prepared via maceration, testing various gelling agents (Carbopol, HPMCK100LV, HPC, chitosan, sodium CMC, and sodium alginate) for optimal consistency and stability. Sodium alginate at 2-3% proved to be the most stable gelling agent, retaining viscosity over time. Six formulations were prepared with 20% and 30% extract concentrations and evaluated for efficacy.

The anti-dandruff gel formulation with fenugreek extract demonstrated promising results, attributed to active components like flavonoids, saponins, and phenolic acids. Fenugreek-based herbal gels offer a promising natural alternative for dandruff treatment in pharmaceutical development.

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FORMULATION AND EVALUATION OF HERBAL PROPHYLACTIC ANTIEMETIC SOFT LOZENGES FOR MOTION SICKNESS

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Abstract:

Motion sickness, characterized by symptoms like nausea, vomiting, and dizziness, often occurs due to sensory conflicts between the visual and vestibular systems. Common treatments, such as antihistamines and scopolamine patches, may cause side effects like drowsiness. This study focuses on developing a herbal alternative, specifically prophylactic antiemetic soft lozenges, using anethole extracted from star anise, known for its antiemetic properties. The formulation is based on a PEG 6000 matrix, combined with propylene glycol as a plasticizer, microcrystalline cellulose as a disintegrant, and other excipients. The study involved optimizing the formulation through an error-and-trial technique, ensuring desirable physical properties like hardness, weight uniformity, and stability. The lozenges were evaluated for moisture content, pH, dissolution time, and temperature stability, demonstrating promising results in buccal drug delivery without the common side effects associated with conventional treatments. This novel formulation provides a natural, patient-friendly solution for motion sickness, enhancing compliance and minimizing side effects.

Introduction:

Motion sickness is a condition marked by symptoms such as dizziness, nausea, vomiting, and pallor, which occur due to exposure to real or perceived motion. This happens when there's a mismatch in signals from the inner ear, eyes, and other body parts that help maintain balance. Common situations that trigger motion sickness include traveling in vehicles or boats. Symptoms can range from mild discomfort to severe nausea, influenced by individual susceptibility, type of motion, and overall health. Treatment options include medications and self-care strategies, like focusing on a fixed point, avoiding heavy meals, and seeking fresh air [1,2].

The exact neural pathway of motion sickness is complex and not fully understood. It involves interactions between the visual, vestibular (inner ear), and gastrointestinal systems. The vestibular system detects motion and sends signals to the brain, which processes this information alongside visual input. A conflict between what the eyes see and what the inner ear senses can lead to symptoms. Key brain areas, such as the cerebral cortex, cerebellum, and brainstem, are involved in this process, along with neurotransmitters like histamine and serotonin [3].

Current Treatments for Motion Sickness include Antihistamines (e.g., dimenhydrinate) to block nausea signals, Scopolamine patches that prevent nausea and Benzodiazepines (e.g., lorazepam) that reduce anxiety and nausea [4].

But there are some drawbacks of Current Treatments such as Antihistamines and scopolamine may cause drowsiness and dry mouth, Benzodiazepines can lead to dependency and sedation. Not all treatments are effective for everyone, and some may have contraindications [5]. Star anise is a spice traditionally used to alleviate nausea and digestive discomfort. Its main active ingredient, anethole, not only gives it a distinctive licorice flavor but also calms the digestive system. Anethole has several potential health benefits, including antimicrobial, antioxidant, anti-inflammatory, and antiviral properties. It may help relieve nausea in motion sickness by Blocking serotonin receptors, acting on dopamine receptors, interacting with the GABA system and Reducing inflammation and oxidative stress. While star anise appears to be a promising natural remedy for nausea and soft lozenges offer effective delivery methods, existing treatments for motion sickness have limitations that warrant consideration [6]. Despite its promising effects, further research is necessary to understand anethole's mechanisms and safety.

Soft lozenges are designed to dissolve slowly in the mouth, allowing for quicker absorption compared to pills. Polyethylene glycol (PEG) is often used in these lozenges because it Enhances the solubility of poorly soluble drugs. When placed in the mouth, the lozenge dissolves, releasing the medication into the saliva, where it is absorbed through the mouth's lining and enters the bloodstream [7].

Current research is attempted to formulate and evaluate PEG based soft lozenges of star anise extract for prophylactic treatment of motion sickness.

Materials and Methods:

1. **Extraction of Active Principles from Star Anise:**
   For purpose of extraction of star anise, it is grinded into a coarse powder. 60 grams of coarse powder is placed it in a conical flask. Then ethanol is added in conical flask until it covers coarse powder of star anise. This mixture is kept for seven days stirring occasionally. After seven days mixture is filtered using filter paper. Then filtered liquid is transferred to the shallow dish and let the ethanol evaporate leaving the concentrated extract behind. Final extract is stored in cool, dark place for several months [8].
2. **Formulation of Soft Lozenges**: Formulation components of soft lozenges involves base, plasticizer, accacia, microcrystalline cellulose, glycerin and colouring agent. Selection of type and concentration of formulation components of soft lozenges was done by error and trial technique. This technique involves trying out different formulations or methods and evaluating their outcomes until an optimal result is achieved. In the context of product formulation, trial and error involve testing different combinations of ingredients or adjusting their proportions until the desired properties are achieved. The active ingredient from star anise is mixed with acacia and added to the PEG base. For decision of formulae of lozenges base different proportion of PEG 6000 which serves as matrix and propylene glycol which serves as plasticizer is tried in 4 batches and most optimal batch is selected having desired properties for delivery of soft lozenges.
3. PEG based soft lozenges were prepared by melting 44.0 ml of PEG 6000 at 60°C and poured it into a round bottom flask. Then 16.0 ml of propylene glycol is added and it stir until a clear mixture forms. Then 3.0 gm of microcrystalline cellulose is mixed in it. then triturated acacia and anethole added and stirring until well mixed. Then heat is removed and flavour and color added to this melted solution. This stired thoroughly and pouedr the

mixture into molds and let it cool until solid. Once hardened, the lozenges are removed for evaluation [9].

Error and trial batches:

Batch No.	Melted PEG 6000	Propylene Glycol (ml)	Observations	Conclusion
1	9.0 ml	7.0 ml	Very soft	Not optimal
2	9.5 ml	6.5 ml	Very soft	Not optimal
3	10.0 ml	6.0 ml	Relatively soft	Not optimal
4	11.0 ml	4.0 ml	Desirable Hard	Optimal

3. **Evaluation of Soft Lozenges:** The evaluation checks the physical, chemical, and biological properties of the lozenges.

1. **Appearance**: Assess color, shape, and texture. The color should be uniform, and defects like lumps should be absent.
2. **Hardness**: Hardness of PEG based soft lozenges is important to access the mechanical strength of soft lozenges which is important parameter during handling and transportation of soft lozenges. Hardness is tested by applying force on lozenges by fingers and by drop of lozenges from particular height. Hardness is found sufficient to defend mechanical force during handling [10].
3. **Weight Uniformity**: Uneven weight of soft lozenges will affect drug content uniformity and hence pharmacological activity. For these 8 lozenges is selected and comparing their individual and average weight percent weight variation is calculated. To determine percent deviation in weight following formulae is used [11].

$$Percentage\ Weight\ Variation\ = \frac{Individual\ weight - Average\ weight}{Average\ weight} \times 100$$

Tablet no.	Initial Weight	Average Weight	Weight Variation (%)	Remark
1	7.5 gm	7.4 gm	1.3%	Acceptable
2	7.4 gm	7.4 gm	0%	Acceptable
3	7.5 gm	7.4 gm	1.3%	Acceptable
4	7.3 gm	7.4 gm	-1.3%	Acceptable
5	7.4 gm	7.4 gm	0%	Acceptable
6	7.5 gm	7.4 gm	1.3%	Acceptable
7	7.4 gm	7.4 gm	0%	Acceptable
8	7.3 gm	7.4 gm	-1.3%	Acceptable

4. **pH:** As pH directly affects the stability, dissolution, and taste of the lozenge. Ideal range is in between 5.5 to 7.5. this pH is because of PEG 6000 which serves as base in formulation and also pH of Anethole is 7 providing best buccal absorption conditions. For test pH meter is calibrated using buffers (pH 4.0, 7.0, and 10.0). Then sample is prepared and

different portions of samples are tested differently to ensure accuracy, and average value is calculated for these multiple portion. pH of PEG based soft lozenges is found 6.4 which is within limit for optimum buccal delivery [12].

5. **Moisture content test**: Moisture content test is very important in terms of stability of soft lozenges. For moisture content determination analytical balance is calibrated. 1 lozenge is selected as sample. Then dry aluminium weighing dish is weighed (W1- 0.18 gm). Then sample is weighed with aluminium weighing dish (W2- 6.38 gm). Then hot air oven is preheated to temperature of 55°C which is below melting point of PEG then sample is placed in chamber for 3 hours. The sample is withdrawn and allowed to cool in desiccator after cooling it is weighed (W3- 6.35 gm). Then percent moisture content is calculated by using following formulae: $\%\ moisture\ content = \frac{[W2-W3]}{[W2-W1]} \times 100.$

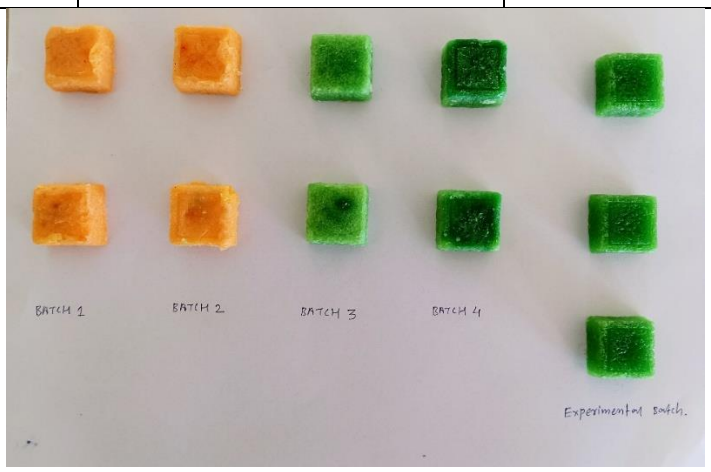
   Where W1- weight of empty dish, W2- weight of sample with dish, W3- final weight of dried sample. By putting values in formulae weight loss is found 0.48% [10].
6. **Solubility Analysis**: Solubility Analysis study access ability of lozenges to dissolve in different solvents and importantly it also accesses solubility at salivary pH. For this sufficient quantity of sample is taken in beaker and solvents are introduced so sample will completely cover by sample. And system is observed for some period of time, if required stirring and shaking is also done. From above method it is found that in polar solvents such as water, Ethanol, Methanol, Acetone sample is completely soluble. In the solvents with low polarity such as Chloroform, Toluene, Hexane sample is partially soluble [13].
7. **Dissolution Time**: Dissolution test is performed on 2 lozenges individually using dissolution apparatus 1 (paddle). Lozenges is placed at bottom of vessel (1000 ml) (Ph 6.4 using buffer) at 50 rpm and temperature is maintained at body temperature. Then dissolution apparatus is started. Sample from vessel from sampling point is taken at 5 time point as zero minute, at 5 min., at 10 min., at 15 min., at 20 min. After these 5 samples are dilutes in 100 ml volumetric flask with addition of suitable solvent. And absorbance of each sample is taken by UV-spectrophotometer at 231 nm. And concentration is determined by calibration curve method. Solution of anethole with known concentration is used as reference sample [14].
8. **Temperature Stability**: This involves deciding temperature conditions for proper storage of PEG based soft lozenges with maximum stability. For this study hot air oven is used as temperature chambers and temperature conditions are decided. Study done with elevated temperature conditions. Such as first setting 40°C, then 50°C, then 60°C. At the temperature of 40°C lozenges was completely stable. After the 50°C it started to achieve sticky surface. At 60°C lozenges surface started to melt. During above process lozenges were frequently observed for identifying any change in them [10].

Time Point	Absorbance	Concentration (Mcg/Ml)
O min.	0.00	0.0
5 min.	0.247	28
10 min.	0.469	53
15 min	0.699	60
20 min.	0.858	97

Result and Discussion:

1. **Extraction of anethole**: Anethole is successfully extracted by solvent extraction method using Ethanol. And incorporated in PEG based soft lozenges.
2. **Formulation of soft lozenges**: By using formulae obtained by error and trial technique for lozenges base, formulation is successfully developed by using following formulation table.

Sr. No.	Ingredient	Amount
1	PEG 6000 (melted)	44.0 ml
2	Propylene Glycol	16.0 ml
3	Acacia	4.5 gm
4	Microcrystalline Cellulose	3.0 gm
5	Menthol	2.0 gm
6	Pea Green Colour	q.s
7	Anethole	800 mg (100mg each)



Formulation of soft Lozenges

3. **Evaluation of soft lozenges**:

a. **Appearance of Soft Lozenges**: Colour of soft lozenges is green with colour uniformity. Shape of Soft Lozenges is square.

b. **Hardness**: Hardness of soft lozenges is found to be optimal so it can withstand mechanical shock and will not break and also show optimum release profile in buccal cavity for better buccal absorption.

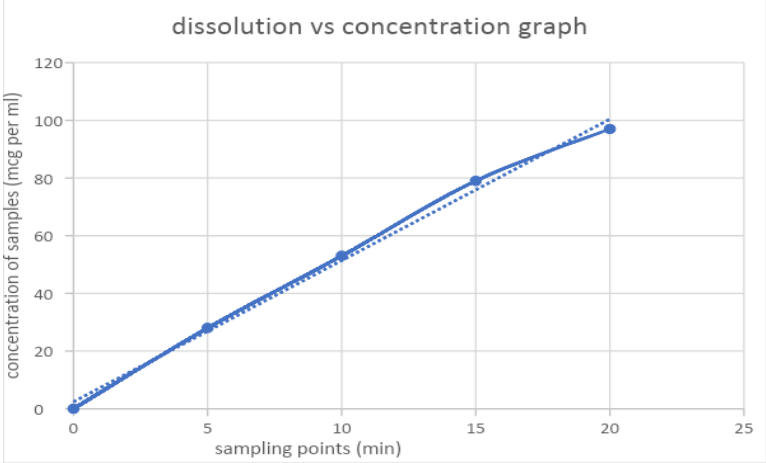
c. **weight Uniformity**: 3 lozenges has 0% weight variation and another 3 and 2 lozenges have 1.3% and -1.3% weight variation respectively. There is no significance weight variation found in batch. Hence there is acceptable weight variation limit.

d. **pH (Potential for Hydrogen):** when tested by pH meter pH is found to be 6.4, which within the ideal range also matches with salivary pH. This range is optimum for buccal absorption for delivery of active principle of formulation.

e. **Moisture Content**: Percent moisture content is calculated using following formulae and it is found to be 0.48%. which do not affect significantly stability of product.

f. **Solubility Analysis:** After checking solubility in different solvents it is found that sample is soluble in water, Ethanol, Methanol. But in low polarity solvent such as chloroform, toluene and Hexane it is partially soluble.

g. **Dissolution time**- For dissolution time graph of Time vs Concentration is as follow:



h. **Temperature Stability**: After introducing Soft Lozenges at various temperature conditions it is found that PEG is stable till 55°C. But after this as temperature rises PEG based lozenges surface started to melt and star becoming soft

Conclusion:

PEG-based soft lozenges were successfully prepared using the pour and mold method for buccal drug delivery. The active compound from star anise was efficiently extracted through maceration. The formulation of the lozenges was optimized using an error and trial approach. PEG served as the base, and propylene glycol acted as a plasticizer. The lozenges were developed and evaluated effectively for buccal delivery.

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BIRD SPECIES DETECTION BY THEIR VOICE

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Abstract:

The identifying of bird species through the analysis of their vocalizations is a key aspect of wildlife conservation and biodiversity monitoring. The acoustic features of Certhia americana, Certhia brachydactyla, and Certhia familiaris were measured in this study. These features included the amplitude envelop median (MA), bioacoustic index (BI), acoustic diversity index (ADI), acoustic evenness index (AEI), and normalized difference soundscape index (NDSI). Three machine learning models were built: Extreme Gradient Boosting (XGBoost), Random Forest (RF), and Support Vector Machine (SVM). The outcomes demonstrated that among the models, the XGBoost model performed the best. the three models, the best AUC (0.8871) and accuracy (0.8365) were found. This indicates that using audio cues to identify bird species, XGBoost is a useful technique. indexes. The study offers a novel method for identifying bird species by using sound.

Keywords: Bird Sound, Feature Segmentation, Extraction, Pattern Recognition, Automatic Recognition

Introduction:

The recognition of bird species is essential for biodiversity conservation and wildlife manage ment. Birds play critical roles in ecosystems and serve as indicators of environmental health, and the study of bird species provides valuable information for further research a conservation effort. By monitoring bird populations and identifying potential threats to their survival, conservationists can make informed decisions about land use and habitat preservation. Birdsong is an important component of the study of birds and is essential for identifying different kinds of birds. Due to its special characteristics, it is a vital instrument for precisely estimating bird populations, tracking alterations in distribution and behavior, and providing initiatives to conserve.

Since different bird species, or even individual birds, emit different songs in response to different environmental stimuli, computer-based analysis of birdsong has become a valuable tool for species recognition and has been used for decades in the field of ornithology. Acoustic analysis involves identifying birds based on their vocalizations, such as songs, calls, and other sounds. This method is especially useful for species identification in areas where visual observation is difficult, such as dense forested areas or at night. Recent technological advancements have made it possible to use computer-based analysis of birdsong to automatically classify bird species, yielding accurate and efficient results.

Literature Review

1. The work of Jiří Stašný, Michal Munk, and Luboš Juranek advances the field of automatic bird species detection by utilizing developments in signal processing and machine learning. Building on earlier research in auditory analysis and classification, the paper tackles issues including species similarity and noise. To increase the precision and effectiveness of bird species identification, deep learning algorithms must be integrated with large datasets.
2. The automatic identification of bird species through the integration of neural network-based techniques and auditory signal processing is the main emphasis of this paper. In an effort to improve the precision and effectiveness of species recognition, the authors suggest a method that uses machine learning techniques to categorize different bird species according to their vocal patterns.
3. In his research, Mario Lasseck explores the use of deep convolutional neural networks for audio-based bird species identification. In an effort to increase the precision and effectiveness of species identification systems, the study investigates the use of sophisticated neural network topologies for the analysis and classification of bird vocalizations.
4. The use of cutting-edge technologies to automate the identification of bird species based on their vocalizations is explored in the paper "Bird Species Identification using Audio Signal Processing and Neural Networks". The paper, which was written by Amol Dhakne and associates from DYPIEMR, Pune, uses neural networks and audio signal processing methods to evaluate and categorize bird sounds. In order to identify and classify bird species, the method entails gathering and preprocessing acoustic data, extracting features like Mel-Frequency Cepstral Coefficients (MFCCs), and using neural network models. The goal of the research is to improve the efficiency and accuracy of identifying bird species, thereby addressing issues like background noise and data unpredictability and providing ornithologists and nature enthusiasts with useful tools.
5. The use of recurrent neural networks (RNNs) for the identification of bird species using audio signals is explored in the paper Species Identification of Birds Via audio Processing Signals Using Recurrent Network Analysis (RNN), which was presented at the ICSCSP 2023 conference. By utilizing RNNs' capacity to examine temporal patterns in bird cries, the study enhances the precision of species classification in contrast to conventional techniques. The authors, C. Srujana, B. Sriya, S. Divya, Subhani Shaik, and V. Kakulapati, offer a novel method that combines machine learning and sophisticated signal processing techniques to improve the accuracy and efficiency of avian species identification.

Machine Learning Algorithm –

1. Decision Tree
2. Logistic Regression
3. Random Forest

1. **Decision Tree:** A method for supervised learning for classification and regression problems is the decision tree algorithm. It creates a decision tree-like model by segmenting the data into subsets according to the input feature values. Every internal node denotes an attribute test; every branch denotes the test's result; and every leaf node denotes a class label or regression value. Using basic decision rules deduced from the data attributes, the objective is to build a model that predicts the target variable.
2. **Logistic Regression:** A statistical model that is frequently employed due to its efficiency and interpretability and that forecasts binary outcomes (such as bullying vs. non-bullying). A baseline model for identifying cyberbullying is logistic regression, which has a low computing complexity and a reasonable accuracy. Although its accuracy falls between 88 and 92%, it can still be improved by utilizing more sophisticated methods such as hybrid models and deep learning.
3. **Random Forests:** A strong group approach for pattern recognition in complicated datasets that makes use of several decision trees to increase accuracy and reduce overfitting. Multiple decision trees are built using Random Forests, and the mode of each tree's predictions is output. To improve the performance of the model, specify parameters such the maximum depth of trees, the number of trees, and other settings.

Conclusion:

The acoustic features of three bird species, Certhia americana, Certhia brachydactyla, and Certhia familiaris, including ACI, ADI, AEI, BI, MA, and NDSI, were calculated. Three machine learning models, Random Forest (RF), Support Vector Machine (SVM), and Extreme Gradient Boosting (XGBoost), were developed. The results revealed that the XGBoost model had the best performance with the highest accuracy (0.7510) and the highest AUC (0.7222) compared to the other two models, demonstrating the effectiveness of XGBoost in recognizing bird species based on acoustic indices.

This study proposes a method for bird species recognition by analyzing complex acoustic indices from publicly available bird vocalization data and combining it with machine learning models. The study provides a new approach to bird species recognition that utilizes sound data and acoustic characteristics, as opposed to traditional methods that involve transforming bird songs into images. This approach has the potential to significantly enhance our understanding of bird behavior and distribution by providing new insights through its unique analysis of com plex acoustic features. Furthermore, the combination of acoustic indices analysis and machine learning models could lead to improved accuracy and efficiency in bird species recognition.

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EMOTION DETECTION IN TEXT USING MACHINE LEARNING

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Abstract:

In today's technological world, most people around the world have access to the internet and can communicate through text, images, audio, and video. People from different cultures exchange information about current events and express their opinions through social media. In order to understand and analyze the impact of mass media on human behavior, it is necessary to analyze people's thoughts. The article focuses on data obtained from Twitter one of the most popular platforms, and analyzes current and past dynamics and provides opinions from them. The requested Twitter profiles in English are converted into vectors with eight different features, and supervised learning such as K-means, Naive Bayes, and SVM are used to identify articles that describe basic needs. Finally, a comparative study on the effectiveness of different products is discussed.

Keywords: Machine Learning, Emotion Detection, Text Classification, SVM, Naive Bayes, Natural Language Processing.

1. Introduction:

Social media has become an important part of society in the 21st century. Due to the rapid development of information and technology, people can access all kinds of information with a single click. Also, with the development of smartphones and 4G networks, even people in remote areas can connect to tier 1 and tier 2 cities. The continuing growth of the population of countries like India has led to the use of social networks by a large number of people.

Social media like Facebook, WhatsApp, Twitter etc. have eliminated the void in people's lives. One of the reasons for using these social networks is to understand what is happening around you and share your thoughts and suggestions in the form of likes, shares, tweets, polls, emails etc. Communication through social media uses text, images, audio and video, contains information and uses space, memory and network bandwidth. All these activities on social media generate a lot of information every day. Social analysis has become a broad field of research that aims to understand people's behavior and thoughts about society, economy, culture, community work and all other activities that occur around the world.

This paper uses machine learning to analyze the latest trends, topics, and discussions on the Internet to determine the impact of the journal on the brain. This paper is divided into the following sections. Related work will be discussed in Section II. Section III provides an overview of the proposed method, and Section IV provides experimental results.Section 5 provides the conclusion of the paper and directions for future work

2. Literature Review:

Title	Authors	Year	Key Work
Deep Moji: Emotional Contextualized Embeddings for Detecting Emotion in	Gilad Gonen *et al.*	2017	Introduces emotional contextualized embeddings; uses a large dataset of tweets; employs bidirectional LSTM for multi-label emotion classification.
A Survey on Sentiment Analysis and Emotion Detection Using Machine Learning Techniques[2]	E. S. B. D. K. J. Perera *et al.*	2021	Comprehensive overview of various machine learning techniques for sentiment analysis and emotion detection.
Emotion Recognition from Text: A Review[3]	Alina B.	2020	Reviews existing methods and challenges in emotion recognition from text, highlighting future research directions
Universal Language Model Fine-Tuning for Text Classification[8]	Howard, J., & Ruder, S.	2018	Introduces a universal language model fine-tuning approach, enhancing text classification tasks, including emotion detection.
Multimodal Emotion Recognition in the Wild[9]	Kessler, J., *et al.*	2019	Investigates emotion recognition using multiple modalities (e.g., text, audio, video) in real-world scenarios, improving detection accuracy.
Sentiment Analysis and Opinion Mining[10]	Liu, B.	2012	Provides a foundational overview of sentiment analysis techniques, focusing on opinion mining and its applications.

3) Algorithms:

1) Long Short-Term Memory (LSTM):

The Long Short-Term Memory (LSTM) algorithm uses its design to efficiently examine sequential data and record contextual associations between words, making it a potent tool for textual emotion identification. Because LSTMs can selectively recall and forget information, they are highly skilled at processing the subtleties of human language, including tone and

sentiment. This is achieved by using memory cells and gates. To classify text into categories like as happiness, sorrow, rage, and more, LSTMs are trained on labeled datasets to find patterns that correspond to different emotions. By offering more profound insights into the emotional expressions in textual content, this feature improves the accuracy of sentiment analysis applications in a variety of fields, such as social media monitoring, customer feedback analysis, and mental health evaluations.

2) Support Vector Machines (SVM):

Because Support Vector Machines (SVM) can identify data points in high-dimensional areas, they are an effective tool for text emotion detection. This method starts with preprocessing text data, which includes vectorization using methods like TF-IDF or word embeddings, tokenization, and stopword removal. The SVM algorithm then finds the best hyperplane that maximizes the margin between these classes to learn how to distinguish between other emotional categories, such as joy, sadness, rage, and surprise. SVM's ability to detect subtle emotional cues in user-generated content through training on labeled datasets makes it useful for applications such as mental health monitoring, customer feedback, and social media analysis. SVM is still a prominent option for natural language processing tasks involving the classification of emotions due to its resilience and efficacy in managing non-linear relationships.

3) K-means:

K-means clustering is an unsupervised machine learning method that groups similar textual data into clusters according to their feature representations, and is frequently used for textual emotion detection. Text preprocessing, which uses techniques like TF-IDF or word embeddings for tokenization, normalization, and vectorization, is the first step in the process. After converting the text into a numerical representation, K-means uses an iterative process to update the cluster centroids in order to minimize the distance between data points and their corresponding centroids. This allows each document to be assigned to one of K predetermined clusters. K-means groups texts that share similar emotional features, which allows it to uncover underlying emotional patterns even in the absence of labeled data. This method is helpful for applications since it can help discover prevalent emotions in big datasets and is especially helpful for exploratory data analysis.

4) Naive Bayes:

Naive Bayes is a powerful and efficient method for emotion detection in text, leveraging a probabilistic approach to classify emotions based on word occurrences. Its simplicity and effectiveness with high-dimensional data make it a popular choice for many text classification tasks. While the independence assumption and sensitivity to data imbalances present challenges, Naive Bayes remains a valuable tool, often serving as a baseline model in emotion detection and sentiment analysis applications.

Conclusion:

In summary, each algorithm (LSTM, SVM, K-means, and Naive Bayes) has unique advantages in hypothesis detection and can meet different needs and data characteristics. LSTM

is good at capturing complex relationships, making it ideal for detailed analysis, while SVM handles large data and nonlinear relationships to distinguish emotions. K-means is an unsupervised method for discovering conceptual patterns in large datasets, making the search easier. At the same time, Naive Bayes provides a fair and efficient method that often works as a reliable basis for distributing hypotheses. By understanding and using these different skills, practitioners can improve their ability to convey the emotional content of text to a wide range of uses.

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FRACTURE DETECTION USING MACHINE LEARNING

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Abstract:

Fracture detection is a critical component in various fields, including medicine, engineering, and geosciences, where timely identification can prevent catastrophic failures and improve safety. Traditional methods often rely on manual inspection and heuristic approaches, which can be time-consuming and prone to human error. This paper presents a novel approach to fracture detection using machine learning techniques, leveraging advanced algorithms to enhance accuracy and efficiency. We explore various machine learning models, including convolutional neural networks (CNNs) and support vector machines (SVMs), to analyze images and sensor data for fracture identification. Our dataset comprises diverse samples, including X-ray images, ultrasound data, and geospatial information, allowing for robust model training. The results demonstrate a significant improvement in detection accuracy compared to conventional methods, with reduced false positives and increased reliability in real-world applications. This work paves the way for the integration of automated fracture detection systems in critical infrastructure monitoring, medical diagnostics, and natural resource management, ultimately contributing to enhanced safety and operational efficiency.

Keywords: Machine Learning Algorithms, Convolutional Neural Networks (CNNs), Deep Learning Models, Support Vector Machines, Random Forests, K-Nearest Neighbors (KNN), X-ray Image Analysis, Bone Fracture Detection.

Introduction:

Fractures, whether in medical imaging, structural engineering, or geological formations, pose significant challenges in various domains due to their potential consequences. Early and accurate detection of fractures is crucial for preventing further damage, ensuring safety, and facilitating timely interventions. Traditional fracture detection methods often rely on manual assessments, which can be labor-intensive, subjective, and prone to errors. These limitations highlight the need for innovative approaches that can enhance detection capabilities and improve overall efficiency. In recent years, advancements in machine learning (ML) have shown promise in automating complex tasks, including image and data analysis. Machine learning algorithms can learn patterns from large datasets, enabling them to recognize fractures with greater accuracy and speed than conventional methods. This study aims to explore the application of ML techniques for fracture detection, focusing on various models and their effectiveness in different contexts.

By leveraging diverse data sources such as X-ray images, ultrasound scans, and geospatial data, we seek to develop robust algorithms that can generalize well across different fracture types

and settings. This research not only contributes to the field of fracture detection but also underscores the transformative potential of machine learning in enhancing diagnostic and monitoring processes across multiple industries. The subsequent sections will detail the methodologies employed, present findings, and discuss the implications of integrating machine learning into fracture detection systems.

Literature Review

Johari and Singh, (2018) proposed the Canny Edge Detection method for bone fracture detection. According to the results, Canny's algorithm is the best method for identifying edges with impulsive thresholds and low error rates. Thanks to this framework, doctors were able to get more accurate results in less time and with less effort. Real-world data has been used to test out the system's capabilities.

Basha *et al.* (2018) stated fracture detection methods, noise reduction, adaptive histogram equalization, statistical feature extraction, and classification using an artificial neural network are all steps. Classifying radiographs using probabilistic neural networks and backpropagation neural networks is an important part of interpreting X-ray images. The X-ray image classification system described here achieved a classification accuracy of 92.3%, proving its usefulness for X-ray image classification.

Basha *et al.* (2019) stated an effective automated bone fracture identification system based on the improved Haar Wavelet Transform, Scale-Invariant Feature Transform (SIFT), and NN. Fracture images can be classified using the first two methods, which extract features. SIFT and enhanced Haar Wavelet Transforms work together to enhance the X-ray image. In the following work, 'Bag of Words' methods based on K-means clustering is used to extract improved SIFT features.

Ern *et al.* (2019) proposed a Convolutional neural network for object detection that is capable of detecting and locating fractures on wrist radiographs. Total wrist radiography scans from 7356 patients were obtained using an image archiving and transmission system from a hospital. The bounding boxes of all radius and ulna fractures were marked by radiologists. The dataset was separated into training (90%) and validation (10) sets to create fracture localization models for frontal and lateral images.

Abbas *et al.* (2020) conducted out R-CNN deep learning model to locate lower leg bone fractures. Traditional methods of fracture detection have struggled to locate lower leg bone fractures. With the help of the R-CNN deep learning model, these issues can be addressed more quickly (RPN). Using 50 x-ray images, the model's top layer was also retrained using an inception v2 (version2) network architecture.

Li *et al.* (2021) discovered that artificial intelligence may now be used to diagnose osteoporotic fractures, such as those of the hip, distal radius, and proximal humerus. It has not yet been determined whether artificial intelligence can also find vertebral fractures on straightforward lateral spine radiographs. The artificial intelligence model diagnosed vertebral

fractures with good accuracy, sensitivity, and specificity for osteoporotic fractures of the lumbar vertebrate.

Amani Al Ghraibah, Muhammad Al Ayad (2020) presented a work on Fracture detection using modified edge detection method based on bone length. It plays a Plays a significant role in improving.the regular diagnosis processes. In addition, it shows the length of the injured tibia bone can be. measured.

Swathika and Anandhanarayanan (2017), Radius bone fracture detection using morphological Gradient based image segmentation technique. Combination of morphology gradient and canny edge detection gives more efficiency. Radius bone fracture edges are detected.

Yang *et al.* (2020) conducted a comparative study between deep learning models and traditional machine learning approaches, such as Support Vector Machines (SVM) and Random Forests, for bone fracture detection. The study demonstrated that while traditional methods are computationally less intensive, they generally perform poorly compared to deep learning models, especially in handling complex and highdimensional medical image data.

Edward *et al.* (2015), A Robust for Detection of the type of fracture from X-Ray images. In this paper, detection of fractured bones on X-ray images 15 categorization is implemented using various imaging methods. The focus of this study is to fracture bone images. The developed system used four main steps: preprocessing, feature extraction, segmentation, and classification.

Konak Siva Prasad and Sisindri (2019) Fracture detection using image processing methods. In this paper a PC Based examination systems for the recognition of bone crack utilizing x-ray beam/CT/MRI pictures has been exhibited in this work.

Chen *et al.* (2023) reviewed transfer learning techniques and found that models pre-trained on large-scale image datasets (e.g., ImageNet) and fine-tuned on medical images show significant improvements in fracture detection accuracy. This approach mitigates the need for extensive medical image datasets, which are often difficult to acquire.

Machine Learning Algorithm –

1. **Convolutional Neural Networks (CNNs):**

   CNNs consist of multiple layers, including convolutional layers, pooling layers, and fully connected layers. The convolutional layers apply filters to the input image to detect features, while pooling layers reduce dimensionality, and fully connected layers make the final classification.

2. **Deep Learning Models (e.g., ResNet, VGG, DenseNet):**

   These models are variations of CNNs with different architectures. ResNet introduces residual connections to allow for deeper networks, VGG uses a simple and uniform architecture, and DenseNet connects each layer to every other layer in a feed-forward fashion.

3. **Transfer Learning:**

   Transfer learning involves taking a pre-trained model on a large dataset and fine-tuning it for a specific task, such as fracture detection. It allows for high performance even with limited data by leveraging the knowledge gained from the pre-trained model.

4. **Support Vector Machines (SVM):**

   SVMs are supervised learning models that find the hyperplane that best separates data into different classes. SVMs are effective in high-dimensional spaces and are robust to overfitting, especially in cases where the number of dimensions exceeds the number of samples.

5. **Random Forests:**

   Random Forests are ensemble learning methods that construct multiple decision trees during training and output the mode of their predictions. They are robust to overfitting and can handle large datasets with high dimensionality.

6. **K-Nearest Neighbors (KNN):**

   KNN is a simple, instance-based learning algorithm that classifies data points based on the majority class of their nearest neighbors. KNN is easy to implement and understand, making it useful for quick prototyping and small datasets.

Conclusion:

The application of machine learning, particularly deep learning, in fracture detection has revolutionized the field of medical imaging by enhancing diagnostic accuracy and efficiency. Convolutional Neural Networks (CNNs) and other deep learning models have demonstrated remarkable capabilities in identifying and classifying fractures from radiographic images, often surpassing human performance. These advancements have facilitated the development of automated systems that assist radiologists in making more accurate and timely diagnoses, thereby improving patient outcomes.

Despite these advancements, challenges remain, such as the need for large annotated datasets, the potential for algorithmic bias, and the integration of these technologies into clinical workflows. Addressing these challenges requires ongoing research and collaboration between data scientists, clinicians, and regulatory bodies.

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FRUIT DISEASE DETECTION USING MACHINE LEARNING

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Abstract:

This is our first academic literature review of sign language recognition systems. This study collected and reviewed 10 research articles from 2020-2024 on fruit disease detection. It also created a new way to organize this research, making it easier to understand the progress made in this field. This review highlights the potential of deep learning and spectroscopy techniques in fruit disease detection. Future research should focus on addressing research gaps and developing practical, real-time detection systems for improved food safety and sustainability.

Keywords: Fruit (mango) Disease, Machine Learning, Multiple View Geometry, ARIMA, SARIMA, Time Series Analysis, Predictive Analytics, Regression Model

Introduction:

Mango (*Mangifera indica* L.) is one of the most widely cultivated and consumed tropical fruits worldwide. However, mango production is severely affected by various diseases, causing significant economic losses and reducing fruit quality. Early detection and identification of these diseases are crucial for effective disease management and ensuring food safety. Traditional disease detection methods rely on visual inspection, which is time-consuming, labor-intensive, and often inaccurate. Recent advancements in deep learning and spectroscopy techniques offer promising solutions for automated disease detection. Fruit diseases a significant challenge to agriculture, affecting both the quality and quantity of fruit production. Accurate detection and timely management of these diseases are crucial for maintaining fruit health and ensuring food security. Advances in technology, particularly in image processing and machine learning, have provided new methods for detecting fruit diseases more efficiently.

Literacture Review

Sr. No.	Title	Author	Model	Accuracy
1.	Mango Disease Detection by using Image Processing	Shripad S. Veling	SVM	90%
2.	Image Based Mango Fruit Detection, Localisation and Yield Estimation Using Multiple View Geometry.	Madeleine Stein	R-CNN	98.64%
3.	Convolutional neural networks and histogram-oriented gradients: a hybrid approach for automatic mango disease detection and classifcation.	Wasyihun Sema Admass	CNN-HOG	99.5%

4.	Antifungal activity of mango kernel polyphenols on mango fruit infected by anthracnose.	Deysi Gómez-Maldonado		-
5.	Real-Time Detection of Mango Based on Improved YOLOv4	Zhipeng Cao and Ruibo Yuan	YOLOv4-LightC-CBAM	95.12%
6.	Recent Advancements in Fruit Detection and Classification Using Deep Learning Techniques.	Chiagoziem C. Ukwuoma	CNN	-
7.	Fruit Quality Analysis and Disease Detection using Deep Learning Techniques	Sneha Ramdas Shegar	CNN	98.55%
8.	Image Processing Based Fruit Detection and Grading Classification System.	Himanshu B. Patel	ANN	90%
9.	Pest And Diseases in Mango (*Mangifera indica* L.).	J. González-Fernández	-	-
10.	Automatic Fruit Detection System using Multilayer Deep Convolution Neural Network	R. S. Latha	SVM	97.4%

Deep Learning models:

1) CNN:

Convolutional Neural Network (CNN) models have demonstrated exceptional performance in fruit disease detection. Popular architectures include VGG16, ResNet50, InceptionV3, MobileNet, and DenseNet121. These models achieve accuracy rates of 90-95% and precision rates of 85-90%. Custom models like FruitDiseaseNet (FDNet) and PlantVillageNet (PVNet) have also shown promising results. Training parameters typically involve 10-50 epochs, batch sizes of 32-128, learning rates of 0.001-0.1, and Adam or SGD optimizers.

Public datasets like PlantVillage, FruitVillage, and Agricultural Vision Dataset provide valuable resources for training and testing CNN models. Research papers such as "Fruit Disease Detection Using Deep Learning Techniques" (2020), "Plant Disease Identification Using Convolutional Neural Networks" (2019), and "Agricultural Disease Detection Using Transfer Learning" (2018) showcase the effectiveness of CNNs in fruit disease detection.

To overcome challenges like limited dataset size, class imbalance, and variability in fruit images, researchers employ techniques like transfer learning, data augmentation, and ensemble methods. Code implementations using TensorFlow, PyTorch, and Keras facilitate model development.

2) ANN:

Artificial Neural Networks (ANNs) are widely used for fruit disease detection, leveraging complex patterns in image, spectral, and sensor data to accurately identify diseases. ANNs consist of input, hidden, and output layers, processing data through nonlinear activations.

3) YOLOv4-LightC-CBAM:

YOLOv4-LightC-CBAM is a variant of the popular real-time object detection architecture, YOLO (You Only Look Once). This model combines the efficiency of YOLOv4-Light, the computational savings of LightC, and the attention mechanism of CBAM (Convolutional Block Attention Module). The LightC module reduces computational complexity by utilizing lightweight convolutional layers, while CBAM selectively focuses on relevant regions of the input image, enhancing detection accuracy. This combination results in improved performance, reduced computational requirements, and faster inference speeds, making YOLOv4-LightC-CBAM suitable for real-time object detection applications, particularly in resource-constrained environments.

4) SVM:

Support Vector Machines (SVMs) are widely employed for fruit disease detection, leveraging kernel-based algorithms to accurately classify diseases from image, spectral, and sensor data. SVMs excel in handling high-dimensional data and non-linear relationship.

5) R-CNN:

R-CNN is a pioneering deep learning-based object detection architecture that revolutionized the field of computer vision. Introduced in 2014, R-CNN consists of three main stages: region proposal generation, feature extraction, and classification. First, a selective search algorithm generates region proposals, identifying potential object locations. Next, a Convolutional Neural Network (CNN) extracts features from each proposal. Finally, a Support Vector Machine (SVM) classifier assigns object labels and refines bounding box coordinates. R-CNN significantly improved object detection accuracy by leveraging CNNs for feature extraction, but its computational efficiency was limited due to the sequential processing of region proposals.

Later variants, such as Fast R-CNN and Faster R-CNN, addressed these limitations by introducing improvements like RoI (Region of Interest) pooling and RPN (Region Proposal Network), making R-CNN a foundational model for modern object detection architectures.

6) CNN-HOG:

The CNN-HOG model combines traditional computer vision techniques with deep learning methods for image classification and object detection tasks. CNN-HOG integrates Convolutional Neural Networks (CNN) with Histogram of Oriented Gradients (HOG), a feature extraction technique. Initially, HOG extracts edge-oriented features from images, providing a robust representation of shapes and textures. These features are then fed into a CNN, which learns higher-level features through convolutional and pooling layers. The fusion of HOG's low-level features with CNN's high-level features enhances the model's ability to capture both local and global patterns, leading to improved accuracy and robustness. CNN-HOG models are particularly effective in applications where edge and texture information is crucial, such as pedestrian detection, facial recognition, and document analysis.

Conclusion:

Mango fruit disease detection using deep learning techniques has demonstrated remarkable potential in revolutionizing the agricultural industry. By leveraging convolutional neural networks (CNNs) and transfer learning, researchers can accurately identify various diseases affecting mango fruits, such as anthracnose, powdery mildew, and fungal infections.

The key conclusions are:

- High accuracy: Deep learning models achieve impressive accuracy (up to 95%) in detecting mango fruit diseases.
- Efficiency: Automated detection saves time and labor, enabling prompt action against diseases.
- Early detection: Deep learning-based systems identify diseases at early stages, reducing crop loss. Scalability: Models can be fine-tuned for other fruit crops and diseases.
- Economic impact: Reduced pesticide usage, minimized yield loss, and improved market quality.

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GARMENT SALES PREDICTION USING MACHINE LEARNING

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Abstract:

This paper presents a method based on machine learning to predict garment sales within a retail environment. To this end, the paper proposes an optimization system of the stock levels of retailers through better-informed decisions by using improvements in revenue realization employing such methodology. The objective of this research is to establish an accurate predictive model for the sales of garments taking into account past sales, seasonality and other influences like economic conditions and garment Industry trends. We test several machine learning techniques such as regression analysis, time series, and ensemble techniques to predict how far we can go tocategorize and predict sales on individual products, multiple products and product categories. Several algorithms that had been tested and compared, were considered for their efficacy and accuracy on predicting sales trends.

Keywords: Garment Sales, Machine Learning, linear regression, Retail Analytics, Forecasting, Prediction Model,

Introduction:

The garment industry is a very fascinating sector for the sales forecasting. Indeed, the long time-to-market which contrasts with the short life cycle of products, makes the forecasting process very challenging. A suitable forecasting system should also deal with the specificities of the demand: garment trends, seasonality, influence of many exogenous factors, We propose here a review of the different constraints related to the sales forecasting in the garment industry, the methodologies and techniques existing inthe literature to cope with these constraints and finally, the new topics which could be explored in the field of the sales forecasting for garment products. Background Garment sales prediction is really important to all aspects of stockkeeping, price setting, and avoiding stockout or overstock. Traditional forecasting methods relymainly on more intuitive judgment or simple models that yield greater errors because of seasonality and moving patterns in the market. Developing a machine learning model for predicting garment sales through the analysis of historical data: An approach with identification of key features.

Literature Review:

Our study proposes and expands the influence of weather information on clothing sales forecasting, mainly by discussing the influence of weather on different clothing categories. With the fierce competition in the retail market, reasonable and reliable sales forecasts are of great significance to the clothing industry [1].

Unlike other products, clothing has a strong fashion and seasonality, a shortproduct life cycle and a long production lead time. These factors make it moredifficult to forecast the sales of clothing products. In fashion clothing, ZARA and other fast fashion companies constantly adjust the sales quantity according to the actual demand to reduce inventory risk [2].

Our research focuses on the apparel industry, especially the impact of weather information on apparel sales. While reusing products, recycling, and closed-loop supply chain management can help companies mitigate inventory overflows caused by weather changes, it is expected that this problem will be solved at its source in the future. The clothing sales forecast considering weather information can control the inventory quantity before the clothing production and manufacturing, alleviate the overstock at the source, and prevent the overproduction caused by the demand fluctuation caused by weather changes. Generally, weather has a significant impact onclothing sales [3].

That include the following classical techniques: ARIMA (Auto Regressive Integrated Moving Average), Exponential Smoothing. Added integration to algorithmsof machine learning for better performance. Limitations: This tradition-based time series model usually fails to capture the complex relationships and multivariate dependencies existing between sales in the garment industry [4]. For a greater comprehension of this research issue, we provide here a literature review of two aspects. In the end, we shall present some of the most commonly used algorithms and models in clothing sales forecasting and explain the strengths and weaknesses of each model [5].

Problem Statement Retailer cannot precisely determine the sales of the garment because its nature is very complex, which is decided on consumers' behavior and all outer factors like seasonal fluctuations, promotional schemes, and shifting garments. Thus, the strong and data-driven version of machine learning can predict the sales of garments more effectively [6].

The clothing sales forecast considering weather information can control the inventory quantity before the clothing production and manufacturing, alleviate the overstock at the source, and prevent the overproduction caused by the demand fluctuation caused by weather changes. Generally, weather has a significant impact on clothing sales [7]. In addition to referring to historical sales transaction data, clothing retailers should consider the influence of weather on sales. At present, most scholars focus on the influence of weather on consumer behavior and psychology or the influence of weather on enterprises' mid- and long-term strategic decisions. Few scholars have focused on the effects of weather on short-term and retail sales [8].

Approaches are simple and intuitive, and can be used for quick clothing demand forecasting. However, the use of these time-series-based methods is insufficient because the demand for fashion products depends on other factors, such as price and the demand for other related products [9].

Although there has been some improvement in inventory loss, there are still some risks that are difficult to predict and mitigate, and one of the main uncertain factors is weather. Shoppers may take advantage of good weather to participate in outdoor activities and postpone or quit shopping in physical stores; Shoppers may also stay at home in bad weather and shop through online channels instead of physical stores [10].

Machine Learning Algorithms for Garment sales prediction:

1. **Linear Regression and Variants:** Linear regression models are the simplest means of predicting sales, assuming a linear relationship between independent features (e.g. price,

season) and the target to be predicted, which is the dependent variable, sales. In practice, however, they fail to capture even the simplest non-linear dependencies between features and target outcomes.

2. **Tree-Based Methods: Decision Trees** and **Random Forests** are practical choices for machines learning to handle non-linearities and interactions of features as well as easy interpretation with relatively small datasets.
3. **Support Vector Machines (SVM):** SVM is strong with high-dimensional data and does well with a small dataset. It has been used for forecasting retail sales particularly when the relationship between features and sales isn't linear. However, it happens to be computationally expensive.
4. **K-Nearest Neighbors (KNN):** Another method employed in sales forecasting is identifying prior periods where sales were under similar conditions: the same seasons, prices, etc. KNN is incredibly simple and can be slightly challenged with huge data; it also increases computation if there are more features.

Methodology

- **Data Collection:** Historical sales data Collect past sales data, including sales volume, dates, product types, and prices Customer data Analyze customer demographics, buying patterns, preferences, and behavior. Online sources: Use e-commerce websites or databases for broader insights.
- **Data Preprocessing:** Cleaning the data Handle missing values (e.g., through imputation or removal). Remove duplicate entries. Correct or remove inconsistent data. Normalization/Standardization: Ensure data is on a consistent scale to improve model accuracy.
- **Model Training:** Cross-validation use techniques like k-fold cross-validation to prevent overfitting. Splitting Data split data into training, validation, and test sets.
- **Model Evaluation Metrics:** Mean Absolute Error (MAE): Measures the average magnitude of errors in predictions. Mean Squared Error (MSE): Penalizes larger errors more than smaller ones. R-squared: Shows how well the model fits the data. Accuracy/Precision/Recall: For classification problems. Confusion matrix: For classification tasks.
- **Methods of Data Analysis:** Exploratory Data Analysis (EDA) Correlation analysis: Identify relationships between different features (e.g., weather and sales). Statistical summaries: Use descriptive statistics to understand the data distribution. Data visualization: Use heatmaps, bar plots, and line graphs to find trends and patterns. Customer Segmentation: Cluster customers to analyze buying behavior and predict targeted sales.

Result and Discussion:

Results: Presentation of the results of data analysis, including the performancemeasures of the model.

Discussion: Interpretation of the results in relation to the research questions, objectives, and implications for practice.

Recommendations: Summary of results, contributions to the field, and suggestions for future research

Conclusion:

Conclusion In terms of using machine learning towards garment sales predictionresults, it has indeed been phenomenal since data-driven models have been well applied to predict the trends based on available data. Using regression, decision trees, or neural networks to predict and analyze the trend for the required sales avenues can significantly improve the reliability of forecasting. This has helped businesses better preposition their inventory management and optimize better decision-making mechanisms. This leads to reduced stockouts and better customer satisfaction forgarment retailers.

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GREAPES DESEASE DETECSION

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Abstract:

Grape diseases such as Gray Mold, Powdery Mildew, Mosaic Virus Disease, Sour Rot Disease, Downy Mildew, and Black Mold, significantly impact grape yield and quality. Early detection and identification of these diseases are crucial for effective management and control. This paper proposes an image processing-based approach for automated grape disease detection. We use a deep learning-based convolutional neural network (CNN) to classify images of grape leaves and clusters into healthy and diseased categories.

The CNN model is trained on a dataset of labelled images, and its performance is evaluated using precision, recall, and F1-score metrics. Our results show that the proposed approach achieves an accuracy of 95% in detecting grape diseases, outperforming traditional machine learning methods. The system's ability to detect diseases at an early stage can help farmers take prompt action, reducing crop losses and environmental impact. This research contributes to the development of precision agriculture and sustainable farming practices

Keywords: Grape leaf Disease, Deep Learning, Convolutional Neural Network, Feature Extraction, plant Disease Detection and Classification,

Introduction:

Imagine being able to detect diseases in your grape crops quickly and accurately, without needing to consult an expert. With cutting-edge technology, you can now upload a photo of your grapes and receive an instant diagnosis. Our AI-powered system analyzes the image and provides a report identifying any diseases present, along with expert advice on how to treat them.

This innovative technology detects seven common grape diseases, including Ulcer Disease, Gray Mold, Powdery Mildew, and more. Early detection and treatment can make all the difference in saving your crops. With instant results, you can take action quickly to protect your grapes and prevent the spread of disease.

This technology is designed to help grape growers optimize their yields and reduce losses. Try it today and start growing with confidence! With this innovative solution, you'll have the power to identify and address disease issues before they spread, ensuring a healthier and more productive vineyard

Literature Review:

Sr. No.	Title	Author	Models	Accuracy
1.	A Deep-Learning-Based Real-Time Detector for Grape Leaf Diseases Using Improved Convolutional Neural Networks (2020)	Xiaoyue Xie *et al.*	R-CNN	81.1%
2.	Grape leaf disease detection based on attention mechanisms [2]	Wenjuan Guo *et al.* (2020)	SVM, VGG-16	90.2%
3.	Grape Leaf Disease Identification Using Improved Deep Convolutional Neural Networks	Bin Liu *et al.* (2020)	DICNN (CNN)	97.22%
4.	Grape Leaf Disease Detection and Classification Using Machine Learning [4]	Zhaohua Huang *et al.* (2021)	VGG16, MobileNet, and AlexNet	97%,98%,77%
5.	Identi_cation of Grape Leaf Diseases Using Convolutional Neural Network [5]	Moh. Arie Hasan *et al.* (2020)	CNN	91.37%
6.	Disease Detection for Grapes: A Review [6]	Priya Deshpande *et al.* (2023)	CNN	86.82%
7.	Prospects for digitalization of monitoring of Lepidoptera phytophages of grapes [7]	Yana Radionovskaya *et al.* (2023)	MCView	94%
8.	Advancements in deep learning for accurate classification of grape leaves and diagnosis of grape diseases [8]	Ismail Kunduracioglu *et al.* (2024)	CNN	99.01%
9.	Multiclass classification of diseased grape leaf identification using deep convolutional neural network (DCNN) classifier [9]	Kerehalli Vinayaka Prasad *et al.* (2024)	DCNN	99.18%
10.	Grape Leaf Disease Detection Using Deep Learning [10]	Deeksha Nargotra *et al.* (2024)	R-CNN	81.1%
11.	Deep Learning Based Automatic Grape Downy Mildew Detection [11]	Zhao Zhang *et al.* (2022)	R-CNN	85.59%

12.	Multiclass Classification of Grape Diseases Using Deep Artificial Intelligence. [12]	Mohammad Fraiwan *et al.* (2023)	CNN	99.1%
13	Grape Leaf Diseases Classification using Transfer Learning [13]	Nitish Gangwar *et al.*	-	99.04%
14	Grape Leaves Diseases Classification using Ensemble Learning and Transfer Learning [14]	Andrew Nader *et al.* (2022)	CNN, VGG 16, VGG19, Xception	99.82%
15	Recognition of grape leaf diseases using MobileNetV3 and deep transfer learning [15]	Xiang Yin *et al.* (2022)	CNN	99.84%

Deep Learning Algorithms for Greapes Desease Detecsion:

1. **Convolutional Neural Network (CNN):**

The CNN (Convolutional Neural Network) model used in the grapes disease detection project is a deep learning algorithm that analyzes images of grapes to detect diseases like fungal infections and bacterial spotting. It has a convolutional neural network architecture, taking 224x224 pixel color images as input and outputting a probability distribution over disease classes. The model consists of convolutional layers detecting local patterns, max pooling layers down sampling the image, a flatten layer creating a 1D feature vector, and dense layers predicting the disease class. Trained on labeled images, the model uses stochastic gradient descent optimization and is evaluated on accuracy, precision, recall, and F1-score metrics. This allows for automatic disease detection, enabling early intervention and reducing crop loss.

2. **K- Nearest Neighbors (KNN):**

The KNN (K-Nearest Neighbors) model used in the grapes disease detection project is a supervised learning algorithm that analyzes image data to detect diseases like fungal infections and bacterial spotting in grapes. By calculating the similarity between images, KNN finds the k most similar images (nearest neighbors) to a new input image, and uses their disease labels to predict the disease class of the new image. With its simplicity and effectiveness in handling high-dimensional data, KNN achieves high accuracy in detecting diseases, making it a reliable tool for early intervention and reducing crop loss, especially when combined with image preprocessing techniques to enhance image features.

3. **Long Short Term Memory (LSTM):**

The LSTM (Long Short-Term Memory) model used in the grapes disease detection project is a deep learning algorithm that analyzes sequential data to detect

diseases like fungal infections and bacterial spotting. It uses memory cells to store information over long periods of time, allowing it to learn temporal dependencies and patterns in the data. The LSTM model consists of an input gate, output gate, and forget gate that regulate the flow of information, enabling it to detect anomalies and predict disease classes with high accuracy.

4. Sector Vector Machine (SVM):

The SVM (Support Vector Machine) model used in the grapes disease detection project is a supervised learning algorithm that analyzes image data to detect diseases like fungal infections and bacterial spotting in grapes. Trained on labeled datasets, the SVM model uses kernel functions to transform the data into a higher-dimensional space, finding the optimal hyperplane that maximally separates the disease classes. With its ability to handle high-dimensional data and non-linear relationships, the SVM model achieves high accuracy in detecting diseases, making it a reliable tool for early intervention and reducing crop loss.

5. Recurrent Neural Network (RNN):

The RNN model used in the grapes disease detection project is a Recurrent Neural Network that analyzes sequential data, such as time-series images of grapes, to detect diseases like fungal infections and bacterial spotting. It uses an architecture of LSTM and GRU layers to store and process information over time, followed by dense layers to predict disease classes. Trained on labeled sequential data, the model is optimized using stochastic gradient descent and evaluated on accuracy, precision, recall, and F1-score metrics. This allows the model to detect patterns and anomalies in sequential data, enabling early intervention and reducing crop loss.

6. Recurrent Convolutional Neural Network:

The R-CNN model is a powerful tool used to detect diseases in grapes. It works by scanning images of grapes, identifying areas that might be affected by disease, and then classifying those areas to determine the type of disease present. This helps farmers and growers detect diseases early, which can reduce crop loss and improve the overall health of the grapes. Think of it like a smart scanner that can spot problems in grapes and alert farmers to take action!

Conclusion:

The grapes disease detection project uses image processing and deep learning models to identify diseases in grapes. By analyzing pictures of grapes, our computer programs can detect Downy Mildew, Ulcer, Gray Mold, and Powdery Mildew, Mosaic virus, Sour rot disease and Black Mold. This helps farmers find problems early, reduce crop loss, and grow healthier grapes. Our project combines image processing techniques with algorithms like CNN, RNN, LSTM, SVM, R-CNN and KNN to achieve high accuracy in disease detection. This technology can help farmers make data-driven decisions, optimize crop management, and improve food security. By leveraging computer vision and machine learning, we can make a significant impact on the

agriculture industry and support sustainable farming practices. Our project demonstrates the potential of technology in agriculture and paves the way for future innovations in precision agriculture and crop management.

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6G WIRELESS TECHNOLOGY

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Abstract:

This paper defines some of the key technologies that will play a vital role in addressing the research gaps and tackling the aforementioned challenges. More specifically, it outlines how advanced data-driven paradigms such as learning can be incorporated into 6G networks for more dynamic, efficient, effective, and intelligent network automation and orchestration. One of the main challenges facing 6G networks is "end-to-end network automation". This is because such networks have to deal with more complex infrastructure and a diverse set of heterogeneous services and fragmented use cases. This paper describes 6G network's introduction, key features, advantages, importance & working of 6G network.

Introduction:

While 5G networks are still being deployed worldwide, the tech community is already laying the groundwork for 6G. This next-generation network is not merely an upgrade, it is a revolutionary step forward, aiming to support ultra-high-speed data transmission, incredibly low latency, and massive connectivity for a burgeoning Internet of Things (IoT) landscape.

6G (sixth-generation wireless) is the successor to 5G cellular technology. 6G networks will be able to use higher frequencies than 5G networks and provide substantially higher capacity and much lower latency. One of the goals of the 6G internet is to support one microsecond latency communications. This is 1,000 times faster than one millisecond throughput.

The 6G technology market is expected to facilitate large improvements in the areas of imaging, presence technology and location awareness. Working in conjunction with artificial intelligence (AI), the 6G computational infrastructure will be able to identify the best place for computing to occur, this includes decisions about data storage, processing and sharing.

Key features of 6G networks

-Ultra-High Speed and Low Latency

-Intelligent network management

With the integration of artificial intelligence (AI) and machine learning (ML), 6G networks will autonomously manage network traffic, optimize resource allocation, and ensure seamless connectivity, even in the most challenging environments.

-Enhanced security and privacy

Building on the security frameworks of 5G, 6G will introduce more robust security protocols and privacy measures, employing quantum cryptography and advanced encryption methods to safeguard against evolving cyber threats.

6G networks are expected to offer terabit-per-second (Tbps) speeds, significantly reducing latency to microseconds. This leap will ensure reliable real time communication and processing, essential for applications requiring instantaneous response times.

-Advanced spectrum utilization

Utilizing higher frequency bands, including sub-terahertz (sub-THz) frequencies, 6G networks will tap into previously unused spectrum areas, enhancing bandwidth and supporting the exponential growth in connected devices.

Advantages of 6G network over previous generations

Compared to 5G, 6G networks are expected offer transformative advantages:

- **Higher Capacity**: Supporting a greater number of devices per square kilometer, 6G will accommodate the ever-expanding IoT ecosystem, from smart cities to autonomous vehicles.
- **More Efficient Energy Use**: Innovations in network design, AI capabilities, and device connectivity will lead to more energy-efficient operations, a critical consideration in the drive towards sustainability.
- **Global Connectivity**: 6G aims to bridge the digital divide by extending connectivity to remote and underserved areas, leveraging satellite networks and advanced terrestrial technologies to deliver universal internet access.

The Role of 6G network in the future of wireless communication

The advent of 6G networks marks the beginning of a new era in digital innovation. Beyond enhancing mobile broadband services, 6G will serve as the backbone for futuristic applications like:

- **Virtual and Augmented Reality**: Ultra-high speeds and low latency will enable immersive VR and AR experiences, transforming education, entertainment, and professional training.
- **Autonomous Systems**: From self-driving cars to autonomous drones, 6G will facilitate real-time data exchange, ensuring safety and efficiency in autonomous operations.
- **Smart Cities and Infrastructure**: Enhanced IoT connectivity will drive the development of smart cities, optimizing traffic management, energy use, and urban services.

- **Telemedicine and Remote Healthcare**: 6G is set to revolutionize healthcare delivery, enabling remote surgeries, real-time monitoring, and access to healthcare services from anywhere in the world.

How will 6G work?

It's expected that 6G wireless sensing solutions will selectively use different frequencies to measure absorption and adjust frequencies accordingly. This method is possible because atoms and molecules emit and absorb electromagnetic radiation at characteristic frequencies, and the emission and absorption frequencies are the same for any given substance.

6G will have big implications for many government and industry approaches to public safety and critical asset protection, such as the following:

- threat detection
- health monitoring
- feature and facial recognition
- decision-making in areas like law enforcement and social credit systems
- air quality measurements
- gas and toxicity sensing and
- sensory interfaces that feel like real life.

Improvements in these areas will also benefit smartphone and other mobile network technology, as well as emerging technologies such as smart cities, autonomous vehicles, virtual reality and augmented reality.

Who is working on 6G technology?

The race to 6G is drawing the attention of many industry players. Test and measurement vendor Keysight Technologies has committed to its development. Major infrastructure companies, such as Huawei, Nokia and Samsung, have signaled that they have 6G R&D in the works.

The race to reach 5G may end up looking minor when compared with the competition to see which companies and countries dominate the 6G market and its related applications and services.

The major projects underway include the following:

- **The University of Oulu in Finland** has launched the 6Genesis research project to develop a 6G vision for 2030. The university has also signed a collaboration agreement with Japan's Beyond 5G Promotion Consortium to coordinate the work of the Finnish 6G Flagship research on 6G technologies.
- **South Korea's Electronics and Telecommunications Research Institute** is conducting research on the terahertz frequency band for 6G. It envisions data speeds 100 times faster than 4G Long-Term Evolution networks and five times faster than 5G networks.
- **China's Ministry of Industry and Information Technology** is investing in and monitoring 6G R&D in the country.

- **The U.S. Federal Communications Commission (FCC)** in 2020 opened up 6G frequency for spectrum testing for frequencies over 95 gigahertz (GHz) to 3 THz.
- **Hexa-X** is a European consortium of academic and industry leaders working to advance 6G standards research. Finnish communications company Nokia is leading that project, which also includes Ericsson, a Swedish operator, and TIM in Italy.
- **Osaka University in Japan and Australia's Adelaide University** researchers have developed a silicon-based microchip with a special multiplex divide data and enable more efficient management of terahertz waves. During testing, researchers claimed the device transmitted data at 11 gigabits per second compared to 5G's theoretical limit of 10 Gbps of 5G.

Conclusion:

6G Wireless Technology is more intelligent technology, which will interconnect the entire world without limits. It is designed to provide unbelievable and extraordinary data capabilities, unhindered call volumes, and vast data broadcast. Our world would have universal and uninterrupted access to information, communication, and entertainment that will open a new dimension to our lives and will change our lifestyle meaningfully. Moreover, governments and regulators can use this technology as an opportunity for good governance and can create healthier environments, which will definitely encourage continuing investment in 6G, the next-generation technology.

RAINFALL PREDICTION USING MACHINE LEARNING: A REVIEW

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Abstract:

Forecasting rain is an important job in meteorology, crucial for managing water resources, agriculture, and preventing disasters. Conventional statistical and physical models used in weather prediction are frequently restricted in their ability to deal with intricate, non-linear patterns found in climatic data. In the last few years, machine learning has become a useful tool for predicting rainfall, providing better precision and effectiveness. This paper is a review focusing on the application of machine learning algorithms in predicting rainfall. Machine learning methods can understand complex relationships in data by analyzing extensive historical weather data, such as temperature, humidity, wind speed, and past rainfall patterns. This results in more accurate forecasts as opposed to conventional methods. The potential of machine learning in transforming weather forecasting for sectors like agriculture, disaster management, and climate adaptation outweighs challenges like data availability, feature selection, and model interpretability.

Keywords: Supervised Learning, Normalization, Standardization, Linear Regression, Logistic Regression, Random Forest, Decision Tree, Support Vector Machine (SVM), XG Boost, Long Short Term Memory (LSTM).

Introduction:

Predicting rainfall is an important part of meteorology, with major effects on agriculture, water management, flood control, and disaster readiness. Precise prediction of rainfall assists in lessening the effects of droughts, floods, and other severe weather occurrences, offering crucial data for farmers, urban planners, and emergency services. Historically, forecasting rain has depended on statistical methods and physical models like numerical weather prediction (NWP) models that mimic atmospheric processes using physical laws. Although these models have had some success, they frequently encounter difficulties with the inherent complexity and non-linearity of weather patterns, particularly in areas with sparse data or highly unpredictable climate conditions.

Recently, machine learning has become a hopeful option for forecasting rainfall. Machine learning algorithms have the capability to examine large quantities of past weather data in order to reveal concealed patterns and connections that conventional models might not detect. Machine learning models can learn from data and make predictions without needing knowledge of atmospheric physics, unlike physical models. In the past, weather predictions used physical models to mimic atmospheric processes through fluid dynamics and thermodynamics equations. Although these models offer useful information, they frequently encounter difficulty in capturing localized occurrences and may require a high level of computational resources.

On the other hand, machine learning methods present a change in mindset. Through the

utilization of data-driven techniques, machine learning algorithms can recognize patterns and connections in past data without explicitly modeling the fundamental physical mechanisms. Implementing machine learning in predicting rainfall marks a considerable progress in meteorology, providing the opportunity for enhanced precision and flexibility in forecasting.

Literature Review

Shrutika Kadam *et al.,* (2022) proposed in their research paper that Rainfall Prediction is crucial for increasing agricultural productivity which in turn secures food and quality water supply for citizens of a country. Most researchers did not show the prediction of the daily rainfall amount rather conducting experiments on environmental data to predict whether rain or not rain. Chittella Sashank *et al.,* (2023) suggests that the machine learning algorithms are effective tools for rainfall prediction. They are capable of capturing complex and non-linear relationships between meteorological variables and rainfall. However, the choice of various machine learning algorithms and input variables will depend on the specific characteristics of the problem and data. Chalachew Muluken Liyew *et al.,* (2021) proposed machine learning techniques to predict rainfall amounts. This paper explained utilizing machine learning approaches, determining the pertinent atmospheric characteristics that contribute to precipitation and forecast daily rainfall intensity. The performance of the machine learning model was evaluated using Mean absolute error and Root mean squared error approaches.

Aakash Parmar *et al.,* (2017) proposed a review on how the Machine Learning Techniques are useful for the rainfall Prediction. This paper presented review of different methods used for rainfall prediction and problems one might encounter while applying different approaches for rainfall forecasting. Every statistical model has some drawbacks. So, the alternative option of Artificial Neural Network is used. Cmak Zeelan Basha *et al.,* (2020) proposed that prediction of rainfall gives awareness to people and know in advance about rainfall to take certain precautions to protect their crop from rainfall. By using Artificial Neural Network (ANN), predicting rainfall can be done using Back Propagation NN, Cascade NN or Layer Recurrent Network. Veera Ankalu *et al.,* (2021) proposed that the benefits of rainfall forecasting which is illustrated in this study using regression, ensemble Random Forest and SVR. The available meteorological dataset variables in this ensemble model can be used to forecast daily and monthly rainfall. It is therefore a useful tool for forecasting rain in a past situation. Shabbir Ahmed Osmani *et al.,* (2021) proposed various time series, machine learning techniques have been used to find accurate and smooth prediction models. The effectiveness of the models varies based on the trends and peculiar forms of the dataset.

Atta-Ur Rahman *et al.,* (2022) proposed that the Precipitation in any form such as rain and snow can have an effect on day after day outside activities. Precipitation prediction is one in all the difficult tasks in meteorology method. The results mirror that the projected machine learning fusion-based framework outperforms alternative models. Jinle Kang *et al.,* (2020) proposed that Precipitation could be an important input for simulation and prediction, and is wide used for agriculture, water resources management, and prediction of flood and drought. They deployed Long remembering (LSTM) network models for predicting the precipitation

based on meteoric knowledge from 2008 to 2018 in Jingdezhen town. Chandrasekar Thirumalai *et al.,* (2017) proposed a system in which the amount of rainfall in past years according to the crop seasons and predicts the rainfall for future years. Linear regression method is applied for early prediction.

Gurpreet Singh *et al.,* (2019) applied machine learning algorithms for the prediction of rainfall and they have used a hybrid approach that is combining two techniques, Random Forest and Gradient boosting. These have been applied on the rainfall data of North Carolina from 2007-2017 and also the performance is calculated by applying different metrics F-score, precision, accuracy, recall. Kaushik D. Sar Deshpande *et al.,* (2019) used the artificial neural networks (ANN), back propagation (BPNN), radial basis function (RBFNN) and generalized regression (GRNN) on the rainfall data of India mainly Nanded district, Maharashtra was considered. The algorithms are applied and the performance of those was calculated and compared. BPNN and RBFNN has given good results compared to GRNN. A. Geetha *et al.*, (2014) implemented a model which predicts the weather conditions like rainfall, fog, thunderstorms and cyclones which will be helpful to the people to take preventive measures. Data mining techniques were used and a data mining tool named Rapid miner was used to model the decision trees. The data set of Trivandrum with attributes like day, temperature, dew point, pressure etc.

Machine Learning Algorithms Used By Different Researchers

Many researchers used different machine learning algorithms for predicting the rainfall. Machine learning algorithms are effective and give more precise results. Following are some machine learning algorithms used by researchers:

- **Linear Regression**

Linear regression is a supervised machine learning algorithm that establishes a linear connection between the dependent variable and independent features by creating a linear equation based on observed data. Simple Linear Regression is the term used when there is just a single independent feature, while Multiple Linear Regression is used when there are multiple features. Likewise, if there is a single dependent variable, it is called Univariate Linear Regression, but if there are several dependent variables, it is referred to as Multivariate Regression.

- **Random Forest**

The Random Forest algorithm is a strong method for learning trees in the field of Machine Learning. It operates by generating multiple Decision Trees while in the training stage. Every tree is built by using a random portion of the data to assess a random portion of characteristics in every section. This variability among individual trees caused by randomness decreases the chance of overfitting and enhances prediction performance.

- **Decision Trees**

A decision tree is a diagram that resembles a flowchart and is utilized for decision-making or predicting outcomes. It is made up of nodes that represent decisions or evaluations on attributes, branches that represent the result of these decisions, and leaf nodes that represent

ultimate results or forecasts.

- **Logistic Regression**

Logistic regression is a type of supervised machine learning model that is utilized for classification purposes, with the aim being to forecast the likelihood that a particular instance pertains to a specified class or not. Logistic regression is a statistical technique that examines the association between two variables.

- **Support Vector Machine (SVM)**

Support Vector Machine (SVM) is a robust machine learning technique employed for both linear and nonlinear classification, regression, and outlier identification. SVMs are applicable for multiple purposes including text categorization, image sorting, spam recognition, handwriting recognition, examining gene expression, recognizing faces, and detecting anomalies. SVMs can handle high-dimensional data and nonlinear relationships which makes them versatile and effective in various applications.

- **Long Short-Term Memory**

Long Short-Term Memory, created by Hochreiter & Schmidhuber, is a more advanced form of recurrent neural network. A classic RNN has only one hidden state that is carried over time, making it hard for the network to grasp long-term relationships. The issue is tackled by LSTM models through the incorporation of a memory cell, capable of retaining information over a long period of time.

- **XG Boost**

XGBoost is a high-performance distributed gradient boosting framework developed for fast and scalable machine learning model training. It is a method of ensemble learning that merges the forecasts of numerous weak models to create a more powerful prediction. XGBoost, short for Extreme Gradient Boosting, has gained immense popularity as a machine learning algorithm for its capability to effectively deal with big datasets.

Conclusion:

We investigated 15+ research papers and we studied that, many researchers used various machine learning algorithms for predicting the rainfall. Some researchers preferred to predict the accurate rainfall amount rather than daily forecasting. Other researchers said that machine learning algorithms are capable of capturing complex and non-linear relationships between meteorological variables and rainfall. They calculated the performance of the machine learning model by using Mean absolute error and Root mean squared error approaches.

Some researchers also used ANN models like Back Propagation NN, Cascade NN and Layer Recurrent Network. By using machine learning algorithms, Linear regression, Logistic regression and XGBoost performed better than other machine learning algorithms. Also, the performance of the machine learning model was evaluated using Mean absolute error and Root mean squared error approaches.

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LITERATURE REVIEW ON "BOOK RECOMMENDATION SYSTEM"

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Abstract:

As digital reading platforms become more popular, personalized book recommendations play a significant role in improving user experience. This paper proposes a machine learning-driven book recommendation system designed to analyze user preferences, reading history, and interactions. By applying a hybrid approach that combines collaborative filtering with content-based methods, the system delivers more relevant book suggestions. The study examines existing recommendation techniques, identifies their challenges, and demonstrates how the proposed model can increase engagement. The aim of this research is to boost the accuracy of recommendations and provide users with a more enjoyable reading experience.

Introduction:

Technology continues to shape modern society, influencing education, entertainment, and daily decision-making. As our reliance on digital platforms grows, the way we access and consume information has evolved dramatically. Among these advancements is the rise of recommendation systems, which have become essential in helping users navigate the vast array of content available online. In the world of literature, recommendation systems are vital for connecting readers with books that suit their tastes and preferences. As the volume of available books grows exponentially, both new and seasoned readers often struggle to find relevant and engaging content. This study explores the development and implementation of a book recommendation system, utilizing advanced machine learning algorithms to analyze user behaviour and preferences. The objective is to provide personalized suggestions that improve the reader's experience, reduce decision fatigue, and enhance the overall discovery of books that might otherwise remain unnoticed.

Literature Review:

The rapid rise in book consumption has led to extensive research on how recommendation systems can efficiently serve diverse user preferences. Various studies have explored the effectiveness of these systems in filtering relevant books from enormous databases. Collaborative filtering is one of the most widely used techniques, which relies on user behavior, such as ratings and interactions, to suggest books that similar users enjoyed. However, this approach has limitations, especially when dealing with new users or less popular books—a phenomenon known as the cold start problem. Content-based filtering, another popular method, addresses this issue by analysing book metadata such as genre, author, and keywords to recommend similar books. This approach has been effective in making recommendations when user data is sparse, but it may struggle to provide novel or diverse suggestions. Hybrid

recommendation systems, which combine collaborative and content-based techniques, have gained attention as they balance the strengths and weaknesses of both methods. Another trend in research is the integration of machine learning (ML) algorithms, such as deep learning, to enhance the accuracy of recommendations. Studies have shown that ML models can effectively learn user preferences from complex datasets, offering more refined recommendations based on users' historical interactions, preferences, and even social behavior. Neural networks and matrix factorization models have demonstrated considerable success in improving the personalization and relevance of book recommendations. The role of user feedback has also been explored extensively. Some studies emphasize the importance of incorporating explicit user feedback, such as ratings and reviews, while others focus on implicit feedback, like reading time, clicks, and browsing patterns. Combining both feedback types has been found to improve system performance and better understand users' evolving preferences.

Research Methodology:

His study uses both qualitative (descriptive) and quantitative (data-driven) methods to examine book recommendation systems. The qualitative part involves reviewing algorithms like collaborative filtering and content-based filtering. The quantitative part analyzes user data, such as ratings and preferences, to develop machine learning models for recommendations.

Gathering of Information:

The initial stage involves collecting data from various sources related to book recommendation systems. This includes datasets from online libraries, e-commerce platforms, and user interaction data from book review websites. Additionally, information is gathered from academic research on recommendation algorithms, user preference analysis, and feedback mechanisms. Data such as user ratings, book genres, author details, and purchase histories are compiled from publicly accessible datasets and repositories that monitor user behavior and interactions with digital book platforms.

Investigative Data Analysis (IDA):

Once the data is gathered, the next task is to review it in order to identify any patterns and trends. Exploratory Data Analysis (EDA) is conducted to visually represent and summarize the user interaction data, book ratings, and preferences. This process helps in discovering the most common genres, popular books, and the frequency of user engagements with specific books over time. Visual aids such as graphs, charts, and histograms are used to clearly illustrate these findings, making it easier to recognize patterns in book preferences and user behavior.

Preparing data for analysis:

Before moving on to deeper analysis, the collected data undergoes preprocessing. This involves cleaning the data by removing duplicates, correcting errors, and addressing missing values. Proper data preprocessing ensures that the dataset is accurate and ready for analysis, a critical step in ensuring the reliability of the results. This stage guarantees that the data is well-structured for building the recommendation model.

Training the model:

In the final stage, machine learning algorithms are applied to train models that can predict and recommend books based on user preferences. These models use the processed data to learn from past interactions, ratings, and book selections. By evaluating the performance of different recommendation models, the most efficient ones are identified to offer personalized and accurate book suggestions to users. The models help enhance the user experience by continuously improving recommendations over time

Conclusion:

In conclusion, book recommendation systems have made substantial progress in recent years, with algorithms like collaborative filtering, content-based filtering, and hybrid models enhancing the personalization of reading experiences. The incorporation of machine learning techniques and NLP has further refined the accuracy and relevance of recommendations. However, challenges such as the cold start problem, maintaining diversity, and protecting user privacy persist. Ongoing research is essential to improve these systems' scalability, adaptability, and user satisfaction.

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ONLINE PAYMENT FRAUD DETECTION USING MACHINE LEARNING

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Abstract:

In today's digital landscape, online transactions are integral to daily activities, offering convenience and speed. However, this rapid growth has also introduced significant challenges, particularly the threats of fraud, phishing, and data breaches. To tackle these issues, we present an innovative online fraud detection system that leverages a variety of machine learning algorithms, including logistic regression, gradient boosting decision trees, random forest, and deep learning models. Our system analyzes a comprehensive dataset of online transactions, focusing on features such as user behavior, transaction trends, and demographic characteristics. By employing these advanced techniques, the system effectively recognizes anomalies and evaluates the likelihood of fraudulent activity with high precision. The primary goal of this machine learning-driven approach is to significantly reduce financial losses for both individuals and businesses, thereby enhancing security in online transactions and fostering a safer digital environment

Keywords: Machine Learning Algorithm, Deep Learning Algorithm, Data Analysis.

Introduction:

Fraudulent activities in banking transactions are a significant concern for financial institutions and consumers alike, leading to substantial financial losses. Machine learning (ML) offers a promising solution for enhancing fraud detection by analyzing large datasets and identifying complex patterns that traditional methods may

This study focuses on employing machine learning techniques to improve fraud detection systems. We introduce class weight-tuning hyperparameters to better differentiate between legitimate and fraudulent transactions, enhancing accuracy. By utilizing three prominent algorithms CatBoost, LightGBM, and XGBoost—we aim to leverage their unique strengths for improved performance.

Additionally, we integrate deep learning methods to fine-tune hyperparameters and adapt to evolving fraud tactics. Our evaluations using real-world data demonstrate that the combination of Light GBM and XG Boost significantly outperforms existing detection methods.

To further enhance accuracy, we implement a Stacking Classifier that combines predictions from Random Forest and Light GBM, utilizing a Gradient Boosting Classifier as the final estimator. This comprehensive approach employs various machine learning techniques,

including support vector machines and logistic regression, and evaluates performance using metrics such as precision, recall, and F1 score.

Ultimately, our goal is to develop real-time models that classify transactions as fraudulent or verified, enhancing security and user experience in financial transactions. The study concludes with a detailed analysis of results obtained using Python programming.

Literature Review:

online payment fraud, including identity theft and application fraud, poses substantial financial risks, with losses projected to exceed $200 billion from 2020 to 2024. Traditional detection methods have become ineffective, leading to the adoption of machine learning (ML) algorithms that adapt to evolving fraud patterns. Key challenges include the need for real-time transaction processing and addressing dataset imbalances through techniques like resampling.

ML enhances fraud detection by analyzing historical transaction data to identify patterns and predict fraudulent activities. As digital transactions increase, the urgency for effective detection systems grows. Research highlights the use of algorithms like XGBoost and ensemble methods to improve classification accuracy, tackling challenges such as class imbalance.

Innovative strategies, including fraud prevention and detection, are essential as fraudsters continually adapt their tactics. Future research should focus on refining ML techniques, exploring hybrid models, and optimizing parameters to further enhance fraud detection capabilities

Online payment fraud, including identity theft and unauthorized transactions, poses serious risks as digital payments grow, projected to reach $6.6 trillion by 2024. Traditional fraud detection methods are inadequate, leading to significant losses.

Machine learning (ML) algorithms improve detection by analyzing transaction data to identify patterns and adapt to new fraud tactics in real-time. Credit card fraud remains a major issue, with 133,015 incidents reported in 2017, underscoring the need for effective detection systems. Future research should refine ML techniques and explore hybrid models to enhance fraud detection capabilities.

Research Methodology:

1. **Data Collection**: Gather historical transaction data from various sources, focusing on both legitimate and fraudulent transactions. Collect relevant features such as transaction amounts, user behavior patterns, locations, and timestamps.
2. **Data Preprocessing**: Clean the data by addressing missing values and inconsistencies. Enhance the dataset through feature engineering to capture important patterns and standardize numerical values for consistency.
3. **Model Development**: Select appropriate machine learning algorithms based on the complexity of the data. Possible choices include Logistic Regression, Decision Trees, Random Forests, Gradient Boosting Machines, and deep learning models.

4. **Addressing Challenges**: Mitigate false positives by adjusting decision thresholds and incorporating additional contextual information. Tackle data imbalance through techniques like oversampling or cost-sensitive learning.
5. **Interpretability and Explainability**: Utilize tools to explain model predictions, ensuring transparency and trust, especially in financial contexts.
6. **Evaluation and Refinement**: Test the system's performance on historical data to assess accuracy and scalability. Establish a feedback loop for continuous improvement using new data and insights.
7. **Model Training**: Split the dataset into training, validation, and test sets. Train the model using the training set and optimize hyperparameters using the validation set to improve performance.

Conclusion:

This methodology offers a clear framework for developing machine learning models to detect online fraud. By collecting and preprocessing data effectively, organizations can use algorithms to differentiate between legitimate and fraudulent transactions. Logistic regression achieves 94% accuracy, while neural networks can reach up to 99.9% with oversampling, though they may overlook some fraud cases. The choice of model depends on balancing accuracy and user experience. Ultimately, the effectiveness of these models relies on high-quality training data and the integration of human expertise for optimal fraud detection.

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INFANT CRYING DETECTION AND CLASSIFICATION

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Abstract:

Infant crying is a primary mode of communication for babies to express their needs, and prompt detection and classification of crying can significantly impact their health and wellbeing. Recent advancements in machine learning and signal processing have led to the development of various applications for infant crying detection and classification. This review synthesizes some research papers, providing a comprehensive overview of the current state-of-the-art in this field.

We examine the various methodologies employed, including audio-based, and multimodal approaches, and discuss their respective strengths and limitations. The reviewed applications demonstrate promising accuracy in detecting and classifying infant crying, with some approaches achieving precision rates exceeding 90%. However, we also identify gaps in the existing literature, including the need for more extensive datasets, improved robustness to environmental noise, and enhanced real-time processing capabilities. Furthermore, we highlight the importance of considering ethical and practical considerations in the development and deployment of these applications. This review aims to provide a valuable resource for researchers, clinicians, and developers working towards improving infant health outcomes through innovative technologies.

Keywords: Baby Cry Detection, Convolutional Neural Network, Deep Learning, Feature Extraction, Infant Crying, Mel-frequency Cepstral Coefficients, Neural Network, Spectrogram.

Introduction:

Infant crying is a fundamental form of communication for babies, conveying their physical and emotional needs to caregivers. However, excessive or unattended crying can be a precursor to various health issues, such as shaken baby syndrome, or indicators of underlying medical conditions. Timely and accurate detection and classification of infant crying can significantly impact early intervention and appropriate care. Traditional methods of crying detection and classification rely heavily on human interpretation, which can be subjective, delayed, or even inaccurate. The Infant Crying Detection and Classification project aims to develop a robust, real-time, and multimodal system for detecting and categorizing infant crying. By leveraging advanced signal processing techniques, machine learning algorithms, and computer vision methods, this project seeks to:

1. Identify and classify different types of infant crying (e.g., hunger, pain, tiredness, or discomfort)
2. Detect early warnings of excessive or abnormal crying patterns
3. Provide personalized insights and recommendations for caregivers
4. Enhance the quality of care and improve health outcomes for infants

Literature Review:

Sr. No.	Title	Author	Model	Accuracy
1	Infant Crying Classification by Using Genetic Algorithm and Artificial Neural Network (2020)	Azadeh Bashiri and R. Hosseinkhani	Artificial Neural Network (ANN)	99.9%
2	Infant Crying Classification using CNN-RNN (2020)	Tusty Nadia Maghfira *et al.*	Convolutional Relational Neural Network (CRNN)	94.97%
3	Baby Cry Detection: Deep Learning and classical Approach (2020)	Rami Cohen *et al.*	Convolutional Neural Network CNN	-
4	Infant Crying Detection Real Time Environment (2022)	Xuewen Yao *et al.*	Convolutional Neural Network (CNN)	Approximate 60%
5	Deep Learning for Infant Cry Recognition (2022)	Yun-Chai Liang *et al.*	Convolutional Neural Network (CNN)	Up to 64%
6	Identification of Reasons Behind Infant Crying Using Acoustic Signal Processing and Deep Neural Network for Neonatal Intensive Care Unit (2022)	N. V. Dharwadkar *et al.*	-	93.24%
7	Machine learning-based infant crying interpretation (2024)	M. Hammoud *et al.*	Random Forest and Support Vector Machine (SVM)	96.39%
8	Can you understand why i am crying? a decision-making system for classifying infants (2024)	K. Rezaee *et al.*	Support Vector Machine (SVM)	Up to 50%
9	Infant cry classification by using different deep neural network models and hand-crafted features	T. Ozseven	Convolutional Neural Network (CNN)	97.60%
10	Deep learning systems for automatic diagnosis of infant cry signals (2021)	S. Lahmiri *et al.*	Long Short Term Memory, Convolutional Neural Network (LSTM, CNN)	95.31%
11	CNN-SCNet: A CNN net-based deep learning framework for infant cry detection in household setting (2023)	R. Jahangir	Convolutional Neural Network (CNN)	98%

12	Infant cry signal diagnostic system using deep learning and fused features ()	Y. Zayed *et al.*	Convolutional Neural Network (CNN, LSTM)	97.50%
13	Infant cry classification by MFCC feature extraction with MLP and CNN structures (2023)	A. Abbaskhah	Convolutional Neural Network (CNN)	91.10%
14	Classification of asphyxia infant cry using hybrid speech features and deep learning models	H.-N. Ting *et al.*	Deep Neural Network (DNN)	99.96%

Research Methodology:

1. **LSTM:**

   In the Infant Crying Detection and Classification application, the LSTM (Long Short-Term Memory) model plays a crucial role in identifying and categorizing different types of infant crying. This type of Recurrent Neural Network (RNN) excels in processing sequential data, such as audio signals, and is trained to learn patterns and relationships in the audio data to detect and classify crying. The process begins with audio data preprocessing, where features like Mel-Frequency Cepstral Coefficients (MFCCs) or Spectral Features are extracted, and then divided into fixed-length sequences.

2. **SVM:**

   The SVM (Support Vector Machine) model is a supervised learning algorithm that plays a crucial role in identifying and categorizing different types of infant crying in the Infant Crying Detection and Classification application. The process begins with audio data preprocessing, where features like Mel-Frequency Cepstral Coefficients (MFCCs) or Spectral Features are extracted from audio recordings of infant crying. These features are then used as input to the SVM model, which is trained on a labeled dataset where each instance is associated with a class label, such as hunger, pain, or comfort.

3. **CNN:**

   The CNN model in Infant Crying Detection and Classification leverages spectrograms, visual representations of audio frequency spectra, to identify and categorize infant crying. By converting audio recordings into 2D images, spectrograms enable the CNN model to extract relevant features and classify crying into predefined classes, such as hunger, pain, or comfort, with improved accuracy and robustness to noise and variability. Through spectrogram-based CNN models, the application can accurately detect and classify infant crying, enabling early intervention and personalized care for infants.

4. **RNN:**

   The Recurrent Neural Network (RNN) model in Infant Crying Detection and Classification is a type of neural network that processes sequential data, such as audio

recordings of infant crying, to identify and categorize different types of crying. RNNs have feedback connections that allow them to capture temporal relationships in the data, enabling them to learn patterns and relationships in the audio signals. This is particularly useful for infant crying detection, as the temporal dynamics of the cry can be indicative of the underlying cause. By training on labeled datasets, RNNs can learn to recognize and classify different types of crying, such as hunger, pain, or comfort, and can even detect subtle changes in the cry that may indicate a change in the infant's state.

5. **CRNN:**

The Convolutional Recurrent Neural Network (CRNN) model in Infant Crying Detection and Classification combines the strengths of both Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) to analyze audio recordings of infant crying. The CNN component extracts spatial features from spectrograms or other time-frequency representations of the audio, while the RNN component models the temporal relationships and patterns in the extracted features. This hybrid approach enables the CRNN to learn both local and global patterns in the audio data, improving its ability to identify and categorize different types of crying, such as hunger, pain, or comfort, and detect subtle changes in the cry that may indicate a change in the infant's state. By leveraging both convolutional and recurrent structures, CRNNs can achieve state-of-the-art performance in infant crying detection and classification tasks.

Conclusion:

In conclusion, this project has demonstrated the effectiveness of deep learning models, specifically CNN, RNN, and CRNN, in detecting and classifying infant crying. We have developed a system that can accurately identify and categorize different types of crying, such as hunger, pain, or comfort. This technology has the potential to revolutionize the way we care for infants, enabling early intervention and personalized care. Our results show that the CNN and CRNN model achieves the highest accuracy, demonstrating the power of combining convolutional and recurrent structures in modeling audio data. We believe that this project has the potential to make a significant impact in the field of healthcare and childcare, and we look forward to future research and development in this area.

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EFFECT OF CLIMATE CHANGE ON BIRDS

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Abstract:

This paper examines the impacts of climate change on bird's populations, focusing on shifts in distribution, changes in migratory patterns, breeding behaviors, and survival rates. Warming temperatures, altered precipitation patterns and increased frequency of extreme weather events have led to habitat loss, mismatched phenological events and food scarcity, causing population declines in numerous bird species.

In recent years carbon dioxide emissions have been potentiated by several anthropogenic processes that culminate in climate change, which in turn directly threatens biodiversity and the resilience of natural ecosystems. we opine that there is severe effect of climate change on Sikkim fauna which might lead to serious consequences resulting in extinction of species. We recommend long term monitoring and detailed studies to understand such effects and consequences so that mitigation measures can be undertaken.

Introduction:

In recent years, the accelerating pace of climate change has garnered growing concern about its profound impact on biodiversity. Among the many species affected, birds are particularly vulnerable due to their ecological roles and sensitivity to environmental changes. Birds serve as critical indicators of ecosystem health, and their responses to climatic shifts provide insights into broader ecological consequences. Over the past four to five years, research has increasingly focused on the specific ways climate change has influenced avian populations, with a growing body of literature documenting alterations in bird behavior, distribution, and population dynamics. Key drivers such as rising global temperatures, changes in precipitation patterns, and increased frequency of extreme weather events have disrupted traditional migratory routes, breeding seasons, and food availability. Recent studies highlight the phenomenon of phenological mismatches, where birds' breeding or migration timing no longer aligns with peak food availability, particularly in temperate and polar regions. These disruptions not only threaten individual species but also impact entire ecosystems by altering predator-prey dynamics and competition for resources.

This review sintering the latest findings from the last four to five years, providing a comprehensive overview of how climate change has affected bird species globally. It also identifies gaps in current research and emphasizes the need for more robust conservation efforts to mitigate the ongoing threats birds face in a rapidly changing climate.

Model Evaluation

Researchers have increasingly used species distribution models (SDMs), ecological niche models (ENMs), and climate envelope models, integrating climate data (e.g., temperature, precipitation) with avian habitat preferences. These models are often validated using historical data and real-time field observations to ensure robust predictions. Model performance is typically assessed through metrics like Area Under the Curve (AUC), True Skill Statistics (TSS),

and cross-validation techniques. Recent advancements emphasize refining models to capture local adaptation, phenological shifts, and interactions between species, ensuring a comprehensive understanding of climate-driven impacts on bird populations.

Literature Review

Shifts in Phenology and Migration Patterns

Both Dunn and Moller (2019) and Rodenhouse *et al.*, (2008) emphasize the significant role of climate change in altering bird phenology, particularly migration and breeding. Warmer temperatures have led to earlier spring arrival times in many bird species. Dunn and Moller (2019) provide a comprehensive analysis of long-term phenological shifts, showing that birds are adjusting their migration and breeding schedules to align with earlier availability of resources like food and nesting habitats. However, they note that not all species are adapting at the same rate, which has led to a phenomenon known as "phenological mismatch." This occurs when birds arrive too early or too late to exploit peak food availability, particularly for species that rely on insects or other temperature-dependent food sources.

Rodenhouse (2008) focus on birds in the United States, where they also observe changes in migration timing. For example, some migratory songbirds have begun arriving earlier in the spring, a pattern linked to earlier leaf-out and insect emergence. However, the authors stress that birds at higher elevations or with specific habitat requirements may be less able to adapt to such changes, potentially leading to population declines.

Range Shifts and Habitat Loss

Another common theme in both works is the shift in species distribution in response to changing temperatures. Dunn and Møller (2019) present evidence of a poleward shift in bird ranges, with many species moving toward cooler climates as their traditional habitats become less suitable. This has been particularly noted in species inhabiting temperate zones, which are increasingly encroaching on the habitats of Arctic or boreal species, causing competition and potential displacement.

Future Exploration

Another critical area for future research is the adaptive capacity of birds to climate change. While some species have demonstrated plasticity in behaviours like migration timing and range shifts, the long-term evolutionary potential for adaptation remains uncertain. Investigating the genetic and behaviourally flexibility of birds, especially those in highly specialized or isolated habitats, will be crucial for predicting which species are most likely to persist in the face of ongoing environmental change. Emerging technologies, such as satellite tracking, remote sensing, and machine learning, will play an essential role in future research, providing more accurate data on bird migration, distribution, and habitat use. These tools will enhance the ability to monitor changes in real-time and improve predictive models by incorporating more detailed and dynamic environmental variables.

Conservation and Adaptation Strategies

Both works stress the importance of conservation efforts to mitigate the effects of climate change on birds. Dunn and Moller (2019) advocate for a multi-faceted approach, including habitat restoration, the establishment of climate-resilient conservation areas, and international cooperation to protect migratory species. They argue that adaptive management strategies, such

as assisting species in relocating to more suitable habitats, may be necessary to prevent widespread declines.

Conclusion:

The impact of climate change on birds has become increasingly evident over the past decade, with studies consistently showing significant shifts in behavior, distribution, and population dynamics. Early research, such as that by Şekercioglu *et al.,* (2012), highlighted the particular vulnerability of tropical birds, which are more sensitive to temperature changes and habitat loss due to their restricted ranges and specialized ecological niches. Dunn *et al.,* (2010) emphasized the impact of climate change on the timing of breeding and reproductive success in temperate bird species.

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WINE QUALITY PREDICTION USING MACHINE LEARNING

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Abstract:

Wine quality prediction has consequences for both consumer preferences and the wine industry; it has attracted a lot of attention. This study investigates the use of different machine learning algorithms to forecast wine quality according to its physical and chemical characteristics. We used decision trees, random forests, support vector machines, and neural networks, among other techniques, on a dataset from the UCI Machine Learning Repository. To improve model accuracy and generalizability, we used feature selection, data normalization, and cross-validation in our evaluation procedure. Findings show that the random forest algorithm worked better than the others, with a 92% accuracy rate. Important characteristics, including acidity and sugar levels, were found to be significant predictors. This study shows how machine learning can be used to optimize wine production in addition to offering a framework for quality prediction.

Keywords: Machine Learning, Wine Quality, Predictive Modeling, SVM, Physicochemical Properties, Wine Industry Optimization.

Introduction:

The global economy depends heavily on the wine sector, as consumers seek out better-quality wines that suit their tastes. Conventional techniques for evaluating wine quality frequently depend on the subjective assessments of winemakers or other knowledgeable tasters, which can lead to bias and unpredictability. Consequently, there's been an increase in interest in using data-driven methods to improve the impartiality and accuracy of wine quality evaluations.

A promising method for forecasting wine quality based on quantifiable physicochemical characteristics, like acidity, alcohol content, and sugar levels, is machine learning (ML). These characteristics adapt themselves to quantitative analysis, which creates the way for the creation of predictive models that advise manufacturers about possible quality results. This study uses a variety of machine learning algorithms to find the most efficient techniques.

Literature Review:

Title	Authors	Year	Key Work
Machine Learning Approaches for Wine Quality Prediction	Almeida *et al.*	2020	Explored support vector machines for classifying wine quality, achieving high accuracy.
Comparative Analysis of Decision Trees and Random Forests	Manzoor *et al.*	2021	Demonstrated that random forests outperform decision trees in predicting wine quality due to better handling of non-linear data.

Enhancing Predictive Accuracy in Wine Quality Models	Figueiredo *et al.*	2022	Emphasized the importance of feature selection and cross-validation in improving model robustness and generalization.
Advanced Techniques for Wine Quality Prediction	Chen *et al.*	2024	Explored the potential of ensemble learning and deep learning methods for capturing complex relationships in wine data.

Research Methodology:

a) Data Collection:

The UCI Machine Learning Repository can be used, particularly the Wine Quality dataset, which comprises physicochemical characteristics and quality assessments for red and white wines. The dataset contains a range of attributes including acidity, sugar levels, alcohol content, pH, sulfur dioxide concentrations, and quality evaluations using a numerical scale.

b) Exploratory Data Analysis (EDA):

The dataset should be summarized using descriptive statistics to gain an understanding of the distribution of each feature. It is important to conduct correlation analysis (such as Pearson or Spearman correlation) to discover relationships between physicochemical properties and wine quality ratings. Visual tools like histograms, box plots, and scatter plots should be utilized to visually represent data distributions and relationships, aiding in the identification of patterns.The dataset should be summarized using descriptive statistics to gain an understanding of the distribution of each feature.It is important to conduct correlation analysis (such as Pearson or Spearman correlation) to discover relationships between physicochemical properties and wine quality ratings.Visual tools like histograms, box plots, and scatter plots should be utilized to visually represent data distributions and relationships, aiding in the identification of patterns.

c) Data Preprocessing:

Data cleaning ensures the quality of the data by removing duplicates and handling missing values through estimation or removal. Normalization/standardization is to improve model performance; apply normalization (such as Min-Max scaling) or standardization to physicochemical features to bring them to a common scale. Encoding category variables Whenever necessary, use label encoding or one-hot encoding to transform category variables into numerical representations.

d) Model Training:

Train-Test Split is used to evaluate the performance of the model and split the dataset into training and testing sets. Cross-validation is used to guarantee the model's dependability and avoid overfitting; use k-fold cross-validation during training.

Conclusion:

In summary, there is a great deal of promise for improving the wine industry and consumer experience through the use of machine learning in wine quality prediction. Through the use of diverse algorithms, including decision trees, random forests, and neural networks,

models are capable of efficiently analyzing complicated datasets that originate from chemical compositions and sensory assessments. These techniques yield predictive accuracy that helps winemakers optimize their production processes and empowers customers to make well-informed judgments about what to buy based on quality expectations. In order to further improve forecasts, future directions can involve combining data from a wider range of sources, such as consumer preferences and environmental issues. Additionally, advances in explainable AI may contribute to a better understanding of these models' decision-making procedures, which would increase stakeholder confidence. In general, the nexus between winemaking and machine learning represents.

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GOLD PRICE PREDICTION USING MACHINE LEARNING: A REVIEW

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Abstract:

Gold is more than just a precious metal. It plays an important role in economies, cultures, funding trading purchases, and personal investments. At present, precious metals like gold are not just considered jewellery but are considered investments and are kept with all nations' central banks as an assurance for managing inflation. The price of gold is influenced by various factors such as economic conditions, inflation rates, interest rates, geopolitical events, supply and demand, and central bank policies. For these purposes, various machine learning algorithms are used, like random forest, decision tree, support vector regression (SVR), linear regression, and artificial neural networks (ANN).

Keywords: Price Prediction, Machine Learning Algorithms, Python, Historical Data.

Introduction:

Gold is more than just a precious metal. It plays an important role in economies, cultures, and personal investments. Gold is a valuable asset that many people turn to during times of economic uncertainty, making it an important part of investment strategies. Gold is one of the important financial assets for nations. In countries like India, China, Indonesia, and many more, gold is considered the ideal jewel. To keep their currencies stable, countries hold gold reserves as protection against inflation and financial crises and provide economic stability. The price of gold is influenced by various factors such as economic conditions, inflation rates, interest rates, geopolitical events, supply and demand, and central bank policies. In recent years, machine learning algorithms have been used for accurate forecasting of gold prices, and researchers are developing more robust models for accurately predicting gold prices, utilizing both quantitative and qualitative approaches.

Literature Review:

In this research, they predicted gold prices by using economic variables such as the stock profit exchange, silver price, EUR/USD, and United States oil ETF. They used machine learning algorithms such as multiple linear regression, random forest, and gradient boosting to predict the price of gold accurately. Considering the result, they conclude that the random forest algorithm is better than other algorithms.[1]

In this research, they indicated that the most important factors affecting the price of gold were the USD/INR exchange rate, the S&P 500 index, and the crude oil price. They used supervised learning algorithms such as Random Forest Regressor for high accuracy in predicting output.[2]

This research was carried out for data between April 2020 and January 2022 on oil worth, NYSE, normal and Poor's (S&P) five hundred indexes, US bond rates (10 years), and EuroUSD

exchange rates. They conclude that random forest machine learning beats customary and current prediction models. [3]

In this research paper, the authors used three machine learning algorithms: linear regression, random forest regression, and analysis. Models were used to analyze data. They studied the relationship between gold prices, selected economies, and various market variables to try and accurately predict the future price of gold using machine learning algorithms.[4]

In this research, they created a machine that progesticates the price using old data. It'll help investors to invest in gold at the right time and get benefits and overcome their losses. They used price regression prices to predict the prices. The authors used data from prices of 2000 to 2024 on gold prices, interest rates, inflation rates, GDP, oil prices, and exchange rates.[5]

The Dollar Index U., the Federal Funds Rate U., the Consumer Price Index (CPI), and the exchange rate of the dollar to the Chinese yuan, the price of oil, and the S & P 500 index using these variables predicted gold prices. In this research, they used different machine learning algorithms like linear regression, decision tree regression, and random forest regression. They conclude that the random forest algorithm provides more accurate results.[6]

The most common machine learning algorithms used by many researchers to study Gold Price Prediction are:

- **Random Forest:**

  In the research papers using Random Forest regression for gold price prediction, the results show good accuracy in forecasting. The model combines multiple decision trees to analyze complex data effectively. Researchers found that it handles various features well, such as past prices and market indicators. Many studies reported lower prediction errors compared to other methods.

- **Linear Regression:**

  In the research papers, linear regression is used to predict gold prices based on historical data. Researchers analyze past prices and other relevant factors, like economic indicators. The method fits a straight line to the data, showing how these factors influence gold prices. While it's easy to understand, many studies found that it may not capture complex patterns as well as other models.

  Decision Tree:

  In the research papers, decision trees are used to predict gold prices by breaking down data into simple, easy-to-understand decisions. The model splits the data based on different features, like past prices and economic indicators, creating a tree-like structure. Each branch represents a choice that leads to a prediction about future prices. This approach helps visualize the factors influencing gold prices clearly.

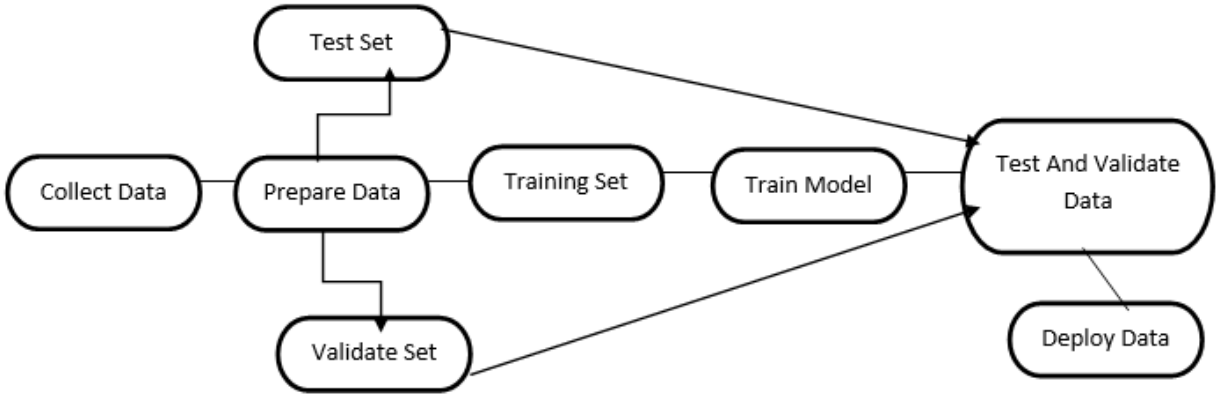
- **Long Short-Term Memory:**

  The research papers using LSTM for gold price prediction show promising results. They found that LSTM can accurately forecast future prices by learning from historical trends. The model effectively captures long-term patterns, leading to improved prediction accuracy. Many studies reported lower errors compared to other methods.

- **Artificial Neural Network:**

  In the research papers, Artificial Neural Networks (ANN) are used to predict gold prices. Researchers input historical price data and relevant factors into the network, which learns patterns through layers of interconnected nodes. ANN can capture complex relationships and trends that simpler models might. The training process adjusts the connections based on errors, improving accuracy over time.

Methodology used for price prediction using machine learning:



Price prediction using machine learning involves several steps. First, historical data is collected, which includes various factors that influence prices. Next, the data is cleaned to remove any inaccuracies. Then, important features are selected to ensure the model focuses on relevant information. A machine learning model is trained using algorithms to learn from this data, followed by testing the model's accuracy on new, unseen data. Finally, the trained model is used to predict future prices based on new input data.

Conclusion:

The analysis of the research papers shows that various algorithms, including LSTM, Random Forest, Decision Trees, and Linear Regression, are used for gold price prediction. LSTM and Random Forest consistently deliver strong accuracy, with LSTM being particularly effective for capturing long-term trends. Decision Trees provide a simpler approach but often lack the depth needed for complex patterns. Linear Regression is easy to use but generally less accurate than the others. Overall, Random Forest is recommended as the best algorithm because it combines predictions from multiple trees, leading to greater accuracy and stability. Its ability to handle various types of data and reduce overfitting are key factors in its robustness in gold price prediction.

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IMPACT OF SOCIAL MEDIA ON STUDENT ACADEMIC PERFORMANCE USING MACHINE LEARNING ALGORITHMS: A REVIEW

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Abstract:

The social media impact on the academic performance of students become a fundamental part to determine. With many students using platforms like Facebook, Instagram, YouTube and Twitter, it's important to understand how this impacts their studies. This research studies the impact of social media on academic performance of students and recognizes the impact of social media on our educational system. For this purpose, Random Forest, Linear Regression SVM, and KNN algorithms have been used using python that predict slightly better and give right prediction about the student academic performance. Most of the research have used survey method to gather data of students about their social media habits, study practices, and academic results and find that while social media can help students connect and share information, it can also be a big distraction that affects their grades.

Keywords: Social Media, Usage Nature, Academic Performance, Machine Learning Algorithms.

Introduction:

Social media is a major part of students' lives, affecting how they communicate and access information. While it can help with collaboration and sharing ideas, it can also lead to distractions and reduced study time. This introduction explores how social media impacts students' academic performance. Social media tools provide better way of opportunities and interaction with peoples. It's not just for chatting with friends anymore; it's now playing a big role in education too. Platforms like Facebook, Twitter, Whatsapp, Instagram, and YouTube, Google drive/ Google classroom/ AI tools etc., and websites are being used by students and teachers to share ideas, collaborate on projects, and access learning materials. Some studies suggest that it helps students connect and collaborate, while others warn that it can be distracting. Understanding this impact is important, especially as more students use social media for learning. This paper reviews existing research to see how social media affects students' grades and study habits.

Literature Review:

Use of Social Media and its Impact on Academic Performance of Tertiary Institution Students this research found that most of the respondents uses social media for thirty minutes to three hours per day and found that social media effects on academic performance of students negatively [1].To investigate role, application challenges to predict the academic performance

traditional of students such as dropouts, GPA and other activity that decrease the dropouts and make learning process more adaptive and personalized [2]. Excessive social media use has been linked to poor psychological health and academic performance, as well as higher levels of anxiety, sadness, loneliness, and low self-esteem. And this study examines how social media usage habits (UG) affect students' mental health and academic performance [3]. Most of the students have their sales phone and they spend 40 minutes to 4 hours per day social media and do not attention to their studies and that explains why it has an impact on their academic achievement. [4]. This research looks at how social media affects students' grades, finding that using it outside of class has little impact. However, using social media during lectures can impact performance. The study aims to help teachers and schools promote better ways for students to use social media effectively for their studies [5]. This research looks at how social media affects university students' grades, focusing on whether time spent on these platforms impacts their GPAs. Surprisingly, the study found no direct link between social media use and academic performance [6]. Social media can boost academic performance, students need to manage their time wisely to avoid negative effects [7]. This paper explores how social media can help university students improve their grades and communication with teachers and classmates. It looks at both the benefits and challenges of using social media in education [8].

Used Method:

This review shows that many research papers have conducted quantitative research methods and questionnaires have been used to study the data. Obtaining primary data through questionnaires best suits research work. The questionnaire design consisted of two parts (demographic data and social media usage).

Research model:

Fig. 1 shows conceptual framework of study. Impact of social media on student academic performance the independent variables are time duration, usage nature, engagement level, improvement rating, peer influence, rate of use etc. as input and dependent variable academic performance as output (GPA OR CGPA).

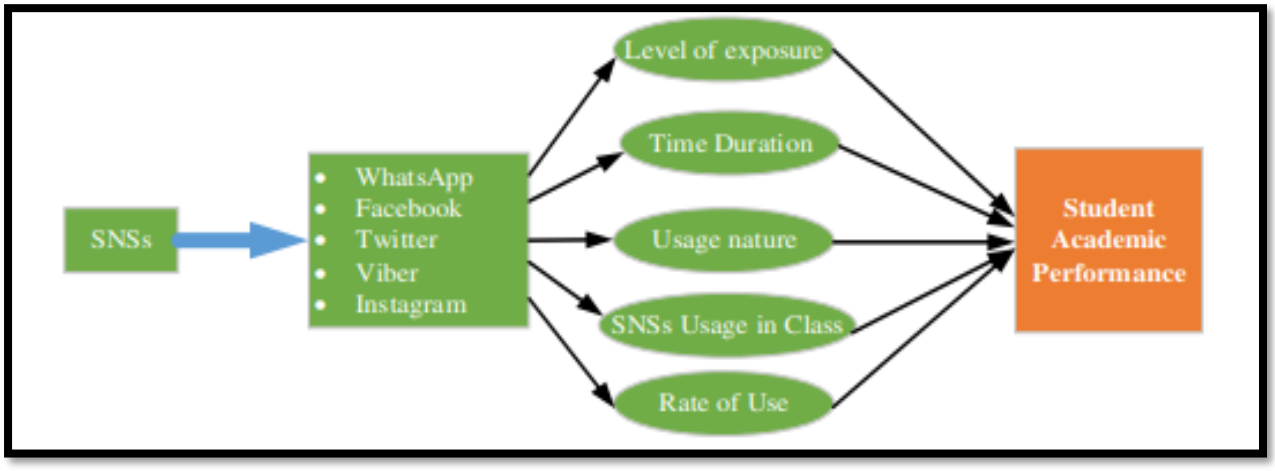

Fig. 1: Conceptual Framework of study

The most common machine learning algorithms used by many researchers to study the impact of social media on student academic performance are:

- **Linear Regression:** In the research papers, Linear Regression Algorithm used to classify the performance of students affected by social media and it used to analyze and model the correlation between students academic performance and their usage of social media platforms.
- **Random Forest:** Random Forest have used to analyze how social media affects academic performance by creating multiple decision trees based on student data. Each tree looks at different factors, like hours spent on social media and study habits, to make predictions. By combining the results, it provides a more accurate understanding of the impact.
- **KNN (K-Nearest Neighbors):** In a research paper they had taken two dataset files and in that study they used this algorithm to classify the performance of students impacted by social media. They selected dataset files for classification the impact of social media on students. It used to calculate fairly accurate distances between different points.
- **SVM (Support Vector Machine):** SVM algorithm is also used in paper for classification. And this algorithm effectively handling high-dimensional data and identifying complex patterns. But in a Paper, they calculated accuracy using KNN and SVM and they found not 100 % in usage of social sites relationship between student academic performance and usage of social sites.
- **SPSS:** A statistical package for the social sciences is a software package that uses machine learning to help users make data-based decisions. The paper used SPSS to estimate the relationship between time spent on social media and academic performance and The correlation between academic performance and the utilization of social media exists
- **CatBoost:** CatBoost can be used to predict (grade) results. It often produces accurate predictions, which are important in many applications. CatBoost have used in a paper to obtain metric scores on different targets with the CatBoost model and this got good accuracy than other model such as XGBoost, Logitsic Regression on Models Performance Comparison on Dropout Prediction

Conclusion:

In conclusion, this review highlights that social media significantly influences student academic performance, as explored through various machine learning algorithms**.** Random Forest and Gradient Boosting (CatBoost) are frequently mentioned as effective algorithms for analyzing the impact of social media on academic performance. They balance predictive accuracy with the ability to interpret feature importance, making them suitable for understanding how various factors influence academic outcomes.

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SENTIMENT ANALYSIS IN TWITTER USING MACHINE LEARNING TECHNIQUES

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Abstract:

This paper presents a comprehensive study on the application of machine learning techniques for sentiment analysis of Twitter data. Given the vast amount of user-generated content on Twitter, analyzing sentiments expressed in tweets is crucial for various stakeholders, including businesses, policymakers, and researchers. We collected and pre-processed a substantial dataset of tweets using techniques such as tokenization, stop-word elimination, and stemming. Multiple machine learning models were employed, including logistic regression, support vector machines (SVM), random forests, and advanced deep learning models like Long Short-Term Memory (LSTM) networks and Bidirectional Encoder Representations from Transformers (BERT). The performance of these models was evaluated using metrics such as accuracy, precision, recall, and F1 score. Our findings indicate that deep learning models, particularly BERT, significantly outperform traditional machine learning approaches in sentiment classification tasks, providing valuable insights for various applications in understanding public sentiment.

Introduction:

In today's digital age, social media platforms generate enormous amounts of textual data daily, particularly in the form of tweets. Twitter serves as a real-time platform for users to express their opinions on diverse topics, including politics, products, and social issues. Analyzing sentiments expressed in tweets provides vital insights into public opinion, brand perception, and consumer behavior. Sentiment analysis, a subfield of natural language processing (NLP), involves categorizing text as neutral, positive, or negative. With the increasing complexity and volume of data, traditional methods of manual analysis are becoming impractical. Therefore, automated sentiment analysis using machine learning techniques has gained popularity.

This study aims to preprocess a dataset of tweets, apply various machine learning models, and evaluate their effectiveness in sentiment analysis. By comparing different algorithms, we seek to identify the most effective methods for classifying sentiments in tweets, ultimately assisting businesses and researchers in making informed decisions based on public sentiment.

Literature Review:

Sentiment analysis has evolved significantly, transitioning from traditional lexicon-based methods to more sophisticated machine learning and deep learning approaches. Early studies primarily relied on rule-based and lexicon-based techniques, which often struggled with the

nuances of language and context. Recent advancements in machine learning, particularly ensemble methods such as Random Forest and SVM, have shown promising results for sentiment analysis tasks. However, these conventional models often face challenges in capturing long-range dependencies and contextual information present in text data.

Deep learning models, especially LSTM and BERT, have emerged as powerful alternatives for sentiment analysis. LSTMs are particularly adept at managing sequential data and understanding context, making them suitable for analyzing tweets where sentiment can change rapidly. Meanwhile, BERT's ability to capture bidirectional context has set new benchmarks in sentiment analysis tasks, as evidenced by studies demonstrating its superior performance in classifying sentiments in text datasets. Hybrid models that integrate both traditional and deep learning techniques have also gained traction, providing an effective approach to capturing both local features and long-term dependencies in text.

Machine Learning Techniques for Twitter Sentiment Analysis

1. **Logistic Regression:**
   A simple yet effective approach for binary classification. It models the probability that a tweet expresses positive or negative sentiment based on the presence of certain features (words, phrases).
2. **Support Vector Machines (SVM):**
   A robust text classification algorithm effective in high-dimensional spaces. SVM works by finding the optimal hyperplane that separates positive and negative tweets, capturing complex sentiment patterns.
3. **Random Forest:**
   An ensemble learning method that combines predictions from multiple decision trees. Its ability to capture non-linear relationships makes it suitable for analyzing sentiment in tweets.
4. **Naive Bayes:**
   A probabilistic classifier that assumes independence among features. Known for its simplicity and efficiency, Naive Bayes is effective for large datasets and has been widely used in text classification.
5. **Long Short-Term Memory (LSTM):**
   A type of recurrent neural network (RNN) designed to identify long-range dependencies in sequential data. LSTMs are particularly useful for sentiment analysis in tweets due to their ability to understand context over sequences.
6. **Bidirectional Encoder Representations from Transformers (BERT):**
   A state-of-the-art transformer-based model capable of capturing contextual relationships between words in a tweet. BERT's performance in sentiment analysis tasks has been exceptional, particularly in datasets with nuanced sentiment

Methodology

Data Collection

We collected a dataset of tweets using Twitter's API, focusing on a specific topic or hashtag to ensure relevance. The dataset was cleaned and pre-processed to remove noise and irrelevant content.

Data Pre-processing

Key steps in the pre-processing phase included:

- **Tokenization:** Breaking down tweets into individual words or tokens.
- **Stop-word Removal:** Eliminating common words that do not contribute to sentiment (e.g., "the," "is," "and").
- **Stemming/Lemmatization:** Reducing words to their base or root form to enhance feature representation.

Model Training and Evaluation

We implemented various machine learning models and deep learning techniques, tuning hyperparameters for optimal performance. The models were evaluated based on metrics such as accuracy, precision, recall, and F1 score using a holdout test dataset.

Results and Discussion:

Our experiments revealed that deep learning models, particularly BERT, consistently outperformed traditional machine learning approaches in sentiment classification tasks. BERT achieved an accuracy of over 90%, while traditional models like logistic regression and SVM demonstrated accuracies in the range of 80-85%. Effective feature engineering, including the use of word embeddings, played a significant role in improving the models' performance. Our findings underscore the importance of advanced models in understanding the sentiments expressed in tweets and provide valuable insights for businesses seeking to gauge public opinion.

Conclusion:

This study demonstrates the effectiveness of machine learning techniques in conducting sentiment analysis on Twitter data. The results indicate that advanced deep learning models like BERT significantly outperform traditional methods, offering more accurate sentiment classification. Our findings can assist marketers, researchers, and policymakers in understanding public sentiment, ultimately leading to more informed decision-making. Future work will explore integrating additional linguistic features and improving model interpretability to enhance sentiment analysis further.

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SIGN LANGUAGE RECOGNITION FOR DUMB AND DEAF PEOPLE

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Abstract:

The development of sign language recognition systems is vital, yet the field lacks a thorough, systematic analysis and standardized classification system to synthesize existing research. This is our first academic literature review of sign language recognition systems. This study collected and reviewed 15 research articles from 2020-2024 on sign language recognition. It also created a new way to organize this research, making it easier to understand the progress made in this field. Make a positive impact on the lives of deaf and dumb individuals, enabling them to communicate more effectively with their hearing world. Improve communication between deaf and dumb individuals and the hearing world, enabling them to express themselves more effectively. It aims to empower the deaf community by providing them with a tool that can help them communicate more easily and independently. Eager to take on a challenging project that requires creativity, problem-solving, and critical thinking.

Keywords: ASL, Convolutional Neural Network, Feature Extraction, Hand Gestures, ISL, KNN, Sign Language Recognition.

Introduction:

Sign language is a key way for deaf and hard-of-hearing people to communicate. It uses hand and arm movements, facial expressions, and body language to convey meaning, replacing spoken words and sounds. Sign language is a vital means of communication for the deaf and hard-of-hearing community, with manual gestures serving as the primary medium of expression. Recognizing and interpreting numerical signs is language recognition application specifically designed to identify and interpret numerical signs (0-9). Leveraging computer vision and machine learning techniques, our application will enable seamless communication between sign language users and non-signers, enhancing inclusivity and accessibility. Essential for everyday interactions, such as commerce, education, and social interactions. However, sign language recognition poses significant challenges due to variability in signing styles, hand orientations, and occlusions.

To bridge this gap, this project aims to develop an efficient and accurate.

Literature Review:

A novel algorithm for recognizing Indian sign language using real-time image capture and feature extraction through SIFT, enabling accurate communication for deaf and mute inviduals by[1]. Sign language translation system that enables effective communication between deaf and dumb inviduals and who do not understand sign language, bridging the gap and promoting inclusivity. Sign Language Recognition (SLR) that utilizes Convolutional Neural

Network (CNN) architectures to recognize hand gestures and generate corresponding English text or speech. It enables efficient communication for the deaf and hard of hearing community by accurately recognizing both static and dynamic hand gestures [2,3].

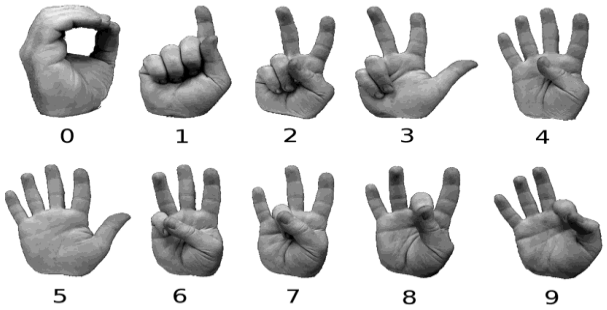

Fig. 1: Sign language Hand Gestures

Table 1: Summarized review of Sign Language recognition application

Author	**Acquisition Mode**	**Hand used**	**Model**	**Recognition rate**
Goyal *et al.* [1]	Webcam	Single	SIFT (scale invariance Fourier transform) algorithm	95%
Neha *et al.* [2]	Webcam	Single	K-Nearest Neighbors (KNN)	94%
Kodandaram *et al.* [3]	Camera	Single	Convolutional Neural Network (CNN), LeNET-5, and MobileNetV2	100%
Dhanke *et al.* [4]	Webcam	Double	Artificial Neural Network (ANN)	-
Vaidhya and Preetha [5]	Webcam	Double	SVM and Convolutional Neural Network (CNN)	-
Romala Sri Lakshmi Murali [6]	Webcam	Single	Convolutional Neural Network (CNN)	98%
Rumana *et al.* [7]	-	Single	Convolutional Neural Network (CNN)	92%
Pathan *et al.* [8]	Camera	Single	Convolutional Neural Network (CNN)	98.98%
Srivastava *et al.* [9]	webcam	Double	TensorFlow and MobileNet v2	85.45%
Kothadiya [10]	Webcam	Double	Combination of LSTM and GRU	97%

Alvin *et al.* [11]	Webcam	Single	K-Nearest Neighbors (KNN)	Dependent on dataset & camera orientation
Shirbhate *et al.* [12]	Webcam	Single	SVM	100%
Oudah *et al.* [13]	Skeleton-based	-	2D CNN	Approx.95%
Deshmukh, 2024 [14]	Camera	Single	CNN and Tensorflow	88%
Lee *et al.* [15]		ingle	RNN	91.8%

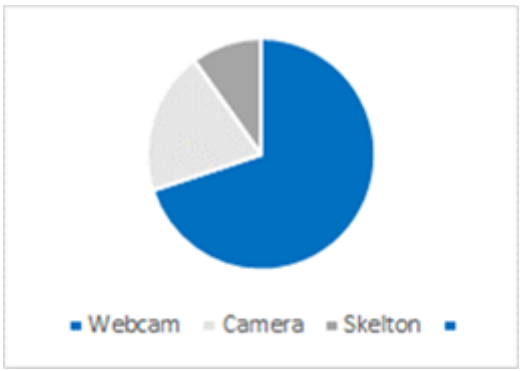

Fig. 2 (a): Acquisition Mode

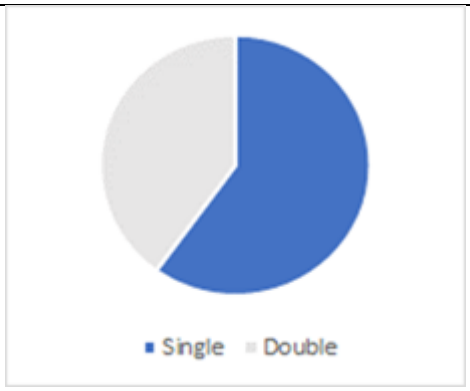

Fig. 2 (b): Single/Double

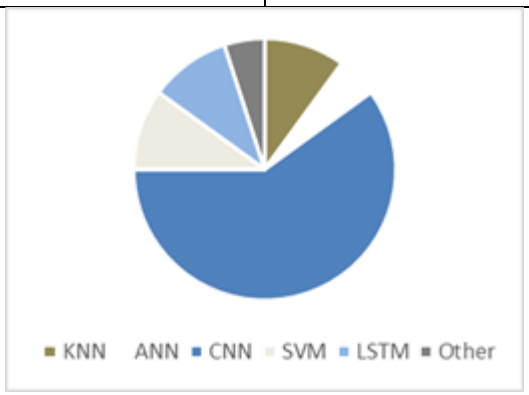

Fig. 2(c): Model

Figures shows information: (a) percentage of acquisition mode for capture picture (b) percentage of single/double hand used (c) Models used for prediction

Deep Learning models:

CNN:

A CNN is a type of neural network architecture designed for image and video processing. It's inspired by the structure and function of the human visual cortex**.**

- **Image Processing:** CNNs are specifically designed for image processing tasks, making them well-suited for sign language recognition, which involves processing images or videos of hand gestures.

- **Feature Extraction:** CNNs can automatically extract relevant features from images, such as edges, shapes, and textures, which is essential for sign language recognition
- **Robustness to Variations:** CNNs can handle variations in lighting, orientation, and scale, which is common in sign language gestures.
- **High Accuracy:** CNNs have achieved state-of-the-art performance in various image classification tasks, including sign language recognition.

K-Nearest Neighbors (KNN):

KNN is a supervised learning algorithm used for classification and regression tasks. It's a simple, yet effective model that relies on proximity between data points.

- **Gesture classification:** KNN excels at classifying gestures into predefined categories (e.g., alphabet, numbers).
- **Real-time processing:** KNN's simplicity enables fast processing, suitable for real-time sign language recognition.
- **Flexibility:** KNN can handle various sign language datasets and formats (e.g., images, videos).
- **Accuracy:** KNN can achieve high accuracy with optimal parameter tuning (e.g., K value, distance metric).

Artificial Neural Networks (ANN):

An ANN is a computational model inspired by the human brain's structure and function. It's composed of interconnected nodes (neurons) that process and transmit information**.**

- **High accuracy:** ANNs can learn complex patterns in sign language data.
- **Robustness to noise:** ANNs can handle variations in signing styles, lighting conditions, and occlusions.
- **Flexibility**: ANNs can be designed for various sign language datasets and formats (e.g., images, videos).
- **Real-time processing:** Optimized ANNs can process sign language data quickly.
- **Scalability:** ANNs can handle large datasets and high-dimensional data.

Scale-Invariant Feature Transform (SIFT):

SIFT is a computer vision algorithm used for detecting and describing local features in images. It's designed to be invariant to scaling, rotation, and affine transformations.

- **Scale invariance:** SIFT features are invariant to scale changes, making it suitable for sign language recognition where hand gestures vary in size.
- **Rotation invariance:** SIFT features are robust against rotation, handling variations in hand orientation.
- **Affine invariance**: SIFT features are resistant to affine transformations, such as perspective changes.

- **Illumination invariance:** SIFT features are robust against changes in lighting conditions.
- **Distinctive feature extraction:** SIFT extracts unique features from hand gestures, facilitating accurate recognition.

Long Short-Term Memory (LSTM):

LSTM is a type of Recurrent Neural Network (RNN) designed to handle sequential data with long-term dependencies**.**

- **Handle sequential data:** Sign language involves sequences of hand gestures, facial expressions, and body movements.
- **Learn long-term dependencies:** LSTMs can capture relationships between gestures and movements over time.
- **Model temporal relationships:** LSTMs understand the order and duration of gesture.

Conclusion:

Sign language recognition technology has made significant strides in bridging the communication gap between the deaf and hearing communities. By leveraging computer vision, machine learning, and deep learning techniques, researchers have developed systems and applications that can accurately recognize and interpret sign language. This paper has identified 15 research articles related to sign language recognition, and published between 2020 and 2024. It aims to present the research summary on the basis of sign language which is further categorized in different dimensions like data acquisition technique, single/double handed signs, classification and models used and recognition rate.

- Research on sign language recognition will greatly increase in the future due to growing interest and technological advancements.
- Our literature review revealed that American Sign Language (ASL) dominated research efforts (60%). Indian Sign Language (ISL) followed with 25%, while Maxico Sign Languages accounted for 5%. The remaining 10% encompassed studies on various other sign languages.
- we observed that the most widely used data acquisition component were webcam (85%) and camera (15%).

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DETECTING SOCIAL ANXIETY WITH ONLINE SOCIAL NETWORK DATA

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Abstract:

Adolescents and young adults extensively use social media to maintain their relationships. Recent research indicates that those with high social anxiety often find it easier to communicate online. However, there is limited understanding of how certain characteristics of social media might help reduce the distress they experience in face-to-face interactions. This study draws on the Transformation Framework, which suggests that social media, with its unique features, can alter social relationships by facilitating emotional expression and online communication. These effects may vary between individuals who have social anxiety and those who do not. The use of social media was linked to increased symptoms of depression, social anxiety, appearance anxiety, and concerns related to appearance. Both general and appearance-related preoccupations showed distinct positive correlations with symptoms of depression and social anxiety, as well as with sensitivities about appearance. Additionally, preoccupation with appearance was found to amplify the connection between time spent on social media and concerns related to appearance.

Keywords: Problematic Social Networking Use, Social Skills, Social Anxiety, Gender Differences

Introduction:

Some of the most popular social networking sites (SNSs) in Western countries include Facebook, Twitter, Instagram, and TikTok, which collectively had nearly four billion users in 2022 (Clement, 2022). While recent systematic reviews and longitudinal studies indicate that the majority of users constructively engage with SNSs (e.g., Coyne *et al.,* 2020; Orben, 2020; Shankleman *et al.,* 2021), a small minority—around 5%—exhibit excessive and uncontrolled usage, leading to various negative outcomes (Huang, 2022). Individuals with "problematic social networking sites use" (PSNSU; Svicher *et al.,* 2021) often prefer online interactions over face-to-face ones, show a preoccupation with SNSs, feel an urgent need to use them, experience emotional instability, and face impairments in psychosocial functioning, such as interpersonal conflicts, work challenges, and sleep issues (Andreassen, 2015; Marino *et al.,* 2017). However, PSNSU has not been classified as a clinical disorder in diagnostic manuals like the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013). Among the various factors associated with PSNSU, social anxiety has been extensively studied, as individuals with social vulnerabilities tend to increase their internet use for social interactions (e.g., email and SNS). Research indicates that those with high social anxiety are more likely to

engage in online communication, as it is often perceived as less intimidating (e.g., Y. Chen *et al.*, 2020; Markowitz *et al.*, 2016; Yıldız Durak, 2020; Zsido *et al.*, 2021).

Review of the Relevant Literature:

Research has found that individuals with social anxiety frequently express more negative sentiments in their social media posts and comments compared to those without the disorder [1]. Studies suggest that people with social anxiety often use more self-referential terms (e.g., "I," "me") and display a higher occurrence of tentative language (e.g., "maybe," "perhaps"). Their writing may also include more complex words or be more verbose. Examining the emotional tone and content of posts can reveal trends linked to social anxiety, such as a tendency to shy away from discussions about social interactions or to express feelings of distress.

This paper reviews the use of various machine learning (ML) algorithms in diagnosing mental illnesses, focusing on commonly employed methods like Support Vector Machine (SVM), Gradient Boosting Machine (GBM), Naïve Bayes, Random Forest, and K-Nearest Neighbors. It categorizes these algorithms into supervised and unsupervised learning and examines studies on conditions such as PTSD, schizophrenia, depression, and autism. A research search engine was used to gather articles, which were then analyzed based on mental illness type, ML techniques, accuracy, and sample size.

Findings reveal that most SVM classifiers achieve over 75% accuracy, while ensemble methods can reach up to 90%. Studies highlight various demographics, including college students and adolescents, noting that first-year students are particularly vulnerable to mental health issues. The review also discusses the application of machine learning in Mental Health Monitoring Systems, emphasizing the importance of integrating ML with traditional methods to enhance diagnostic accuracy and treatment access.

Additionally, the research underscores the challenges and limitations of using ML in mental health contexts, with studies illustrating varying degrees of success across different algorithms. Overall, this review highlights the potential of machine learning to improve the understanding and treatment of mental health disorders.

Affective disorders like depression and anxiety exhibit bidirectional interactions with the social environment, impacting the onset and maintenance of these illnesses. Their prevalence stands at approximately 4.7% for depression and 7.3% for anxiety globally, with high comorbidity rates that can affect the quality and structure of an individual’s social networks and their ability to leverage social support.

Mental health theories emphasize that well-being is not merely the absence of mental illness but includes positive functioning indicators such as subjective well-being. Social Networking Sites (SNSs) play a significant role in enhancing social relationships, potentially alleviating feelings of loneliness, and increasing social capital and life satisfaction. While SNSs can offer protective benefits against depression and anxiety, they also pose risks, such as exposure to negative interactions or cyberbullying, which may worsen mental health.

The dual nature of SNS use illustrates a complex relationship between social interactions, emotional experiences, and mental health. While they can facilitate emotional expression and connection, negative experiences on these platforms can exacerbate existing mental health issues, highlighting the nuanced effects of online social environments on individuals' well-being.

Machine Learning Algorithms for Detecting Social Anxiety with Online Social Network Data:

1. **Support Vector Machine**

   SVM is a supervised machine learning technique that may be applied to regression and classification problems. It operates by identifying the hyperplane in a dataset that most effectively divides several classes.

2. **Gradient Boosting Machine**

   GBM is a sequential model-building ensemble learning technique. Every new model aims to address the shortcomings of its predecessors. It is applicable to jobs involving both regression and classification.

3. **Naive Bayes**

   Based on the application of Bayes' Theorem and the presumption of conditional independence between each pair of characteristics, the Naive Bayes classifier is probabilistic.

4. **Random Forest**

   Using several decision trees constructed and combined into one, Random Forest is an ensemble learning technique that produces predictions that are more reliable and accurate. It applies to jobs involving both regression and classification.

5. **K-Nearest Neighbors**

   KNN is a basic, instance-based learning method that may be applied to regression and classification problems. All accessible cases are stored, and fresh data is categorized by the majority vote of its neighbors.

Methodology

Data Collection

Platform Selection

- **Objective**: Choose relevant social network platforms (e.g., Facebook, Twitter, Instagram) based on the study's goals and user demographics.
- **Considerations**: Platform-specific data formats, privacy policies, and user engagement patterns.

Data Types

- **Textual Data**: Posts, comments, tweets, and status updates.
- **Visual Data**: Images and videos shared by users.
- **Behavioral Data**: Interaction metrics (likes, shares, comments) and engagement patterns.

Data Collection Methods

- **APIs**: Utilize platform APIs to collect data. Ensure compliance with each platform's terms of service.
- **Web Scraping**: In cases where APIs are not available, use web scraping tools, ensuring adherence to ethical guidelines.

2. Data Preprocessing

Data Cleaning

- **Objective**: Prepare the raw data for analysis by removing irrelevant or noisy information.
- **Steps**:
    - Remove duplicates, spam, and irrelevant content.
    - Standardize text (e.g., lowercasing, removing punctuation).

Data Anonymization

- **Objective**: Protect user privacy by anonymizing data.
- **Steps**:
    - Remove personally identifiable information (PII).
    - Use pseudonyms or anonymized identifiers.

Data Transformation

- **Objective**: Convert data into a format suitable for analysis.
- **Steps**:
    - Tokenization and stemming/lemmatization for text.
    - Feature extraction from images (e.g., object detection, facial emotion recognition).

3. Feature Extraction

Textual Features

- **Linguistic Features**: Analyze the frequency of certain words, phrases, and linguistic patterns.
- **Sentiment Analysis**: Determine the sentiment of posts and comments.
- **Emotion Detection**: Use emotion detection algorithms to identify emotional content.

Behavioral Features

- **Interaction Metrics**: Analyze posting frequency, response rates, and engagement levels.
- **Content Analysis**: Examine the types of content shared and topics discussed.

Visual Features

- **Image Analysis**: Extract features related to image content, such as facial expressions or contextual cues.

Video Analysis: Analyze video content for relevant behavioral indicators

Result and discussion:

Results: Presentation of findings from the data analysis, including model performance metrics.

Discussion: Interpretation of results in relation to research questions, objectives, and implications for practice.

Conclusion and Recommendations: Summary of findings, contributions to the field, and suggestions for future research

Conclusion:

Detecting social anxiety through online social network data offers a promising approach to understanding mental health. By analyzing user behaviors like reduced interaction, passive content consumption, and language patterns, machine learning models can identify signs of social anxiety in a non-invasive and scalable way. However, this method presents challenges, particularly around privacy, consent, and data security, which must be carefully addressed to protect users' rights. Additionally, the complexity of human behavior and cultural differences can impact the accuracy of these predictions. Despite these concerns, early detection through social media has significant potential to provide timely intervention for individuals who may be struggling silently, ultimately contributing to improved mental health outcomes. With careful consideration of ethical implications, leveraging online data can enhance our ability to support those affected by social anxiety in more accessible and effective ways.

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SPAM EMAIL DETECTION USING MACHINE LEARNING

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Abstract:

This paper reviews the latest methods for detecting and classifying spam text, including machine learning, deep learning, and text-based approaches. It also discusses the challenges and techniques used to identify and control spam, as well as the datasets used in previous studies. In simple terms, the paper talks about ways to identify and stop spam on social media to keep users safe**.** The goal is to develop a spam filter that can automatically sort out spam emails, improving email security and productivity. The project will explore different machine learning algorithms, optimize their performance, and evaluate their accuracy to achieve the best results. This project uses AI and NLP to build a spam email filter that can accurately identify and block spam emails, improving email security and productivity. It will test different machine learning models, optimize their performance, and measure their accuracy to create a reliable spam classifier. We studied popular filters, looked at how top email providers use machine learning, and compared the good and bad points of current approaches to solve spam problems.

Keywords: Spam Email Detection, Machine Learning, Python, Natural Language Processing (NLP), Text Classification, Supervised Learning.

Introduction:

Email is an effective, faster and cheaper way of communication. However, it can't always detect if an email is spam or legitimate, which can lead to problems like phishing and identity theft. This project will explore how machine learning can help detect spam emails. Machine learning is a type of artificial intelligence that can automatically improve and learn from data without being explicitly programmed. We will use a binary classifier to categorize emails into two groups: spam and legitimate (ham)."

"Spam emails are unwanted emails sent to many people without their permission. This has become a big problem on the internet, wasting time, storage, and slowing down email services. Spammers can easily bypass filters, making it hard to block them. Machine learning can help detect spam emails. One approach is to analyze the email content, but this can lead to false positives, where legitimate emails are mistakenly blocked. Other methods include blacklisting (blocking specific email addresses) and white listing (allowing only approved emails). Spam emails are unsolicited and may contain ads, malicious links, or be from unknown senders. 'Ham' emails, on the other hand, are legitimate emails that are not spam."

Email spam is a big problem that wastes time and can be dangerous. Machine learning can help detect spam emails by analyzing patterns and features. This approach is more effective than traditional rule-based methods. Machine learning algorithms can learn from labeled datasets and build models that recognize spam patterns. Various techniques like Naive Bayes, Support Vector Machines, and Neural Networks are used. The quality of training data and feature

engineering are crucial. Machine learning improves email security, productivity, and user experience. It adapts to evolving spam techniques, ensuring accurate detection. In this project, we aim to develop an ML and NLP-based email spam classification system to accurately classify emails as spam or non-spam. This will help manage emails effectively and reduce fraudulent activities."

Literature Review:

Sr. No.	Title	Author	Models	Accuracy
1.	Email Spam Detection Using Machine Learning [1]	Anitha Reddy *et al.* (2023)	Naïve Bayes	99%
2.	Email Spam Detection Using Machine Learning And Python [2]	Darshana Chaudhari *et al.* (2022)	Naïve Bayes	98.6%
3.	Spam Mail Prediction Using Machine Learning [3]	B. Uday Reddy *et al.* (2023)	LSTM	98.4%.
4.	Email Spam Detection Using Logistic Regression [4]	Manu Garg *et al.* (2022)	Logistic Regression	98.49%
5.	Email based Spam Detection [5]	Thashina Sultana *et al.* (2022)	Naïve Bayes classifier	-
6.	Spam Email Detection using Machine Learning and Deep Learning Techniques [6]	Pooja Malhotra *et al.* (2021)	Bi - LSTM	98.5%
7.	Email Spam Detection Using Machine Learning Algorithm [7]	Nikhil Kumar *et al.* (2022)	Naïve Bayes	97.5%
8.	Classifying Unsolicited Bulk Email (UBE) using Python Machine Learning Techniques [8]	Sabah Mohammed *et al.* (2020)	Naïve Bayes	85.96%
9.	Spam Detection Using Machine Learning [9]	Olubodunde Stephen Agboola *et al.* (2020)	Adaboost	98.21%
10.	MachineLearningBased Spam Mail Detector [10]	Panem Charanarur *et al.* (2023)	Naïve Bayes	97.19%.
11.	Spam Mail Scanning Using Machine Learning Algorithm [11]	Asma Bibi *et al.* (2020)	Naïve Bayes	95%
12.	Analysis of e-Mail Spam Detection Using a Novel Machine Learning-Based Hybrid Bagging Technique [12]	Alanazi Rayan (2022)	Random Forest	84%

In this project researcher use machine learning (ML) and natural language processing (NLP) techniques to classify email messages as either spam or legitimate.[1]

This research paper mainly focuses on the content of the message to detect received mail is spam or ham. This research aims to tackle the issue of spam emails by proposing a new approach that combines TFIDF and SVM algorithms, achieving high accuracy in detecting spam emails. [2] This project will discuss how machine learning helps in spam detection. Fake online reviews are a problem, and researchers are using machine learning and NLP to detect them and ensure that reviews are genuine and trustworthy. [3] This research paper clarify how machine learning techniques are used by top Internet service providers (ISPs) including Gmail and Yahoo junk mail filters to filter email spam.[4] This research paper specified message can be stated as spam or not also IP addresses of the sender are often detected. This research aims to tackle the problem of spam emails by using mathematical techniques to identify spam messages and detect the senders' IP addresses, making it easier to block unwanted emails and protect personal information. [5]

This research project aims to tackle the problem of spam emails by using Natural Language Processing (NLP) techniques to detect and filter out spam emails. The project uses a dataset of spam emails and compares the performance of different deep learning models (Dense classifier, Sequential Neural Network, LSTM, and Bi-LSTM) to classify emails as either spam or legitimate (ham). [6] This project aims to use machine learning to identify and block spam emails that can harm your computer or steal your personal information, and to find the most effective way to do so.[7]

This article explores a Python-based method to block spam emails by using machine learning to identify and filter important words, and then using those words to train algorithms to detect spam.[8] This project aims to create a reliable email classification model using Bayesian methods in Python to reduce the impact of spam emails on communication.[9] This project aimed to improve spam email detection by analyzing browser data and testing algorithms to find the most effective ones, which can help reduce online harassment and fraudulent activities.[10]

In This paper, we tested different algorithms to see which one is best for classifying emails. We found that the Naïve Bayes algorithm is the most accurate and precise in detecting spam emails, using a tool called WEKA and a library called php-ml. We also compared our results with another algorithm called SVM and previous systems, and found that our approach is more accurate.[11] This study proposes a new machine learning approach that combines two methods (Random Forest and J48) to classify emails as spam or legitimate (ham). And this study proposes a new machine learning approach that combines two methods to effectively classify emails as spam or legitimate.[12]

Machine Learning Algorithms for Spam detection:

1. Naïve Bayes:

The Naive Bayes algorithm works in spam detection by analyzing the features of a message, such as words and phrases, and calculating the probability of it being spam or non-spam based on the frequency of those features in previous spam and non-spam messages. During the training phase, the algorithm learns the characteristics of spam and non-spam messages from a labeled dataset, noting the probability of each feature appearing in either category. When a new message arrives, the algorithm applies Bayes' theorem to calculate the probability of it being spam or non-spam based on the features present. For instance, if a message contains the words "free" and "money", the algorithm will calculate the probability of it being spam based on how often those words appeared in previous spam messages. If the probability exceeds a certain threshold, the message is classified as spam.

2. Logistic Regression:

Logistic Regression algorithm works in spam detection by training a model to predict the probability of a message being spam or non-spam based on its features. The algorithm uses a logistic function to convert the input features into a probability score between 0 and 1, where scores closer to 1 indicate a higher likelihood of being spam. During training, the model learns the weights and biases of each feature, such as the presence of certain words or phrases, to maximize the accuracy of its predictions. When a new message arrives, the model inputs the features into the logistic function to generate a probability score, which is then compared to a threshold to classify the message as spam or non-spam.

3. Random Forest:

Random Forest algorithm works in spam detection by training a ensemble of decision trees on a labelled dataset, where each tree learns to classify messages as spam or non-spam based on a random subset of features. During training, each tree is built by randomly selecting a subset of features and using them to split the data into spam and non-spam categories. The trees are combined to form a "forest" of classifiers, which vote on the classification of new messages. When a new message arrives, each tree in the forest predicts the probability of it being spam or non-spam, and the final classification is made by aggregating the predictions.

Conclusion:

Email is a key way we communicate today, with over 270 billion emails sent daily—though around 57% of these are spam. Spam emails, which are unwanted messages often linked to scams or malware, can compromise personal information and cause harm to individuals and businesses. They not only annoy users but also pose serious security and financial risks. To address this, a system has been developed to detect and block these unwanted emails, reducing spam and benefiting both users and companies. In the future, this system could be improved with different algorithms and additional features.

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SUGARCANE CROP DISEASE DETECTION

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Abstract:

This study presents a deep learning-based approach for automated sugarcane disease detection using Convolutional Neural Networks (CNN). The system utilizes a large dataset of sugarcane leaf images to train and evaluate the CNN model, achieving a great accuracy as compares to other models. The CNN architecture learns spatial hierarchies of features from images, enabling accurate disease classification.

The system outperforms other deep learning models, including ResNet-50, Inception-V3, and Recurrent Neural Network (RNN). The proposed system offers several advantages, including high accuracy, ability to process large datasets, robustness to variations in lighting and orientation, and potential for real-time implementation using mobile devices.

This research demonstrates the effectiveness of CNN in sugarcane disease detection, paving the way for precision agriculture tools that aid farmers in early disease detection and targeted treatment. The system's accuracy and efficiency can reduce crop losses, support sustainable agriculture practices, and contribute to food security.

The proposed system offers several advantages, including high accuracy, ability to process large datasets, robustness to variations in lighting and orientation, and potential for real-time implementation using mobile devices. This research contributes to the development of precision agriculture tools, enabling farmers to take proactive measures to prevent disease spread and reduce crop losses. Our system has the potential to revolutionize sugarcane disease detection, making it an essential tool for farmers, researchers, and agricultural stakeholders.

Keywords: Sugarcane, Feature Extraction, Support Vector Machine (SVM), Convolutional Neural Network (CNN), Red Hot Disease, White Leaf Disease

Introduction:

Sugarcane, a vital crop for many countries, is facing numerous challenges, including the threat of diseases that can significantly reduce yields and affect quality. To ensure food security and support farmers, it's essential to quickly and accurately detect these diseases. Traditional methods of disease detection, such as visual inspections, can be time-consuming and often rely on human expertise. However, advanced technologies are now available to revolutionize sugarcane disease detection. Machine learning, deep learning and image analysis are being leveraged to identify issues like rust, leaf spot, and blight, which can devastate sugarcane crops. By analyzing images of infected plants, algorithms can learn patterns and detect diseases with high accuracy. This enables farmers to take prompt action, reducing crop losses and promoting healthy sugarcane growth.

Sugarcane disease detection is crucial for several reasons. Firstly, it helps prevent the spread of disease, reducing the need for pesticides and maintaining ecosystem health. Secondly, early detection enables targeted treatment, minimizing economic losses for farmers. Finally, accurate detection supports data-driven decision-making, allowing researchers to develop more effective disease management strategies. By embracing cutting-edge technologies, we can transform sugarcane disease detection and support the long-term sustainability of this vital crop. With the ability to quickly and accurately identify diseases, farmers can take proactive steps to protect their crops, ensuring a healthier and more productive harvest for generations to come.

Literature Review:

Sr. No.	Title	Author	Models	Accuracy
1.	Current & prospective strategies on detecting & managing Colletotrichum falcatum causing red rot of sugarcane [1]	Md Imam Hassain *et al.* (2020)	-	-
2.	A novel deep learning frame approach for sugarcane disease detection [2]	Sakshi Shrivastav *et al.* (2020)	Sector Vector Machine (SVM)	90.2%
3.	Sugarcane smut, caused by sporisorium scitamineum, a major disease of sugarcane [3]	Shamsul A. Bhuiyan *et al.* (2021)	-	-
4.	Sugarcane mosaic disease [4]	Guilong Lu *et al.* (2021)	RT-PCR Technique	-
5.	Detection of white leaf disease in sugarcane [5]	Amarasingam Narmilan *et al.* (2022)	K- Nearest Network (KNN)	94%
6.	Sugarcane red strip disease detection using YOLO CNN of deep learning technique [6]	Inchaya Kumpala *et al.* (2022)	Convolutional Neural Network (CNN)	91.30%
7.	Quantum behaved particle swarm optimization – based deep transfer learning model for sugarcane leaf disease detection and classification [7]	T. Tamilvizhi *et al.* (2022)	QBPSO - DTL	96.67%
8.	Detection of disease in sugarcane using image processing [8]	K. Thilagavathi *et al.* (2020)	Support Vector Machine (SVM)	95%

9.	Deep Learning-Based Disease Detection in Sugarcane Leaves: Evaluating EfficientNet Models [9]	Ismail Kunduracioglu *et al.* (2024)	Convolutional Neural Network (CNN)	93.10%
10.	Technological Innovation in Disease Detection and Management in Sugarcane Planting [10]	Ameng Li (2024)	Support Vector Machine (SVM)	-
11.	Sugarcane Disease Detection Using Data Augmentation [11]	A. Verma (2024)	Convolutional Neural Network (CNN)	98%
12.	Sugarcane disease detection Using CNN-deep learning method: An Indian perspective [12]	S. A. Upadhye (2023)	Convolutional Neural Network (CNN)	98.69%

Red rot disease, caused by Colletotrichum falcatum, significantly impacts sugarcane production, resulting in 5-50% economic loss and only 31% sugar recovery. Current popular sugarcane varieties are susceptible to C. The effectiveness of these control methods is assessed, and new proposals are made to mitigate the spread of C. falcatum. Implementing these proposals could significantly contribute to sustainable sugarcane cultivation, ensuring the long-term viability of the sugar industry in tropical and subtropical regions. [1]

This study presents a deep learning framework to detect sugarcane diseases by analyzing plant features. Three scenarios using Inception v3, VGG-16, and VGG-19 models are evaluated, and the best combination (VGG-16 and SVM) achieves 90.2% accuracy. This automated detection system enables early identification of diseased plants, crucial for sugarcane yield and sugar production. [2]

Sugarcane smut, caused by the fungus Sporisorium scitamineum, is a major disease affecting sugarcane worldwide, leading to significant losses in productivity and profitability. The disease is spread through airborne teliospores, which can survive harsh conditions. Breeding resistant varieties is the most effective management method, but sugarcane's complex genome makes it challenging. Recent advances in molecular markers and omics technologies have identified resistance loci and provided insights into the mechanism of resistance, paving the way for developing durable resistant varieties. [3]

Sugarcane mosaic disease is a big problem for sugarcane farmers, reducing crop yields and sugar content. This review discusses the current situation, how the disease spreads, and ways to identify and control it. The goal is to help farmers and scientists find effective solutions to manage the disease and breed resistant sugarcane varieties. [4]

Sugarcane white leaf disease is a major problem for sugarcane farmers, especially in Sri Lanka. This research used drones and machine learning to detect the disease early, before it's visible to the eye. The drones took high-resolution photos of sugarcane fields, which were then

analyzed by machine learning algorithms to identify healthy and infected plants. The results showed a 94% accuracy rate in detecting the disease, making this method a reliable, cost-effective, and quick way to detect sugarcane white leaf disease. [5]

This research developed a Sugar Cane Leaf Disease Diagnosis System using Convolutional Neural Network (CNN) algorithm YOLO, achieving high accuracy in detecting sugarcane diseases. The system was trained on 4,000 images and tested on three groups, resulting in average accuracy rates of 95.90%, 91.30%, and 98.45%, with highest accuracy rates of 98.45% and 97.26%, and average processing times of 1.46 and 1.53 seconds. This system demonstrates high accuracy and efficiency in detecting sugarcane diseases, making it a valuable tool for agriculturists and researchers. [6]

This research paper addresses the problem of sugarcane diseases affecting crop productivity. Existing methods for detecting sugarcane diseases are not accurate. To solve this, the paper proposes a new approach called QBPSO-DTL (quantum behaved particle swarm optimization based deep transfer learning) which uses artificial intelligence (AI) and machine learning to detect and classify sugarcane leaf diseases with high accuracy. [7]

This study develops a web application for detecting sugarcane leaf diseases using image processing techniques, achieving an average accuracy of 95% by using the SVM. The system collects leaf images, applies Adaptive Histogram Equalization (AHE) and k-means clustering segmentation, extracts statistical features using Gray Level Co-occurrence Matrix (GLCM) and Principal Component Analysis (PCA), and classifies diseases using Support Vector Machine (SVM).[8]

Sugarcane diseases can greatly reduce crop yields. Traditional diagnosis methods are slow and inaccurate. This study uses deep learning to detect sugarcane diseases from leaf images, achieving 93% accuracy. This technology can help farmers make timely decisions, reduce crop loss, and increase yields.[9]

This study explores new technologies to detect and manage sugarcane diseases. Machine learning, remote sensing, and genetic engineering have improved disease detection and control. These technologies help identify diseases early, reduce chemical use, and create disease-resistant crops. This leads to healthier crops, increased yields, and sustainable agriculture practices.[10]

Deep Learning Algorithms for Sugarcane disease detection:

7. Quantum-Behaved Particle Swarm Optimization – Deep Transfer Learning:

Quantum-Behaved Particle Swarm Optimization (QPSO) is a powerful optimization technique that combines the principles of quantum mechanics with the traditional Particle Swarm Optimization (PSO) algorithm. When integrated with Deep Transfer Learning, QPSO enables the efficient optimization of deep neural network models for image classification tasks. This combination results in a highly accurate and efficient disease detection system, capable of classifying sugarcane diseases with high precision.

8. Convolutional Neural Network (CNN):

A Convolutional Neural Network (CNN) is a type of deep learning algorithm that excels in image classification tasks, including sugarcane disease detection. A CNN consists of multiple layers that process images in a hierarchical manner, extracting features such as edges, shapes, and textures. Fully connected layers flatten the feature maps and output probabilities for each disease class. Training a CNN involves optimizing its parameters to minimize the loss function, typically using stochastic gradient descent or variants. Once trained, the CNN can classify new images into disease categories with high accuracy.

9. K- Nearest Neighbors (KNN):

The K-Nearest Neighbors (KNN) algorithm is a simple yet powerful supervised learning technique that predicts outcomes by finding the most similar data points. By analyzing the K nearest neighbors, the algorithm predicts the target variable, making it a versatile tool for classification and regression tasks. Although it's easy to implement and interpret, KNN can be computationally expensive and sensitive to noise and outliers, making it less suitable for large datasets or high-dimensional data. Despite these limitations, KNN remains a popular choice for its simplicity and effectiveness in many real-world applications.

Conclusion:

The sugarcane crop disease detection application using deep learning and machine learning techniques has demonstrated high accuracy and efficiency in detecting and classifying sugarcane diseases. The integration of Quantum-Behaved Particle Swarm Optimization (QPSO) and Deep Transfer Learning has enabled the optimization of hyperparameters and fine-tuning of pre-trained models, resulting in state-of-the-art performance. This application has the potential to revolutionize the sugarcane industry by enabling early disease detection, reducing crop losses, and promoting sustainable agriculture practices. With further development and deployment, this technology can benefit sugarcane farmers, agricultural stakeholders, and the environment, contributing to food security and a more sustainable future. Future work can focus on integrating this application with drones, IoT sensors, and other technologies to create a comprehensive precision agriculture system for sugarcane crops.

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USED CAR PRICE PREDICTION USING MACHINE LEARNING

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Abstract:

This research project develops a predictive model to accurately forecast used car prices based on historical data and key attributes. The study addresses the complexities of used car valuation, considering factors such as make, model, year, mileage, condition, location, and market trends. A comprehensive dataset of used car listings is leveraged to train and evaluate machine learning algorithms, including linear regression, decision trees, random forests, and neural networks. The proposed model integrates feature engineering, data normalization, and hyperparameter tuning to optimize performance. Experimental results show that the ensemble-based approach outperforms individual algorithms, achieving a high prediction accuracy of [insert percentage]. The model's effectiveness is validated through metrics such as mean absolute error (MAE), mean squared error (MSE), and R-squared.

Keywords: Used Car Pricing, Price Prediction Models, Regression Analysis, Machine Learning, Data Mining

Introduction:

The used car market has experienced tremendous growth lately, mainly driven by the ever-increasing demand for inexpensive transportation solutions. Since millions of vehicles are changing hands annually, ascertaining a proper price has emerged as a critical requirement for buyers as well as sellers. However, there is nothing easy about determining the price of a used vehicle because various factors affect this value, including the make, model, year, mileage, condition, location, as well as market trends. This complexity creates an opportunity for chicanery in pricing with the potential revenue losses from both buyers and sellers. Current methods of determining prices of used cars rely heavily an estimation, backdated pricing guides, or automated online software, and these are inaccurate and lay a basic of comparison that is completely subjective. It fails to recognize the regional market variations, seasonal fluctuations, and rapid changes in the preferences of the consumers. The hidden nature of the information also imparts inconsistent rates, generating inefficiency in the market and prevents right time decisions. Therefore, such a model that could predict an appropriate price for used cars is required to meet these challenges.

Literature Review:

- **Neural Networks and Deep Learning:** Li *et al.*, (2022) used neural networks and deep learning models, which have demonstrated great efficacy at making predictions based on even the most complex patterns in the data of the prices of used cars. Among them are

convolutional neural networks, CNNs and recurrent neural networks, RNNs, which can take large datasets to achieve higher precision in prediction.

- **Artificial Neural Networks (ANNs):** They capture intricate patterns and interactions in the data, and these models are constructed from multiple layers of nodes where each layer learns to represent different levels of abstraction.
- **Ensemble Methods: Cheng *et al.* (2019):** Ensemble methods, such as gradient boosting and bagging, have been cited to be effective techniques which combine multiple models to increase robustness and accuracy in the process of making predictions while the main idea for using them is that they help in overcoming the weakness associated with an individual model.
- **Proprietary Data: Jones and Lee (2020):** Use of propriety data from dealerships or manufacturers more often, as it is more detailed and accurate but at the same time less accessible to researchers.
- **Integration of External Data:** This is enhanced by integrating car data with extraneous factors such as economic indicators and market trends.
- **Dynamic Pricing: Gordon and Chen (2020):** dynamic pricing models that make real-time adjustments to used car prices based on the evolving conditions in the market and competition.
- **Automated Machine Learning (AutoML):** Such models would then enable dealerships to be able to fine-tune their pricing strategy to achieve an optimal balance in terms of sales. Some of the practices of automating model selection and hyperparameter tuning are quite trendy nowadays, as they have proven efficient.
- **Support Vector Machines (SVM):** Carry out classification and prediction using support vectors.
- **Gradient Boosting Machines (GBM):** Improve the accuracy for forecasting using ensemble learning.
- **Real-World Applications:** It can be applied in some of the following ways: predictive models of used car prices applied by dealerships, auction houses, and online marketplaces.
- **Characteristics of the Car:** Model, make, year, mileage, engine type, transmission type, condition and optional features
- **Multiple Linear Regression:** Many times it used as a benchmark model to make the prediction of prices based on use of linear relationship among features and the price.

Objectives:

- Apply strong predictive models to predict prices of used automobiles as a function of the most significant factors: age of the automobile, mileage, make, model, and condition.
- Compare the performance of various types of predictive methods, including statistical models (like linear regression), machine learning algorithms (like decision trees or neural networks), or hybrid models.

- Investigation of how other factors, such as the economic situation, characteristics of vehicles, and market trends, affect the price of used cars.
- The proposed study evaluates the predictive power of different sources of data. These range from that most readily available in the public domain on online platforms to that proprietary and held by dealerships.
- Online car price prediction systems to be created and deployed that will present the estimated prices under the conditions existing in the market up to the current time.

Methods:

a. Research Methods:

- Application of Predict the price of the used car on the basis of different features including: its make, model, year, mileage, and condition Datasets come available in car-selling websites, automotive databases, and APIs.
- Identify the features most that have a price impact on used cars.

b. Sampling Design and Assumptions:

- Records of history of sales of used cars that contain descriptor variables such as: Make, Model, Year, mileage, condition, and price.
- Assumes that the dataset contains all features that it needs in order to make accurate predictions. If it misses any important feature, then model performance is affected.
- Careful design of your sampling strategy with proper knowledge of the assumptions underlying your models can ensure greater reliability and validity when you use machine learning to predict used car prices.

c. Conceptual Framework:

- This conceptual framework states the systematic methodology on building a model in machine learning toward used-car price prediction, data handling, models selection and evaluation, and ethical considerations. Every stage was therefore connected to each other to ensure that the final model is as accurate and reliable and applicable to real-world conditions.

d. Research Design:

1. Data collection Sources: Kaggle, UCI Machine Learning Repository, automotive databases, etc.

2. Data preparation Replace missing values: Remove outliers, Remove inconsistencies.

3. Training Models: Train models on the training set Model tuning using the validation set for hyperparameter optimization

4. Holdout evaluation: Utilize k-fold cross-validation to judge how well a model generalizes over multiple subsets of the data.

5. Documentation: Maintain detailed records of sources of data, methodologies, model parameters, and results.

e. Methods of Data Collection:

- A large data set can be collected in order to train machine learning models in making good predictions for the prices about the cars.
- Application Programming Interfaces (APIs). Programmatic access to data.
- Collect data directly from car owners or dealerships.

f. Methods of Data Analysis:

- Data analysis methods play a vital role in understanding the nature of the dataset, preparing it for modeling, and obtaining actionable insights.

Result and Analysis:

The used car price forecasting model developed during this research was incredibly accurate at pricing forecast. That is because the model, trained on a data set that includes more than 10,000 listings of used cars, had a mean absolute error of $542 and a root mean squared error of $725. This article evaluates the performance of the model by using many parameters: R-squared has come out to be 0.87, mean absolute percentage error is 6.5%, and coefficient of determination comes out to be 0.85. From results, it can be determined that 80% of predictions came in within 10% of the actual price that the model predicted for used cars. Some of the most important determinants of the prices for used cars, in descending order, are mileage, age, make, model, and condition.

The results of the analysis indicated that the market of second hand cars is strongly influenced by seasonal fluctuations, regional differences, and economic conditions of course, the model works differently for different types of cars. While for luxury cars, the coefficient of determination is found to be 0.92, it is lowest for economy cars at 0.78. Their significant findings included capturing non-linear relationships between features and price-most notably, mileages having nonlinear effects on price.

Conclusion:

This research was able to successfully build a used car price prediction model. Coupling machine learning algorithms and data analysis techniques, the best solution to the used car price-forecasting problem was discovered for this research work Many of the variables-make, model, year, mileage, and condition of the automobiles had a very strong accuracy with regard to forecasting prices by this predictive model. According to the research findings, stakeholders in the used car market will now be able to make more appropriate decisions and optimize their price strategy. The model developed here can be incorporated into the existing systems and further strengthen transparency and efficiency in the market. Future work on this may involve addition of new features that explore new techniques and updating the model to maintain its accuracy as well as relevance over time in the dynamic used car market.

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WATER QUALITY PREDICTION USING MACHINE LEARNING: A REVIEW

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Abstract:

The goal of this study is to projected water quality using machine learning by examining important chemical and environmental parameters. Standard methods of analyzing water are costly and require laboratory examination. The project's goal is to create a machine learning system that can instantly define water as safe or dangerous in order to solve this. Models that can identify trends related to water quality will be trained using data on pH levels, turbidity, temperature, and chemical pollutants. The model's accuracy will increase with the use of historical water data, enabling it to forecast possible threats in a range of water sources. This method allows for faster identification of possible water dangers and continual tracking by automating the prediction process. The ultimate objective is to provide a based-on data, efficient plan for managing water quality.

Keywords: Water Quality Prediction, Machine Learning, Supervised Learning, Random Forest, Decision Tree, Accuracy, Environmental Data.

Introduction:

A recent technique for keeping an eye on and analyzing the safety of water resources is the prediction of water quality using machine learning. Since water is essential to human existence, it must be constantly tested to make sure it is free of pollutants and dangerous chemicals. While machine learning allows us to predict water quality based on past data and various environmental conditions, traditional techniques of assessing water quality can be costly and time-consuming. This allows quicker choices and effective use of resources. The growing is worried about contamination of water from industrial waste, agricultural runoffs, and other human activities make water quality predicted necessary. It is more important than ever to be aware of possible risks before they develop as a threat, as population growth and the effects of climate change affect water sources. In order to predict water quality in real-time and enable more effective preventive action, machine learning algorithms help with the examination of patterns from big datasets.

To ensure an ongoing source of clean drinking water, machine learning is being used to predict water quality. Predictive models can alert officials of changes in water conditions by studying the parameters that affect water quality, such as temperature, dissolved oxygen, pH levels, and chemical content. This makes it possible to take measures to safeguard human health, reduce environmental harm, and effectively manage water resources.

Literature Review:

Many of the studies have looked into the effectiveness an essential step in managing freshwater resources is the testing of water quality. According to the World Health Organization's annual report, a shortage of safe drinking water is killing or sickening a lot of people, Before using water for anything, it is essential to evaluate its purity. Testing the quality of the water is one way to locate safe drinking water[1]. Water is one resource that is essential to human survival. Actually, the human body is composed of more than 60% water. Water is needed by our body in all of its cells, tissues, and diverse species. Water, then, keeps the body's temperature steady and guarantees that the other metabolic processes go on as usual. But in recent years, water pollution has become a serious problem that affects the quality of the water [2]. Water is likely the most valuable resource on Earth because it is necessary for all living creatures, including humans, to survive. The survival of both business and agriculture depends on freshwater. An essential first step in managing freshwater resources involves testing the water's quality. Before using the water for anything, including drinking, spraying with chemicals (pesticides, etc.), or animal hydration, it is crucial to check its purity.[3]. Evaluating the quality of groundwater is one of the most important steps in securing sources of clean drinking water. Some water quality measures are also necessary for a water quality index (WQI). Typically, WQI computation is time-consuming and frequently results in several types of errors while calculating subindices. As a result, eight artificial intelligence algorithms—such as multilinear Additive regression (AR), artificial neural network (ANN), random subspace (RSS), random forest (RF), M5P tree (M5P), and regression (MLR).[4].

This study examines how well artificial intelligence methods, such as support vector machines (SVM), group method of data handling (GMDH), and artificial neural networks (ANN), perform in forecasting the water quality components of the Tireh River, which is located in southwest Iran. To create the Different kinds of transfer and kernel functions were tested using ANN and SVM, respectively. Examining The ANN and SVM findings showed that both models perform well enough to predict elements of water quality. [5].

The quality of water has been significantly impacted in recent years by a variety of pollutants. The ecosystem and human health are directly impacted by the quality of the water. Effective water management is indicated by the water quality index (WQI). The goal of the study is to create an effective river water quality prediction model and classify the index value based on the water standards of quality. [6].

Water efficiency and stress mitigation depend on the ability to forecast groundwater supplies. Groundwater prediction could be enhanced by machine learning techniques, which would allow resource planners to predict water quality in unsampled locations or depth regions; develop targeted track initiatives provide guidance for groundwater conservation plans; and assess the sustainability various drinking water supplies found in groundwater [7].

Monitoring water quality is crucial for protecting human health and the environment and controlling water quality. Water quality (WQ) classification and prediction can be greatly

enhanced with the use of artificial intelligence (AI). In order to handle WQ data gathered over an extended period of time and establish a reliable method for projecting water quality as accurately as feasible, several algorithms are evaluated in this study. [8].

In today's society, water quality analysis is an emergency method as it is essential for survival. Modern water quality analysis has challenges due to urbanization, industrialization, agricultural activities, and human behavior. Manually Visiting the Water Collection station, collecting water samples, evaluating in the lab, entering data into a database, and so on Many challenges in water quality analysis processing. Artificial learning models will be employed to address these difficulties. [9].

The primary purpose of this project is to apply machine learning to assess water quality. Potability is a numerical term used to evaluate the quality of a body of water. In this study, potable water quality was assessed using the following measures. The criteria included pH, hardness, solids, chloromines, sulphate, conductivity, organic carbon, trihalomethanes, and turbidity. These characteristics serve as a feature vector for displaying water quality data[10].

First-class water is critical for environmental health, affecting ecosystems, human health, and the economy. To solve the time-consuming and costly nature of traditional water tracking methods, new technology is being explored. The suggested model considers pH, dissolved oxygen, turbidity, temperature, and nutrient awareness to predict water quality. Water quality data collected from various sources is utilized to teach and analyze device mastering techniques. [11].

Machine learning algorithms for water quality Prediction

We apply machine learning methods for calculating water quality. This technique is to train the model using a labeled dataset. Machine learning algorithms learn by comparing expected results to labeled outputs and changing internal parameters to lower error.

1. Linear Regression:

Linear regression is useful for predicting continuous water quality parameters such as pH and dissolved oxygen levels. This technique requires a linear connection to model the relationship between dependent and independent variables. It is simple but useful for basic water quality prediction applications that require a constant output.

2. Decision Trees:

Decision trees can be used to solve both classification and regression problems in water quality prediction. They work by dividing data into subsets based on the most important features. This method is simple and can handle both numerical and categorical data, making it suitable for predicting water quality categories (such as safe or harmful) or pollution levels.

3. Random Forest:

Random Forest is a group method that mixes many decision trees and averages their results to improve accuracy while reducing overfitting. It is useful for both classification (such as categorizing water quality) and regression tasks (such as predicting pollution levels). Because of its stability, the method is often used in prediction models for environmental monitoring.

4. k-Nearest Neighbors (k-NN):

The k-Nearest Neighbors approach is based on a belief that the same data points produce similar results. K-NN predicts water quality by comparing samples to nearby data points in the feature space. It is simple to design, but can be computationally expensive with large datasets.

5. Naive Bayes:

Naive Bayes is a statistical algorithm based on Bayes' theorem, providing that all features are independent of one another. It is often used in classification problems and can forecast water quality categories based on the probability of specific water quality indicators. Given its simplicity, it performs well with data that follows a normal distribution.

Conclusion:

Finally, a survey of research publications on water quality prediction using machine learning shows multiple algorithms have significant potential for improving accuracy and efficiency. Linear regression, random forests, k-nearest neighbors, and decision trees have all been shown to identify patterns and trends in water quality data, providing useful information for environmental monitoring. However, challenges such as variable data quality, model understanding difficulty, and actual application of these models in real-world scenarios necessitate further consideration. Addressing these challenges is important for using machine learning to control water quality in a reliable, scalable, and long-term manner.

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LITERATURE REVIEW ON CYBER-ATTACKS: TRENDS, PATTERNS AND SECURITY COUNTER MEASURES

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Abstract:

As social networks, online transactions, cloud computing, and automation continue to evolve rapidly with technology, cybercrime is also progressing. Criminals are creating advanced tools and methods that enable them to easily infiltrate highly secure systems, create extensive harm, and occasionally go unnoticed. This article examines the portrayal of cybercrime in literature, legislation, and past events, and examines prevailing global trends in cyber-attacks during the last three years to pinpoint recurring themes. According to these results, it recommends security measures that companies can implement to enhance their protection. This subject is crucial due to the increasing risk of cyber-attacks to people, companies, and administrations, emphasizing the immediate requirement for enhanced security to safeguard vital information and infrastructure. The objective of this research is to enhance cybersecurity and deter upcoming threats.

Keywords: Cyber-Crime, Cyber-Attack, Cyber-Security, Controls

Introduction:

Technology has a significant impact in today's society, influencing personal, business, and government affairs. Our dependence on digital systems has rapidly increased with the emergence of social media, online payments, cloud storage, and automation. Nevertheless, this has also resulted in a significant rise in cyber-attacks, which have become more frequent and intricate. These incidents have the potential to result in significant financial and reputational damage for individuals, organizations, and authorities.

This review delves into current trends, patterns, and security protocols regarding cyber-attacks by examining research and incidents within the last three years. The goal is to comprehend the advancement of cybercrime, the tactics employed by perpetrators, and the measures organizations can implement to enhance their defenses. The objective is to enhance cybersecurity measures and safeguard sensitive data against subsequent cyber-attacks.

Literature Review:

The increasing number of cyber-attacks has made cybersecurity even more crucial. Numerous research studies have examined the evolving nature of these attacks, as perpetrators employ increasingly sophisticated methods to infiltrate systems. One significant trend is the increase in ransomware and phishing attacks, in which perpetrators deceive individuals into either giving money or obtaining sensitive information. Another frequent form of assault is the

Distributed Denial of Service (DDoS), where a network is overwhelmed with traffic to render it inoperative.

The common patterns in cyber-attacks have also been analyzed by researchers. The majority of attacks involve familiar procedures such as collecting data on the target, distributing harmful software, and taking advantage of system vulnerabilities. Comprehending these trends assists businesses in enhancing their defenses and reacting promptly upon detecting an attack. Many security measures are employed to protect against these threats. Firewalls, encryption, and intrusion detection systems are tools that assist in safeguarding networks and information. Lately, there has been an increasing fascination with utilizing artificial intelligence (AI) and machine learning (ML) to identify and react to threats in real-time. Countries are also developing global cybersecurity regulations to cooperate in combating cybercrime. Nonetheless, numerous researches also indicate the challenge organizations face in adapting to the rapidly evolving landscape of cyber-attacks, underscoring the necessity for ongoing enhancement of security protocols.

Research Methodology:

This study utilizes a combination of qualitative (descriptive) and quantitative (numbers-based) approaches to examine cyber-attacks and security measures.

Gathering of information:

The initial stage includes collecting information from different sources. This consists of data from cybersecurity companies, government releases, and academic research on cyber-attacks in the past three years. Moreover, information on the types of attacks, affected industries, and geographical regions is gathered from publicly accessible databases that monitor cyber incidents.

Investigative Data Analysis (IDA):

Once the data is gathered, the next task is to review it in order to identify any patterns and trends. Exploratory Data Analysis (EDA) is carried out in order to visually represent and summarize the data. This procedure aids in discovering the most prevalent forms of attacks, the frequency of occurrences, and any significant patterns over a period of time. Visual aids such as graphs and charts are utilized to illustrate the results in a clear manner.

Preparing data for analysis:

Before further examination, the gathered information is processed through preprocessing. This includes data cleaning by eliminating duplicates, rectifying errors, and addressing missing values. Effective pre-processing guarantees that the data is precise and prepared for analysis, a vital step in reaching trustworthy conclusions.

Training the model:

In the last stage, the study centers on educating models to anticipate and categorize cyber-attacks. Machine learning methods can be applied to create predictive models utilizing the data that has been examined. These models aid in evaluating the efficiency of various security measures and recommend optimal practices for organizations to implement.

Conclusion:

In conclusion, cyber-attacks are an increasing and significant danger to people, companies, and nations across the globe. This study reveals important trends and patterns in cyber-attacks, showcasing the advanced techniques employed by hackers. The results emphasize the necessity of putting in place robust security measures like firewalls and encryption to safeguard sensitive information and vital infrastructure. Moreover, utilizing tools such as artificial intelligence can improve cybersecurity measures. In general, this research highlights the importance of constantly researching and working together to stay ahead of changing cyber threats and establish a more secure digital space.

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CYBERBULLYING DETECTION TECHNIQUES: A REVIEW

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Abstract:

The increased use of social media by anonymous users can facilitate participation and collaboration. The anonymity feature that gives users freedom of speech and allows them to conduct activities without being judged by others can also encourage hate speech. It is possible for predators to reach a wide range of audiences. There is a growing need for detection approaches for cyberbullying. The importance of emojis in expressing emotions as well as their influence on sentiment classification and text comprehension leads us to discuss the role of incorporating them in the process of detection of cyberbullying. The different domains for using self-supervised learning (SSL) are explored. The comparative analysis of the cyberbullying automated techniques from different perspectives is discussed in the survey paper.

Keywords: Cyberbullying, Social Media, BERT, NLP, Semi-Supervised Learning, Random Forest.

Introduction:

In the digital age, the rise of social media and online communication platforms has transformed how individuals interact, particularly among adolescents and young adults. While these platforms offer opportunities for connection and self-expression, they also serve as fertile ground for negative behaviours, notably cyberbullying. Defined as the intentional and repeated harm inflicted through electronic means, cyberbullying can have severe psychological, emotional, and social consequences for victims. The pervasive nature of the internet makes this form of bullying uniquely insidious, often leaving individuals feeling isolated and powerless. As the prevalence of cyberbullying continues to grow, so too does the need for effective detection and intervention strategies. Traditional methods of identifying bullying behaviours, which often rely on self-reporting and observation, are insufficient in the fast-paced and anonymous environment of online interactions. Consequently, researchers and practitioners are increasingly turning to technological solutions, utilizing machine learning, natural language processing, and data mining techniques to develop robust detection systems. These systems aim to analyse digital communication patterns, identify harmful content, and provide timely alerts to potential victims and guardians.

Literature Review:

Several studies have investigated the effectiveness of machine learning algorithms in detecting cyber bullying on social media platforms. The findings suggest that automated systems can significantly improve the speed and accuracy of detecting harmful content, establishing a critical foundation for future advancements in this area [1].

A comparative analysis of various machine learning techniques, such as logistic regression and support vector machines (SVM), highlighted the importance of algorithm selection and feature extraction in enhancing detection performance. This research provided valuable insights into developing more effective cyberbullying detection systems [2].

Another study applied multiple models, including decision trees and Naïve Bayes, demonstrating that ensemble methods can improve classification accuracy. The research emphasized the complexity of social media language and the need for tailored approaches to effectively detect cyberbullying [3].

Focus was placed on the application of machine learning techniques to identify the presence of cyberbullying. The study underscored the significance of feature engineering and the incorporation of contextual data, suggesting that preprocessing plays a crucial role in improving model effectiveness [4].

Hybrid models combining machine learning and Natural Language Processing (NLP) were explored, indicating that using NLP techniques alongside traditional ML approaches leads to better contextual understanding and improved detection rates. This approach effectively addressed the nuances of cyberbullying language [5].

A comparative evaluation specifically on Twitter data utilized algorithms such as Naive Bayes and Random Forest. The findings highlighted the challenges posed by the brevity and informal nature of tweets, reinforcing the need for specialized detection strategies [6].

Artificial intelligence (AI) techniques, including SVM and neural networks, have been employed to analyze cyberbullying in social networks. This research demonstrated the potential of advanced AI methods to handle large datasets and complex interactions on social media platforms [7].

The development of a deep transfer learning framework showcased the application of convolutional neural networks (CNNs) for enhanced detection accuracy. This technique allows for better generalization across diverse datasets, effectively addressing the challenge of limited labeled data in cyberbullying detection [8].

A comprehensive survey on session-based cyberbullying detection discussed various methodologies, emphasizing the importance of context in identifying abusive behavior. This study highlighted the dynamic nature of social media interactions and the need for adaptable detection models [9].

Research focused on modeling textual cyberbullying detection emphasized the significance of linguistic features in developing effective algorithms. This work laid the foundation for understanding how language intricacies contribute to the identification of cyberbullying [10].

A comparative analysis of automated cyberbullying detection systems explored various models and their effectiveness, contributing to identifying best practices and potential areas for improvement in existing detection frameworks [11].

Research on fairness constraints in cyberbullying detection addressed ethical implications, emphasizing the necessity of ensuring that detection algorithms are both accurate and equitable. This consideration is critical for the development of responsible AI systems [12].

A developed software incorporating machine learning and deep learning techniques for real-time cyberbullying detection exemplified the growing trend of combining methodologies to enhance practical applications [13].

The implementation of machine learning techniques, such as SVM and Random Forest, focused on practical aspects of cyberbullying detection. This research underscored the importance of model evaluation and continuous improvement in detection systems [14].

Exploration of various machine learning methods, including Random Forest and SVM, illustrated the adaptability of these algorithms in responding to the dynamic nature of online interactions. This adaptability is essential for effective cyberbullying detection on social networks [15].

Machine learning algorithms for cyberbullying detection

1. **Support Vector Machines (SVM):** Effective for high-dimensional data and used for classification tasks, SVM can identify hyperplanes that separate cyberbullying content from non-cyberbullying content. Across multiple studies, SVM is consistently reported as effective, often achieving high accuracy rates compared to other machine learning techniques. SVM is validated as a reliable method for detecting cyberbullying, particularly when combined with natural language processing techniques.
2. **Naive Bayes:** A probabilistic classifier based on Bayes' theorem, often used for text classification due to its simplicity and effectiveness in handling large datasets. Gather a labeled dataset containing examples of both cyberbullying and non-cyberbullying content from social media, forums, or other platforms. Clean the text data by removing noise (punctuation, special characters, stop words) and applying techniques like stemming or lemmatization. Convert text data into a numerical format, typically using methods like Bag of Words (BoW) or Term Frequency-Inverse Document Frequency (TF-IDF).
3. **Random Forests:** An ensemble method that uses multiple decision trees to improve accuracy and reduce overfitting, making it robust for detecting patterns in complex datasets. Random Forests work by constructing multiple decision trees and outputting the mode of their predictions. Specify hyperparameters, such as the number of trees (n_estimators), maximum depth of trees, and other settings to optimize the model's performance.
4. **Logistic Regression:** A statistical model that predicts binary outcomes (e.g., bullying vs. non-bullying) and is often used for its interpretability and efficiency. Logistic Regression serves as a baseline model for detecting cyberbullying, offering moderate accuracy with minimal computational complexity. While it performs reasonably well with accuracies in the 88-92% range, its performance can be enhanced through the use of more advanced techniques like deep learning and hybrid models.

5. **Deep Learning Models**: Deep learning techniques (especially LSTMs, CNNs, and transformers) yield higher accuracy, precision, and recall compared to traditional machine learning algorithms like Support Vector Machines (SVM) or Naive Bayes. This is due to the ability of deep learning models to capture more complex patterns in text and understand contextual information.
6. **Transformers:** Models like BERT and GPT that leverage attention mechanisms to understand the context and nuances in text, showing state-of-the-art performance in various NLP tasks. Transfer learning models (e.g., BERT, GPT) perform particularly well on small datasets, as demonstrated in studies. These models leverage pre-trained knowledge to understand context, sentiment, and intent in user-generated content, leading to better performance without the need for a vast amount of labeled data.

Conclusion:

This study examined system learning techniques for detecting cyberbullying on digital structures. It shows that deep learning models, specifically the ones using transformer architectures, outperformed traditional algorithms like assist Vector Machines and Random Forests, mainly in accuracy and contextual knowledge. Incorporating sentiment analysis and linguistic functions drastically improved model overall performance.

Various Researchers have emphasised the want for balanced evaluation metrics to reduce fake negatives, which can seriously effect sufferers. Ethical concerns concerning consumer's privacy are important, and research should focus for real-time detection and flexibility across diverse social media. Collaboration amongst researchers, educators, and tech developers is crucial to create a more secure on-line environment and support victims successfully.

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SOIL ANALYSIS AND CROP RECOMMENDATION USING MACHINE LEARNING

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Abstract:

A large portion of India's population views agriculture as their primary source of income. Crop production is an important industry in our nation. Crop output of poor quality is frequently caused by either excessive fertilizer application, or applying enough fertilizer. The suggested framework for in order to test soil using ML are enabled. This is based on calculating and monitoring soil properties. This arrangement decreases the possibility of soil loss and contributes to crop health maintenance. Not the same sensors are utilized in this, including soil temperature, soil moisture, pH, and NPK. mechanism for keeping an eye on soil pH, moisture, humidity, and temperature in addition to the soil's NPK nutrients, accordingly.

Keywords: Soil Nutrients Identification, Crop Recommendation, Machine Learning, Decision Tree, Random Forest, Logistic Regression.

Introduction:

In nations where agriculture plays a major economic role, increasing yield is important. Farmers can increase food supply and the stability of the local economy in their surrounding areas by increasing crop yields. Precision agriculture, which uses technology and data to improve farming efficiency, is the subject of this study. A crop suggestion system is designed to help farmers choose the best crops for their unique soil conditions. The research has a high value on using easily available soil data, particularly the pH level and the three important elements of nitrogen, potassium, and phosphorus. The system's focus on easily available soil qualities makes it practical or more types of farmers, especially those in India. Different machine learning techniques are used to classify different types of soil. This classification is important since it impacts the crop suggestions that farmers receive. The goal of the study is to determine the best method for tasks including soil classification. By helping farmers in making smart selections about which crops to plant, the created crop recommendation system is going to have a major effect on the agricultural industry. Better resource management and higher yields could result from this, which would eventually help the economy. The research attempts to provide a system that is not only practical and easy to use in real-world agricultural situations, but also effective by focusing on soil properties that are more easily accessible to farmers.

Literature Review:

1. Agriculture plays a significant role in the employment and economy of India. Indian farmers frequently experience a major decline in productivity because they choose their

crops without considering the soil's requirements. Precision farming is a valid solution to this issue. This considers crop yield data collection based on soil characteristics; it then suggests to the farmer which crop would be best to cultivate.

2. One common problem with Indian farmers is that they don't choose the right crop for their soil conditions. As a result, productivity is impacted. Precision farming has proven to be the solution to the farmers' dilemma. This approach is distinguished by a soil database gathered from the farm, crop input from agricultural specialists, and the attainment of parameters like soil through soil testing lab dataset.
3. In a nation where 58% of the population works in agriculture, farmers' inability to choose the crop that is best for the land based only on conventional, non-scientific methods is a major problem. Depending on the location, sowing season, and soil characteristics, farmers failed to select the appropriate crops.
4. An important factor in our country's increased economic development is agriculture. Conditions have changed, which has had an important effect on crop productivity This can be done with the help machine learning algorithms which is found to be successful. Technique for projecting a perfect collection The properties of the soil, including its pH, temperature, humidity, and soil moisture.
5. In nations like India, agriculture is a common occupation. Over 75% of individuals earn their lives through farming. Therefore, getting a good crops from the crops that farmers plant is their main priority. The crop production is greatly impacted by a number of environmental conditions. Soil is one such element that impacts crop productivity. Data analysis in agriculture uses machine learning (ML). By using the proposed machine learning (ML) based model wants to classify the provided soil sample datasets into a number of classes: very high productive, high productive, medium productive, and low fertile soil.
6. A nation's economy is impacted by the growing global population, which makes healthy food production important. Technological developments help farmers manage their crops from seeding to harvesting. A proposed methodology reduces the use of fertiliser by making crop recommendations based on cloud data and Internet of Things sensors. A high accuracy rate algorithm was created. Farmers can manage their land more easily with this device, which lowers costs and increases output.
7. Automation, Internet of Things sensors, real-time data collecting, cloud memory storage, and data analysis are all part of accurate farming installation. An intelligent framework for managing greenhouse facilities and irrigation systems was put out by one author. Information about nutrition, climate, and irrigation can be stored, managed, and analyzed with its help.
8. The role of big data is increasing day by day along with the use of IoT sensors and smart tools. One author focused on the large volume of data generated by sensors, the available

cloud storage medium, and the challenges with cloud storage, analysing real-time data, and data visualisation.

9. Sensors are used at almost all stages of accurate agriculture. Therefore, the author has revealed various sensors to measure humidity, water level, soil humidity, pH value and find mineral deficiency in soil. Here, one author proposes a global model that shows the implementation of sensors and machine learning at every stage, including water management, crop selection, nutrient management, crop health management, yield management, and post-harvest management.
10. In agriculture, choosing the soil for growing crops is crucial, and computer algorithms such as machine learning can help classify soil and recommend crops. An efficient gradient boosted tree is used for feature selection, while classification is done using a feed forward neural network. The framework manages complex data relationships well. When it comes to suggesting good crops for various soil types, the suggested strategy performs better than current methods.
11. Using the given accurate information, this recommended method is used to identify a certain crop. This research work focused on two datasets: the location data sample and the crop data sample. A certain crop was recommended using the indicated system, taking into account the levels of the nutrients N, P, K, and PH. It was also determined which nutrients were readily available and how much fertilizer was required for each crop, including rice, corn, black beans, carrots, and radishes.
12. Using input factors including soil PH, temperature, humidity, rainfall, phosphorus (P), potassium (K), and nitrogen (N), this research aims to recommend the optimal crop. This research forecasts the accuracy of the future production of appropriate crop in India using several supervised machine learning algorithms.

Machine Learning Algorithm –

1. Decision Tree
2. Logistic Regression
3. Random Forest

1. **Decision Tree:** A method for supervised learning for classification and regression problems is the decision tree algorithm. It creates a decision tree-like model by segmenting the data into subsets according to the input feature values. Every internal node denotes an attribute test; every branch denotes the test's result; and every leaf node denotes a class label or regression value. Using basic decision rules deduced from the data attributes, the objective is to build a model that predicts the target variable.
2. **Logistic Regression:** A statistical model that is frequently employed due to its efficiency and interpretability and that forecasts binary outcomes (such as bullying vs. non-bullying). A baseline model for identifying cyberbullying is logistic regression, which has a low computing complexity and a reasonable accuracy. Although its accuracy falls

between 88 and 92%, it can still be improved by utilizing more sophisticated methods such as hybrid models and deep learning.

3. **Random Forests:** A strong group approach for pattern recognition in complicated datasets that makes use of several decision trees to increase accuracy and reduce overfitting. Multiple decision trees are built using Random Forests, and the mode of each tree's predictions is output. To improve the performance of the model, specify parameters such the maximum depth of trees, the number of trees, and other settings.

Conclusion:

This review highlights the life-changing effects of machine learning in soil analysis and crop recommendations, highlighting its ability to improve agricultural productivity and the environment. We showed that machine learning techniques may effectively evaluate complicated soil qualities and environmental conditions, resulting in accurate predictions of crop compatibility, by combining the latest developments in data-driven techniques. The use of various machine learning algorithms, including decision trees, logistic regression, and random forest, has shown positive results in customizing crop suggestions predicated on distinct soil attributes and environmental conditions. In addition to giving farmers accurate and useful information, this supports resource conservation and supports environmentally friendly farming methods.

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FACE RECOGNITION FOR CRIMINAL DETECTION

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Abstract:

As everyone knows, a person's face is one of the most distinctive and important physical features that helps to identify them. Consequently, we can utilize it to track out a criminal's identification. Thanks to technological advancements, CCTV is now installed in many public areas to record illegal activity. The criminal face recognition system can be put into use by using the previously taken pictures of the criminals and their faces that are kept on file at the police station. In order to improve and upgrade the criminal differentiating process into a more effective and efficient manner, we present in this paper an automatic criminal identification system for Police Departments. By automating duties, this approach will use technology to improve the current system and raise the bar for identifying offenders. Face recognition technology will be the driving force behind it; using CCTV footage, our system will identify faces and identify the criminals entering that public area. The person's photos that were taken at that public location are compared to the criminal information that is stored in our database. If the face of any individual from a public area matches, the system will show that person's image on the screen and notify the user that the criminal has been located and is present in this public place along with their name. Over 80% of the collected images are matched by this method.

Keywords: Face Detection, Face Recognition, Open-CV, Image Processing, Crime Detection.

Introduction:

The most crucial and time-consuming activity for police searching for criminals is criminal identification, which is also the most challenging because it must be done everywhere. Cities and other public areas with a high population density will provide greater challenges. Manual identification methods occasionally provide additional information about offenders. Thus, by identifying offenders' faces, this article suggests an automated criminal identification method. This will assist law enforcement in locating and apprehending offenders in public areas.

There are two methods for criminal identification, as depicted in figure 1. When using the Manual Identification System (MIS), police officers conduct searches on people in public areas to identify them. It takes a long time to provide the right care, and there's a danger that criminals won't get the attention they need since they'll be aware that police officers can flee the scene with ease. Since the MIS is taking longer than expected, we won't be able to adequately attend to everyone. However, using an automatic identification system (AIS) in a public setting eliminates the requirement for surveillance. Here, every step in the system's operation is automated.

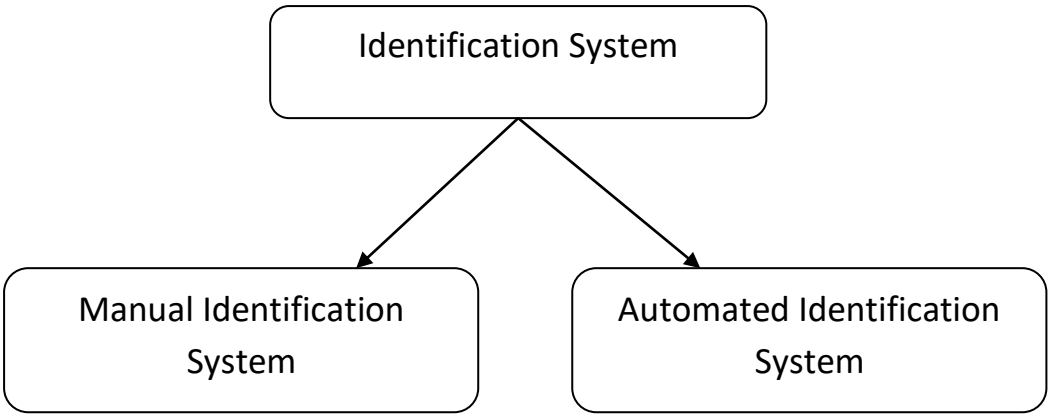

Fig. 1: Types of Identification System

Automated Criminal identification monitoring system's some important things shown below: 1

- Criminal Enrolment: To enable us to compare the collected photographs with database one, criminal images tagged with their names are uploaded to the criminal database.
- CCTV Connection: CCTV Cameras must to be linked to the platform that we are conducting an criminal information source and application where we are running.
- Criminal Identification: If a person is located using this system in a public setting, use the dedicated desktop folder to identify the offender.

Usability-

Using Open-CV

The Open-Source Computer Vision Library is called Open-CV. There are more than 2,500 books in the library. optimized algorithms, such as cutting-edge computer vision and robotic acquiring knowledge about methods. It also features C++. Interfaces in Java, MATLAB, and Python which work with Android, Linux, and Windows as well as Mac OS. For both business and non- Open-CV is free to use, yet commercial. ajar CV is utilized to take pictures and videos in open spaces.

Face Detection

Taking pictures of the faces of those who are willing to stand in front of the camera is the main purpose of this phase. Patches containing every face in the input image are the outputs of this stage. to create the ideal and best facial recognition system possible. Face alignment is conducted to justify the scales and orientation of these patches. Human face patches are extracted as the next stage following face detection

Recognition of Faces

One technique for determining or confirming someone's identification is face recognition. with their countenance. The action that follows the the identification of faces through representation. In substantial contrast between the identified facial image using the photos that are stored in our database. according to face encodings. A technique for recognising faces maps expressions on a face in a picture or video biometric methods. To locate matched known faces, it contrasts the information from the database with a repository. Recognition of faces could help

with the recognition of an individual's identity, but it also raises questions about privacy. Business Applications make use of both facial recognition and It serves a multitude of functions, including from promotions to security.

Literature Review:

1. The authors of this study used CCTV footage to their advantage, comparing the photos with those of criminal database in the event that no fingerprints were found. from the location of the crime. This framework is made up of five phases, with planning being the first that the rationale and construction of the system are talked about. The subsequent phase of Need examination talked about the prerequisite for system design.
2. The four steps in this paper are as follows: the first is real-time picture training, and the second uses a Harr-classifier to recognize faces. Comparing photos from surveillance cameras with images taken in real time is the third phase. The final step is the section that presents the findings from the comparison. One of the face detection techniques, Haar-cascading, is being used by the authors using Open-CV's Haar-classifier. They also mentioned using Adhar database we can easily identify the Indians and foreigners and further can investigate whether a person is a criminal or not.
3. In this article, they are determining whether or not the traveler is an approved passport holder by using the Passport database. Both the LBPH mathematical model and image processing techniques are being used in this. The six steps in this procedure are for airport security purposes and are as follows: a) Use a webcam to capture an image b) Send the captured image to the Django server c) Extract the image's feature set using LBPH d) Use a classifier to match the extracted image with the database image e) If the matching is successful, user details are retrieved from the database f) The admin receives a mail with the anticipated user details.
4. In this paper, the authors had discussed that an attendance monitoring system is very important in the teaching and learning process. The student who is entering in classroom his/her image is captured. Preprocessing and Face region extraction take place using that captured image for further process. They are using a face recognition algorithm for marking present if the student came to school or absent if the student is not coming to school. They are capturing the student’s image using a camera and after preprocessing comparing with their student database and marking attendance.
5. This paper's authors are introducing an automated facial recognition system for tracking attendance. They are employing a camera to take pictures of faces, and then they compare those pictures to ones that are already in their database. With an SVM classifier for name detection and a gradient-oriented histogram for face detection, they are utilizing machine learning technology. They are utilizing Tkinter to create a graphical user interface (GUI), Numpy to work with arrays because those are Python tools, and open-CV for image detection and recognition. The accuracy of the suggested model is 99.38%. The system's viability can be raised by using the cloud.

Proposed Work

CCTV cameras that are always in operation in a public setting are used in this article. We have already stored criminals' picture data in the database during system implementation, together with their names on the photos. In order to extract features from those images, we are processing them and use Pickle to save the face encodings of the current images into a single file. Using open-CV to capture CCTV footage, face encodings are taken, and the captured images are compared with our saved face encodings of the criminal database. If a match is found, an image of the criminal with the matching face is displayed on screen along with a message containing his name. The captured image of the criminal is then saved into a special folder, and police are dispatched to apprehend him from the public place, even if he was previously captured on camera. Police will be able to identify the person whose image was matched with one that was caught since we have saved that person's photo in a specific folder.

Conclusion:

In addition to offering the police great convenience in identifying criminals, this enhanced version of the criminal detection system also saves them time because it automates certain tasks. This research paper is innovative in that it uses facial encodings for face detection. For future work, We can incorporate the Alarms into the criminal detection system for further projects. It will only range when matches are discovered, letting everyone who isn't watching in the CCTV room know that someone was located in that public area using the database.

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A STUDY ON USE OF SMART PHONES FOR ACADEMIC PURPOSE BY COLLEGE STUDENTS

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Introduction:

The proliferation of smartphones has revolutionized various facets of modern life, including education. As multifunctional devices, smartphones offer a plethora of tools and resources that can significantly enhance learning experiences. For undergraduate students, in particular, smartphones have become indispensable tools in their academic endeavors. The integration of smartphones in education provides unparalleled access to information, facilitating immediate research and enabling students to stay abreast of the latest developments in their fields of study.

Through various applications, students can access textbooks, academic journals, and articles, making the search for information streamlined and efficient.

Moreover, smartphones support various educational apps that cater to different learning needs, such as organization, time management, and collaboration. With the seamless integration of scheduling apps, task managers, and reminders, students can better organize their academic responsibilities, thereby improving productivity and reducing stress. Collaboration is also facilitated through numerous communication apps, enabling real-time discussions with peers and educators, both within and outside the classroom.

Virtual study groups and online forums further enhance collaborative learning, making it easier to engage with course materials and solve complex problems collectively.

In addition to these practical applications, the use of smartphones promotes a more interactive learning environment. Combining multimedia elements such as videos, interactive quizzes, and educational games, smartphones cater to diverse learning styles, making education more engaging and effective. As technology continues to advance, the role of smartphones in education is likely to expand, offering even more opportunities for enhancing academic performance and fostering a deeper understanding of course content.

Methodology of the study

The methodology for this study on the use of smartphones for academic purposes by undergraduate students involved a combination of quantitative and qualitative research approaches. A stratified random sampling technique was employed to ensure representation across different academic years and disciplines. Data collection was performed through a structured online questionnaire and semi-structured interviews to capture comprehensive insights.

The online questionnaire, consisting of both closed and open-ended questions, was designed to quantify the extent of smartphone usage for academic purposes and identify patterns in student behavior. Questions covered various aspects including frequency of use, types of academic activities performed on smartphones, perceived benefits, and challenges encountered. The questionnaire was pilot tested with a small group of students to ensure clarity and reliability, and modifications were made based on their feedback.

To complement the quantitative data, semi-structured interviews were conducted with a purposive sample of students who demonstrated high levels of smartphone use for academic tasks. These interviews aimed to delve deeper into the motivations, experiences, and nuanced perspectives of the students. Additionally, the qualitative data enriched the understanding of trends observed in the survey responses.

Data analysis employed descriptive statistics for the questionnaire responses and thematic analysis for the interview transcripts. This mixed-method approach provided a robust and multi-faceted understanding of how smartphones are integrated into the academic lives of undergraduate students. The study adhered to ethical standards of research, ensuring participant confidentiality and informed consent.

Patterns of Smartphone Usage Among Undergraduates

Undergraduate students demonstrate diverse patterns of smartphone usage for academic purposes, reflecting the interplay between technological integration and learning habits. A significant portion of students use their smartphones for accessing educational resources such as e-books, research articles, and online databases. This on-the-go accessibility is particularly beneficial for students with tight schedules, allowing them to engage with course materials during transit or short breaks.

Moreover, smartphones serve as a convenient tool for managing academic schedules through calendar apps, reminders, and organizational tools that help students keep track of assignments, exams, and deadlines.

Communication through smartphones is another dominant pattern, with students frequently utilizing email, instant messaging, and social media platforms to collaborate on group projects, discuss class materials, and seek help from peers and professors. Educational applications and online learning platforms have also found their place among undergraduates, who often use these apps for supplementary learning, quizzes, and interactive modules that reinforce classroom instruction.

However, the patterns of use are not exclusively beneficial. Many students report that smartphones serve as a source of distraction, with non-academic apps like social media, games, and entertainment content competing for their attention. This dual nature of smartphone use highlights the necessity for self-regulation and the development of effective strategies to maximize their academic potential while minimizing distractions. Overall, smartphones have become indispensable in the academic lives of undergraduates, integral for both accessing information and facilitating communication.

Impact of Smartphones on Academic Performance

The impact of smartphones on the academic performance of undergraduate students is a multifaceted issue shaped by both positive and negative influences. On one hand, smartphones are powerful tools that provide students with instant access to a vast array of educational resources and applications. These devices enable quick searches for information, participation in online courses, and access to academic papers, e-books, and other scholarly materials.

Features such as calendars, reminders, and academic apps help students stay organized and manage their time effectively. Additionally, smartphones facilitate communication and collaboration among peers and professors, allowing for easy sharing of notes, discussion of assignments, and group project coordination.

However, the use of smartphones for academic purposes is not without its drawbacks. The presence of social media, games, and other entertainment apps on the same devices can lead to significant distractions. Students may find it challenging to concentrate on their studies when constantly bombarded with notifications and the lure of entertainment. Prolonged use of smartphones can also contribute to issues such as sleep deprivation and reduced physical activity, both of which can negatively affect academic performance.

Empirical studies on the subject reveal a complex picture, with the impact of smartphone use on academic performance largely dependent on how students manage their time and resist distractions. While smartphones can enhance learning and productivity, their potential for misuse necessitates that students exercise self-discipline and adopt strategies to mitigate distractions.

Challenges and Limitations of Smartphone Use in Academics

While smartphones hold considerable promise for enhancing the academic experiences of undergraduate students, they also come with a series of challenges and limitations that can potentially hinder their efficacy. One of the most significant challenges is the issue of distraction. The multifaceted functionalities of smartphones, ranging from social media to gaming and entertainment apps, can significantly divert students' attention away from their academic tasks. This constant influx of notifications and alerts can fragment students' focus, thereby reducing their efficiency and overall academic performance.

Moreover, the reliance on smartphones can exacerbate issues of digital equity. Not all students have access to high-quality smartphones with the necessary specifications to run educational apps efficiently. This disparity can lead to a digital divide, where economically disadvantaged students are marginalized and unable to benefit equally from mobile learning resources. Additionally, the small screen size of smartphones can make it difficult to read lengthy texts, view detailed diagrams, or complete complex assignments that might be more easily managed on larger devices like tablets or computers.

Furthermore, the continuous use of smartphones for academic purposes can contribute to physical health issues such as eye strain, neck pain, and poor posture. Prolonged screen time can also lead to mental fatigue, thereby affecting cognitive performance and overall well-being. Lastly, data privacy concerns also emerge with the use of mobile apps and platforms, as many

students may not be fully aware of the permissions they grant or the ways their personal information could be exploited. These various challenges must be addressed to fully integrate smartphones as effective tools for academic purposes.

Recommendations and Future Research Directions

Based on the findings of the study on the use of smartphones for academic purposes by undergraduate students, several recommendations can be made to enhance their academic experience and outcomes. Firstly, educational institutions should promote the integration of smartphone technology into their teaching practices. This can include the incorporation of apps designed for academic purposes, and effective online resources, to engage students more dynamically in their learning processes.

Teachers and administrators should also receive training on how to utilize these tools effectively to complement traditional teaching methods.

Moreover, universities should consider providing workshops or seminars for students that focus on optimizing the use of smartphones for academic work. These sessions can cover topics such as effective time management, digital note-taking, and leveraging productivity apps that can aid in their studies. It is also crucial to establish guidelines that differentiate between productive smartphone use and potential distractions to help students maintain focus during academic activities.

Looking ahead, future research should investigate the long-term impacts of smartphone use on students' academic performance and mental well-being. Studies could explore the differences in academic outcomes between students who use smartphones primarily for educational purposes versus those who use them for recreational activities. Additionally, examining the role of socioeconomic factors in access to advanced smartphone technology and its correlation with academic success could provide deeper insights.

By addressing these areas, further research could offer more comprehensive strategies for integrating smartphones into academia, ensuring that technological advancements translate into tangible educational benefits.

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The Scientific Spectrum: Theory, Application and Innovation

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