

Biofertilizers

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Introduction:

Biofertilizers: Biofertilizers are living microorganisms that enhance plant growth by increasing the supply or availability of essential nutrients through natural processes such as nitrogen fixation, phosphate solubilization, and the stimulation of plant growth through the synthesis of growth-promoting substances. As eco-friendly alternatives to chemical fertilizers, biofertilizers are essential for sustainable agriculture. This article explores the types, mechanisms, applications, advantages, and challenges of biofertilizers, with special emphasis on their role in soil health and integrated nutrient management.

The intensification of agriculture to meet global food demand has led to overreliance on chemical fertilizers, resulting in soil degradation, environmental pollution, and declining soil microbial biodiversity. As the world pivots towards sustainability, biofertilizers have emerged as a viable, eco-friendly solution for enhancing soil fertility

and crop productivity without compromising environmental integrity. Biofertilizers, consisting of beneficial microorganisms, help mobilize nutrients from the soil or atmosphere, improving plant health while maintaining long-term soil quality. Their use aligns with the principles of organic farming, integrated nutrient management (INM), and sustainable agriculture. According to the **Indian Council of Agricultural Research (ICAR)**, biofertilizers are "products containing living or latent cells of efficient strains of microorganisms that help crop plants' uptake of nutrients by their interactions in the rhizosphere when applied through seed or soil."

Types of Biofertilizers: Biofertilizers are broadly categorized based on the **type of microorganism** and the **nutrient** they mobilize or fix.

1. Nitrogen-Fixing Biofertilizers: These microorganisms fix atmospheric nitrogen into forms usable by plants.

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Gucchi Mushroom

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Introduction:

Gucchi Mushroom: *Gucchi* mushrooms, belonging to the genus *Morchella*, are considered a **culinary delicacy** and **nutraceutical treasure** in many parts of the world. In India, they are found in the wild across Jammu and Kashmir, Himachal Pradesh, Uttarakhand, and parts of the Northeast, particularly in forested and alpine regions between 1,500 and 3,000 meters above sea level. Despite their high market demand and price (ranging from ₹20,000 to ₹40,000 per kilogram dried), *gucchi* mushrooms remain underutilized due to a lack of scientific cultivation techniques and over-reliance on wild harvesting. Their seasonal availability, ecological sensitivity, and difficulty in identification further complicate their widespread usage and conservation. *Gucchi* mushrooms are **mycorrhizal** and **saprotrophic**, growing in association with forest trees or decaying organic matter.

Taxonomy and Botanical Description:

Kingdom: Fungi

Phylum: Ascomycota

Class: Pezizomycetes

Order: Pezizales

Family: Morchellaceae

Genus: *Morchella*

Common species in India: *Morchella*

esculenta, *M. conica*, *M. deliciosa*, *M. angusticeps*

Morphology:

- ❖ **Cap:** Conical or ovoid with ridges and pits (resembles a honeycomb), yellowish-brown to dark brown.
- ❖ **Stipe (stalk):** Pale, hollow, and attached to the cap at the base.
- ❖ **Spores:** Produced in asci within the pits of the cap.

Habitat and Distribution: Geographical Distribution in India

1. **Jammu & Kashmir:** Kupwara, Shopian, Anantnag, Kishtwar
2. **Himachal Pradesh:** Kullu, Chamba, Lahaul-Spiti.

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Keeda Jadi

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Introduction:

Keeda Jadi, scientifically known as *Cordyceps sinensis* and popularly referred to as Yarsagumba in the Himalayan region, is a rare and valuable entomopathogenic fungus that parasitizes the larvae of ghost moths. Revered in traditional Chinese and Tibetan medicine for its therapeutic benefits, it is often dubbed the "Himalayan Viagra" or "soft gold" due to its high medicinal value and market price. This article explores the biology, ecology, distribution, harvesting practices, medicinal uses, economic significance, conservation issues, and cultivation prospects of Keeda Jadi, highlighting its role in Himalayan livelihoods and global nutraceutical markets. Keeda Jadi (literally "insect herb" in Hindi) is a unique fungus-insect complex that has fascinated scientists, traders, and traditional healers for centuries. It is the fruiting body of a parasitic fungus, *Ophiocordyceps sinensis*, which infects and mummifies the larvae of ghost moths (*Thitarodes* spp.) and sprouts a club-like stalk

from the corpse. Primarily found in the alpine grasslands of the Himalayas, particularly in Nepal, Bhutan, India, and Tibet (China), Keeda Jadi is harvested annually between May and July and commands an astronomical price of ₹10–20 lakh per kilogram in international markets. With increasing demand and declining availability, concerns about sustainability, conservation, and ethical harvesting have emerged.

Taxonomy and Biological Identity:

- a) **Kingdom:** Fungi
- b) **Phylum:** Ascomycota
- c) **Class:** Sordariomycetes
- d) **Order:** Hypocreales
- e) **Family:** Ophiocordycipitaceae
- f) **Genus:** *Ophiocordyceps*
- g) **Species:** *Ophiocordyceps sinensis* (formerly *Cordyceps sinensis*)

Life Cycle:

1. The fungus infects larvae of ghost moths in the soil.
2. It consumes the host from within,

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Biopesticides

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Introduction:

Biopesticides: Biopesticides are substances derived from natural materials like animals, plants, bacteria, and certain minerals that are used to control pests. Unlike conventional chemical pesticides, biopesticides are generally target-specific, biodegradable, and less harmful to beneficial organisms and the environment. Biopesticides have emerged as a promising alternative. Derived from natural sources such as plants, bacteria, fungi, and minerals, biopesticides offer environmentally friendly pest control options. They are often more specific in their action, biodegradable, and pose less risk to non-target organisms, including humans. Biopesticides can be broadly classified into three categories: Microbial Pesticides, Botanical Pesticides and Biochemical Pesticides.

1. Microbial Pesticides: Microbial pesticides are based on microorganisms such as bacteria, fungi, viruses, and protozoa. These microorganisms either infect the

pest directly or produce toxins that harm the pest.

- a. Bacterial Biopesticides:** The most well-known microbial biopesticide is *Bacillus thuringiensis* (Bt). Bt produces crystalline toxins that are lethal to specific insect larvae when ingested. Bt-based products have been used extensively against caterpillar pests in crops such as cotton, corn, and soybeans.
- b. Fungal Biopesticides:** Entomopathogenic fungi like *Beauveria bassiana*, *Metarhizium anisopliae*, and *Trichoderma* species are effective against a wide range of insect pests and plant pathogens. These fungi infect their host through the cuticle and proliferate within, leading to the insect's death.
- c. Viral Biopesticides:** Baculoviruses are commonly used viral biopesticides that infect specific insects, such as caterpillars. These viruses are highly host-specific, making them safe for beneficial insects,

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Hi-Tech Horticulture

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Introduction:

Hi-Tech Horticulture: Horticulture plays a crucial role in enhancing agricultural income, nutritional security, and employment generation. However, conventional horticulture practices often suffer from low productivity, high input costs, post-harvest losses, and climate vulnerability. Hi-tech horticulture refers to the application of advanced technologies and scientific practices to the cultivation, post-harvest handling, and marketing of horticultural crops such as fruits, vegetables, flowers, and medicinal plants. This includes innovations like protected cultivation, micro-irrigation, fertigation, tissue culture, precision farming, and digital agriculture. As India and the world face growing challenges from climate change, population pressure, and food insecurity, hi-tech horticulture offers sustainable solutions by improving productivity, profitability, and resource-use efficiency. Hi-tech horticulture includes a range of technological interventions designed to improve crop production efficiency, ensure

high quality, extend shelf life, and access domestic and international markets. This system is knowledge-intensive and capital-intensive but offers high returns.

Components of Hi-Tech Horticulture: Hi-tech horticulture integrates various modern technologies across the entire horticultural value chain. The main components include:

- 1. Protected Cultivation:** Protected cultivation involves growing horticultural crops in controlled environments such as greenhouses, polyhouses, net houses, and tunnels. This protects plants from adverse weather, pests, and diseases and allows off-season production of high-value crops like capsicum, tomato, strawberry, and gerbera.
- 2. Micro-Irrigation and Fertigation:** Drip and sprinkler irrigation systems deliver water and nutrients directly to the root zone, enhancing water and fertilizer use efficiency. Fertigation—the application of fertilizers through irrigation—is a core

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Robotics in Agriculture

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Introduction:

Agriculture has been the cornerstone of human civilization for thousands of years. As the global population continues to rise—projected to reach nearly 10 billion by 2050—the demand for food is increasing exponentially. At the same time, the agricultural industry is facing serious challenges: labor shortages, climate change, shrinking arable land, and the pressure to reduce environmental impacts. In response, robotics in agriculture is emerging as a key solution to meet these challenges by revolutionizing how farming is conducted. Robotics in agriculture involves the use of automated machines and intelligent systems to perform agricultural tasks such as planting, harvesting, irrigation, pest control, and crop monitoring. These technologies are enhancing productivity, reducing labor dependency, and enabling more sustainable farming practices. The integration of machinery in agriculture is not new. The mechanization of farming began in the 19th century with the invention of

tractors and harvesters. However, the current wave—referred to as **Agriculture 4.0**—goes beyond mechanization to embrace artificial intelligence (AI), machine learning (ML), computer vision, GPS, and Internet of Things (IoT). These technologies are embedded in modern robotic systems, enabling them to **perceive, decide, and act** autonomously in complex agricultural environments.

Types of Agricultural Robots:

Agricultural robots are designed to perform specific tasks. Some of the most common types include: **1. Autonomous Tractors:** These driverless tractors can navigate fields using GPS and sensors. They plow, till, and sow with high precision, reducing the need for human operators. **2. Planting and Seeding Robots:** These robots automate the sowing process with precision planting technologies, ensuring optimal spacing and seed depth, which improves germination rates and crop yields. **3. Weeding Robots:** Equipped with AI and computer vision, these robots distinguish

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Drones in Agriculture

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Introduction:

Agriculture has always adapted to changing technologies, from animal-drawn ploughs to tractors and satellite imagery. Today, with increasing challenges such as climate variability, rising input costs, labor shortages, and food security concerns, the agricultural sector is rapidly turning to **smart farming** technologies. One such innovation is the use of **drones**—unmanned flying machines that can capture data, spray inputs, and monitor field conditions with speed and accuracy. The use of drones in agriculture is a key aspect of **Precision Agriculture (PA)**. They enable site-specific interventions, thus enhancing productivity, conserving resources, and reducing environmental impact.

What Are Drones? Drones are unmanned aircraft that can fly autonomously or be remotely controlled, typically equipped with cameras, sensors, GPS, and data processing tools.

Types of Agricultural Drones:

1. **Fixed-Wing Drones:** Have a single

rigid wing and fly like airplanes. Suitable for large-area coverage and longer flight durations.

2. **Rotary-Wing Drones (Multirotors):**

Includes quadcopters, hexacopters, and octocopters. Ideal for hovering, vertical take-off and landing, and detailed field inspections.

3. **Hybrid Drones:** Combine features of both fixed-wing and rotary-wing drones for versatility.

Key Components of Agricultural Drones:

1. **GPS Modules:** For navigation and geotagging.

2. **Cameras and Sensors:** RGB, multispectral, thermal, and hyperspectral for imaging and analysis.

3. **Spray Tanks and Nozzles:** For pesticide, fertilizer, or liquid application.

4. **Software and Controllers:** For flight planning, mission execution, and data processing.

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Modern Irrigation Practices for Water-Smart AgriculturePardeep Kumar¹, Ratnakiran D. Wankhade* and Riya Jakhwal³**Abstract: -**

Water scarcity poses a serious challenge to Indian agriculture, especially in arid and semi-arid regions. Modern irrigation practices like drip and sprinkler systems, mulching, and rainwater harvesting have emerged as reliable, farmer-friendly methods to ensure water-efficient farming. This article focuses on the adoption and benefits of these techniques, including their suitability for different crops and soil types. Case studies of farmers successfully implementing micro-irrigation systems are included, highlighting water savings and increased productivity. The article also covers government schemes promoting modern irrigation and provides practical guidance for their field-level adoption.

Introduction:

Water is the most critical input in agriculture, directly impacting plant growth, soil health, and crop yields. In India, nearly 60% of cultivated land is rainfed, and even irrigated areas often face water scarcity due to declining groundwater levels, inefficient irrigation practices, and unpredictable rainfall patterns. Traditional flood irrigation results in over 50% water wastage through evaporation and runoff.

In this scenario, **modern, water-efficient irrigation practices** are essential to

enhance water productivity, increase crop yields, and ensure the sustainable use of water resources. This article provides field-level, farmer-friendly irrigation methods that conserve water, reduce input costs, and improve farm income.

Problems with Conventional Irrigation

- ☞ Excessive water wastage
- ☞ Soil erosion and water logging
- ☞ Nutrient leaching
- ☞ High cost of irrigation pumps and fuel
- ☞ Salinity build-up in poorly drained

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Application of Biofertilizers and Biopesticides in Organic FarmingPardeep Kumar¹, Riya Jakhwal***Abstract: -**

Biofertilizers and biopesticides play a vital role in organic farming by improving soil fertility and managing pests without chemical residues. This article describes various bio-inputs like Rhizobium, Azotobacter, PSB, Trichoderma, and neem-based products that farmers can easily produce or procure. Application methods, dosages, and crop-wise recommendations are detailed. The practical benefits of reduced input costs, soil health enhancement, and eco-friendly crop protection are emphasized. Case studies of farmers successfully adopting organic techniques using biofertilizers and biopesticides demonstrate their field-level effectiveness.

Introduction:

In Indian agriculture, rising soil health issues, declining crop productivity, and increasing input costs have forced farmers to look for reliable, sustainable, and low-cost alternatives to chemical fertilizers and pesticides. Organic farming, once a traditional practice, is making a strong comeback as a modern, eco-friendly, and profitable farming system. The success of organic farming, however, depends on timely nutrient supply and effective pest and disease management without using harmful chemicals. This is

where biofertilizers and biopesticides have proven their worth.

Biofertilizers are natural, living microbial products that enhance the nutrient availability in soil, making them easily absorbable by plants. Similarly, biopesticides are nature-derived pest and disease control agents that safely protect crops without damaging soil fertility or harming humans and beneficial organisms. Their combined use not only improves soil fertility but also helps produce chemical-free, healthy, and market-attractive crops. This article aims to explain

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Biochar for Sustainable Soil Health

Pardeep Kumar¹, Riya Jakhwal*

Abstract:

The continuous degradation of soil due to excessive chemical use, declining organic matter, and unsustainable farming practices poses a significant challenge to Indian agriculture. Biochar, a carbon-rich by-product of biomass pyrolysis, offers a low-cost, farmer-friendly solution to restore soil health, enhance crop yields, and build climate resilience. This article explores the potential of biochar as a soil amendment, highlighting its benefits such as improved water retention, nutrient availability, microbial activity, and carbon sequestration. It also outlines practical on-farm biochar production and application methods suitable for small and marginal farmers. By integrating biochar into existing organic and natural farming systems, India can move towards a more sustainable and economically viable agricultural future.

Introduction:

In recent years, Indian farmers have faced growing challenges in maintaining soil fertility and crop productivity. Continuous cropping, excessive chemical input use, and declining organic matter levels have led to widespread soil degradation. The rising cost of fertilizers and declining soil health has made sustainable soil management a pressing need for farmers, especially those with small and marginal landholdings. Among various natural soil amendments, **biochar** has emerged as a promising, low-cost, and eco-friendly option

that can be easily produced on farms and applied to fields to improve soil fertility, enhance crop yields, and restore degraded soils.

This article explores the concept of biochar, its benefits for soil health and farming profitability, its preparation methods suitable for Indian farmers, and practical ways it can be integrated into existing farm practices.

What is Biochar?

Biochar is a stable, carbon-rich product obtained by heating organic materials such as

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Protected Farming for Off-Season Crop ProfitabilityPardeep Kumar¹, Riya Jakhwal***Abstract:**

Protected cultivation, involving the use of polyhouses, shade nets, and low tunnels, offers an opportunity for farmers to grow off-season, high-value horticultural crops. This article presents practical information on designing low-cost protected structures, suitable crop varieties, and management practices for smallholder farmers. It discusses the advantages of protected cultivation in improving crop quality, protecting against pests and extreme weather, and enhancing profitability. Successful case examples of farmers cultivating vegetables and flowers under protected conditions are shared to inspire wider adoption at the village and peri-urban levels.

Introduction:

Farming today is full of uncertainties, whether it's sudden rain, hailstorms, or pest infestations. Traditional open-field vegetable and flower cultivation is risky because these crops are delicate and sensitive to changing weather and insects. Many farmers have lost their standing crops to unexpected weather and heavy pest attacks just days before harvest.

To tackle this, protected cultivation has become an excellent way for farmers to safeguard their crops and grow off-season vegetables and flowers for better prices. In

simple terms, protected cultivation means growing crops under covers made of plastic sheets, green shade nets, or insect-proof nets to control temperature, light, moisture, and insect attacks. These structures can be small or big depending on the farmer's need and investment capacity.

What is Protected Cultivation?

Protected cultivation involves growing crops inside specially designed structures that control the surrounding environment. These structures help maintain favorable conditions

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Soil Health Management Techniques for Sustainable YieldsPardeep Kumar¹, Riya Jakhwal***Abstract: -**

Healthy soil is the foundation of sustainable agriculture and food security. Continuous use of chemical fertilizers and poor soil management practices has led to declining soil fertility and imbalanced nutrient availability. This article discusses practical soil health management techniques such as green manuring, vermicomposting, crop rotation, residue incorporation, and balanced fertilization. Special emphasis is placed on biofertilizers and organic amendments as cost-effective solutions for farmers. The use of soil health cards for precise nutrient application and sustainable tillage practices for preserving soil structure are also covered. These field-level techniques enhance soil productivity, improve crop yields, and support long-term agricultural sustainability.

Introduction:

Soil is the lifeline of agriculture. A healthy soil supports high crop yields, sustains soil biodiversity, retains water efficiently, and resists pests and diseases naturally. However, continuous cropping, excessive use of chemical fertilizers, imbalanced nutrient application, and declining organic matter have severely affected soil health in many parts of India. This has led to reduced soil fertility, poor crop productivity, and increased production costs for farmers.

Farmers often overlook soil health and focus only on crops — but restoring and maintaining soil fertility is the most economical, sustainable, and risk-proof method to ensure long-term farm profitability. This article presents practical, farmer-friendly, and low-cost soil health management practices that can be adopted at the field level for sustainable, profitable agriculture.

What is Soil Health?

Soil health refers to the capacity of soil to function as a living ecosystem that sustains

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Indigenous Livestock Management for Sustainable Soil Fertility and Farm Profitability

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Abstract: -

Indigenous livestock management practices play a crucial role in promoting sustainable soil fertility and enhancing farm profitability, particularly in smallholder and low-input systems. Rooted in traditional knowledge, these practices—including manure recycling, controlled grazing, and the use of native breeds—support nutrient cycling, soil health, and ecological balance. This review highlights their environmental and economic benefits, while also addressing current challenges such as policy neglect and erosion of indigenous knowledge. Recognizing and integrating these time-tested approaches into modern farming systems can contribute significantly to climate-resilient and sustainable agriculture.

Introduction:

Indian farming traditions have long upheld the value of livestock as an inseparable part of agriculture. Particularly, indigenous livestock breeds such as Sahiwal, Gir, Tharparkar cows, Murrah buffaloes, and Jamunapari goats have served as sources of milk, draught power, and natural manure to keep the soil fertile. However, in the modern era of chemical-based farming and exotic breed introduction, this ecological and economic synergy was disrupted, resulting in soil fertility decline, rising input costs, and loss

of livelihood security for small farmers.

Now, as farmers grapple with poor soil health, high fertilizer expenses, and climate instability, integrating scientifically managed indigenous livestock with systematic soil fertility practices is emerging as a sustainable, profitable, and climate-resilient solution. This article offers a complete, farmer-friendly guide to adopting this integrated system successfully.

Why Indigenous Livestock Breeds Matter to Farmers

Indigenous livestock are naturally

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ICT Tools

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Introduction:

ICT tools are technologies that provide access to information through telecommunications. These include the internet, wireless networks, mobile phones, computers, software, digital platforms, and satellite systems. The integration of ICT tools in sectors like agriculture, education, healthcare, and governance has enabled unprecedented transformations in both rural and urban settings. In agriculture, ICT is essential for climate-smart farming, market access, extension services, and resource management. In education, ICT facilitates e-learning, online assessment, smart classrooms, and digital content creation.

The adoption of ICT tools aligns with the goals of Digital India, Sustainable Development Goals (SDGs), and global digital transformation strategies.

Definition and Components of ICT:

According to UNESCO (2015), Information and Communication Technologies (ICTs) are a diverse set of technological tools and resources used to transmit, store, create, share or exchange information.

Major Components of ICT Tools:

- 1. Hardware:** Computers, tablets, mobile phones, GPS devices, servers
- 2. Software:** Data management systems, mobile apps, learning management systems

Classification of ICT Tools:

Category	Examples
Communication Tools	Mobile phones, SMS, email, social media
Data Management Tools	GIS, MIS, databases, cloud platforms
Decision Support Systems	AI, machine learning, expert systems
Educational Tools	Learning Management Systems (LMS), MOOC platforms
Monitoring Tools	IoT sensors, remote sensing, drones
Interactive Tools	Video conferencing, webinars, AR/VR, interactive whiteboards

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Vertical Gardening

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Urbanization has drastically altered landscapes around the globe, leading to reduced green spaces, increased pollution, and a host of ecological challenges. Vertical gardening emerges as an ecologically sound, space-efficient, and visually appealing method of reintroducing greenery into cities. By transforming barren walls and urban structures into vibrant gardens, vertical gardening combines architecture and horticulture to create green oases in the concrete jungle. The concept has gained momentum in residential spaces, commercial buildings, schools, hospitals, and public infrastructure due to its adaptability and environmental benefits. As cities expand and population density increases, available land for traditional gardening becomes scarce. In this context, vertical gardening, also known as living walls or green walls, offers an innovative and sustainable solution to urban greening. Vertical gardening is the practice of growing plants on vertical surfaces using structures like trellises, containers, hydroponic systems, or modular panels. Beyond its aesthetic appeal, vertical gardening improves air quality, reduces heat, conserves space, and promotes mental well-being. This article explores the history, types, techniques, benefits, challenges, and future prospects of vertical gardening, with an emphasis on its role in urban sustainability.

Historical Background: Although often seen as a modern concept, vertical gardening has deep historical roots: 1. **Babylon's Hanging Gardens** (600 BCE): One of the Seven Wonders of the Ancient World, featured tiered gardens growing vertically. 2. **Ancient Mediterranean Vines:** Cultures across Italy, Greece, and Egypt used vertical structures to support grapevines and climbing plants. 3. **Asian Courtyards and Temples:** Ivy, bamboo, and climbing roses adorned walls in countries like China, Japan, and India. Modern vertical gardening evolved with technological advancements in hydroponics and architecture, with French botanist **Patrick Blanc** pioneering the contemporary green wall concept in the 1980s.

What is Vertical Gardening? - Vertical gardening involves growing plants upward rather than outward by using walls, panels, hanging structures, or trellises. It is ideal for small urban spaces where horizontal gardening is not feasible. It integrates Plant cultivation, Structural support, Irrigation and nutrient systems, Design aesthetics. Vertical gardens can be indoors or outdoors, and either soil-based, hydroponic, or aeroponic.

Types of Vertical Gardens: 1. **Trellis and Climbers:** One of the simplest vertical gardening methods where climbing plants (e.g., money plant, ivy, jasmine) grow on a wooden or metal trellis. 2. **Wall Planters and Pocket Panels:** Modular systems with fabric or plastic pockets



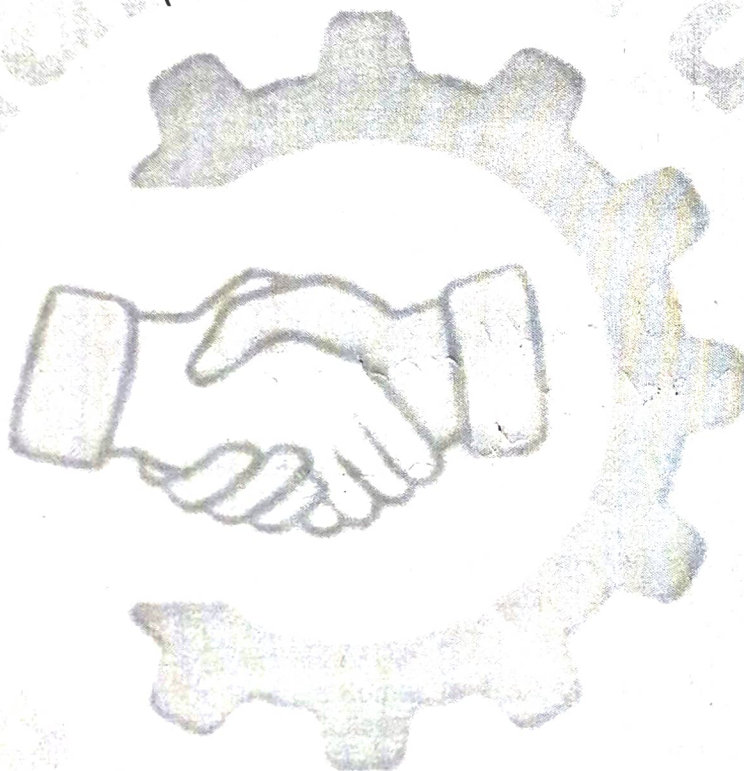
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COMPARATIVE STUDY OF DIGITAL ASSETS VS. TRADITIONAL FINANCIAL INSTRUMENTS (STOCKS, BONDS, GOLD)

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ABSTRACT

The rapid growth of digital assets—particularly cryptocurrencies, stablecoins, and tokenized assets—has significantly transformed global financial markets. Investors, institutions, and policymakers are increasingly evaluating whether digital assets can serve as alternatives or complements to traditional investment instruments such as stocks, bonds, and gold. This research paper provides a comparative study of digital assets and traditional financial instruments based on risk, return, liquidity, market behavior, volatility, regulatory environment, and long-term stability. The findings highlight that while digital assets offer high returns, global accessibility, and technological advantages, they carry substantial risks in terms of volatility, regulation, and systemic uncertainty. In comparison, traditional instruments remain more stable and widely accepted but generally deliver moderate returns. The study concludes that digital assets represent a growing but still maturing asset class, best suited as part of diversified portfolios rather than outright replacements for traditional instruments.

Keywords: Digital assets, Gold, Bonds, Stock, Portfolios, Instruments

1. Introduction

Financial markets have historically evolved in response to changes in technology, economic structures, and investor preferences. Traditional assets such as stocks, bonds, and gold have long served as foundational investment instruments—providing returns, security, and diversification options. However, over the past decade, digital assets have emerged as a significant new class of financial instruments. Cryptocurrencies such as Bitcoin, Ethereum, and stablecoins, along with digital tokens representing commodities or real-world assets, have attracted substantial global investment.

The rise of blockchain technology and decentralized financial systems (DeFi) has enabled new methods of value storage, transactions, and

investment. This shift raises fundamental questions: **How do digital assets compare to traditional financial instruments? Can they substitute or only complement traditional holdings? What risks and returns do they offer?**

This paper conducts a comparative study to understand the financial, economic, and structural differences between digital assets and established instruments like stocks, bonds, and gold. The comparison is based on key parameters such as volatility, liquidity, risk profile, return potential, regulatory frameworks, and investor perception.

2. Objectives of the Study

The primary objectives of this research include:

- i. To analyze the characteristics of digital

BRIDGING DATA SCIENCE AND FINANCIAL DECISION-MAKING: A HOLISTIC REVIEW OF ML/DL MODELS IN FINANCIAL SYSTEMS

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ABSTRACT

This paper provides a comprehensive, holistic review of machine learning (ML) and deep learning (DL) applications in financial systems. Covering major domains as credit risk assessment, asset pricing, cryptocurrency markets, and macroeconomic policy modelling. In this synthesis, methodological advances, data sources, evaluation strategies, and real-world deployments are discussed from both academic and industry literature. Research identifies recurring architectures (e.g., tree-based ensembles, feedforward and recurrent neural networks, attention mechanisms), common feature engineering practices, and evaluation pitfalls such as look-ahead bias and data leakage. The review highlights strengths of ML/DL nonlinear pattern recognition, automated feature extraction, and scalability while discussing limitations including model interpretability, regulatory constraints, and fairness concerns. It concludes by proposing a research agenda and practical recommendations for bridging model development and financial decision-making, emphasising transparent evaluation, robust back testing, interpretability augmentation, and domain-aligned objectives.

Keywords: Machine Learning, Deep Learning, Finance, Credit Risk, Asset Pricing, Cryptocurrency, Macroeconomic Modelling, Interpretability, Systematic Review

Introduction

The financial sector has undergone a profound transformation driven by the confluence of abundant data, computational advances, and innovative algorithms. Over the past decade, machine learning (ML) and deep learning (DL) techniques have transitioned from academic curiosities to operational tools used across banks, asset managers, fintech, and regulators. These methods promise the ability to detect complex, nonlinear relationships in data, automate feature

extraction from high-dimensional inputs (including text, images, and time series), and scale predictive and prescriptive analytics to new problem sizes. However, while the technical capabilities of ML/DL rapidly evolve, integrating these models into sound financial decision-making raises unique domain challenges—risk management, regulatory compliance, economic interpretation, and alignment with business objectives.

This review aims to bridge two communities: data scientists developing ML/DL models, and

INTELLECTUAL PROPERTY RIGHTS (IPR) AND ITS IMPORTANCE FOR E-COMMERCE

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ABSTRACT

Intellectual property rights refer to the property rights which are granted to an author or creator of a new invention or intangible asset. The concept of intellectual property was developed in the 18th century, with the first federal statute on patents being passed in 1790. Intellectual property rights are the legal protection granted to individuals who have invented something new or created something original that is capable of being physically reproduced or transmitted. The scope of intellectual property rights varies from country to country, but generally any form of expression that falls within the jurisdiction of copyright law and patent law is protected as intellectual property.

More than other business models, e-commerce frequently involves the sale of goods and services that are dependent on IP and its licensing. Through e-commerce, you may exchange things like software, designs, training materials, systems, and more, with the IP serving as the major source of value. Because valuable commodities traded online must be safeguarded by technological security measures and IP laws, or entire firms risk being ruined by theft or piracy. This paper studies the history of IPR, Its types and role of IPR in e-commerce. The protection for any creative work such as music, text, software code, graphic design etc. cannot be revoked by anyone at all as it is not owned by anyone in particular. IP rights protect intellectual property in a wide variety of ways, covering protection of inventions and designs, protection for data and software, as well as protection for literary material like books and films. IP plays a role in facilitating smoother E-Commerce transactions.

Keywords: IPR, E-commerce, Legal protection.

Introduction

Intellectual property (IP) is the term used to describe exclusive rights pertaining to creative works. Intangible assets including innovations, literary and artistic works, designs, phrases, symbols, and images can be protected under IP law. This protection is made possible by various IP rights, including patents, trademarks, designs, and copyright. These rights allow their owners to profit financially or gain recognition from their inventions

or creations. Electronic commerce, or simply E-commerce, is the practice of conducting business dealings online. Among them would be starting or running a business, trading products and services, or both, primarily online. E-commerce platforms like Amazon, Swiggy, Zomato, and others might serve as examples.

E-commerce often entails the sale of goods or services based on licensed intellectual property. Music, photos, graphics, software, content, and so

CORPORATE SOCIAL RESPONSIBILITY AND THE BANKING SECTOR : AN ANALYSIS OF ESG INTEGRATION AND FINANCIAL STABILITY

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ABSTRACT

This paper investigates the evolving relationship between Corporate Social Responsibility (CSR), specifically through the framework of Environmental, Social, and Governance (ESG) integration, and financial stability within the banking sector. Historically viewed as a peripheral “goodwill” activity, ESG has emerged as a core strategic component of risk management. This analysis synthesizes recent empirical evidence to demonstrate that robust ESG performance generally correlates with enhanced financial stability by mitigating credit, liquidity, and operational risks. However, the transition is not without challenges; data inconsistency, greenwashing risks, and short-term implementation costs remain significant hurdles. The paper concludes that ESG integration is no longer optional but a critical determinant of long-term viability in the modern financial landscape.

1. Introduction

The role of the banking sector has traditionally been defined by profit maximization and shareholder value. However, the 2008 financial crisis and the accelerating climate emergency have catalysed a paradigm shift toward “stakeholder capitalism.” In this new era, banks are increasingly evaluated not just on their balance sheets, but on their impact on society and the environment.

Corporate Social Responsibility (CSR) in banking has evolved from philanthropic donations to a systemic integration of Environmental, Social, and Governance (ESG) factors into lending, investment, and operational decisions. Financial stability—the ability of a bank to withstand shocks and maintain operations—is now intrinsically linked to how well a bank manages non-financial

risks. This paper analyses the mechanisms through which ESG integration influences financial stability, arguing that ESG compliance acts as a buffer against systemic and idiosyncratic risks.

2. Literature Review: The ESG-Stability Nexus

Recent academic literature presents a compelling, though complex, picture of the relationship between ESG scores and bank stability.

2.1 The Risk Mitigation Hypothesis

A dominant theme in the literature is the “risk mitigation hypothesis.” Studies suggest that banks with high ESG scores exhibit lower insolvency risk (often measured by the Z-score) and reduced earnings volatility.

USE OF TECHNOLOGY IN EDUCATION AND ITS IMPACT ON LEARNING

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ABSTRACT

The advancement of digital technology has significantly transformed the field of education in recent years. The increasing use of devices such as smartphones, tablets, laptops, and online learning platforms has introduced new opportunities for interactive learning, instant information access, and student-teacher communication. Technology-based tools including e-learning software, virtual classrooms, educational applications, audio-visual content, and online assessments are helping educators make the learning process more engaging and effective. However, the rapid integration of technology in the education system also raises concerns regarding distractions, screen dependency, unequal access to digital resources, and reduced face-to-face interaction. This study examines how the use of technology in education influences students' learning and academic performance. The research focuses on identifying both the positive and negative impacts of digital learning tools in the classroom and at home. Primary data will be collected from students to analyze how frequently they use technology for educational purposes, the challenges they face, and the learning outcomes they experience. The findings of this study are expected to assist teachers, parents, and educational institutions in adopting technology in a balanced manner, maximizing its benefits while minimizing its drawbacks to enhance learning efficiency.

Keywords: Technology, Education, Learning

Introduction

Education is one of the most dynamic fields influenced by modern technological developments. In today's digital era, technology has become an integral part of the learning process, reshaping the traditional methods of teaching and classroom interaction. Schools, colleges, and universities are increasingly adopting technological tools such as smart classrooms, virtual learning platforms, educational software, digital libraries, and multimedia resources to make learning more interactive, accessible, and student-centered. Technology provides students with instant access to vast learning material, personalized learning

opportunities, and improved collaboration. Tools like videos, simulations, and interactive modules help students understand complex concepts more easily and maintain long-term retention of knowledge. Teachers also benefit from technology through advanced teaching methods, improved evaluation systems, and online platforms for continuous student engagement. Despite its advantages, the excessive use of technology can also create challenges such as dependency on screens, distractions from academic tasks, reduced physical interaction, and digital divide among students where economic background limits access to digital devices. Therefore, it is important

A STUDY ON THE AWARENESS AND CUSTOMER'S SATISFACTION TOWARDS ONLINE PAYMENT APP

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ABSTRACT

Payment systems have evolved over time, beginning with the stone age barter system and progressing to coins and virtual payment. Online payment apps are used for simple transactions and payments. Nowadays, the number of people using online payment apps has increased dramatically and payment options have spread throughout the local market. Smart phone users conduct financial transactions by using application installed on their device. Customers find payment apps to be extremely beneficial and satisfying. The objective of the study has been to know the level of awareness towards online payment apps; to study the effectiveness of online payment apps; To analyze the level of customer's satisfaction towards online payment apps; To examine the problems faced by the people while using online payment apps. The study has been conducted with a sample size of 103 respondents using both primary data and secondary data. Convenience sampling techniques has been applied. The primary data has been collected through questionnaire. Appropriate statistical tools namely simple percentage analysis, ranking, weighted average and chi square test were used to analyze the data collection. The present research paper is mainly focusing on study on the awareness and customer's satisfaction towards online payment apps.

Thus, E-payment apps play an important role in the development of our society and the Growth of our country

Keywords: Online Payment Apps, Digital Payment, Customer Satisfaction.

Introduction

The journey began with carrying gold coins and progressed to carrying currency in wallets. It further altered the scenario by accepting payments via debit and credit cards. With online mobile payment apps, the bank appeared on your phone's screen. Customers are increasingly using digital devices to reduce the amount of time they spend on banking. Digital payment refers to consumer transactions made at point of sale (POS) for services and products via internet banking or mobile banking using a Smartphone or card payment.

This digital payment is very useful for

transferring funds without taking any risks, and it is also very simple to handle and use. We have all seen how technology has advanced in the modern world. In this case, online payment apps were also introduced and well received by customers.

The functions of the online payment app are "Faceless, Paperless, and Cashless". UPI payments can be made using a variety of payment apps, such as Google pay, PhonePe, Paytm and others redefined the banking system by offering services such as payment of electricity bills, water bills, mobile recharge, online shopping, scan any QR code and so on. Coupons, discounts, rewards, loyalty points,

THE ROLE OF AI AND MACHINE LEARNING IN FRAUD DETECTION: ENHANCING RISK MANAGEMENT IN CORPORATE FINANCE

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ABSTRACT

Financial fraud poses substantial operational and reputational risk to corporations. Recent advances in artificial intelligence (AI) and machine learning (ML) enable detection systems that analyze large, complex datasets in near real-time, improving detection rates and reducing false positives. This paper reviews contemporary AI/ML approaches to fraud detection in corporate finance, examines operational case examples, discusses limitations (bias, explain ability, data quality, regulatory concerns), and proposes an integrated framework for deploying AI-enhanced fraud-detection systems within corporate risk management. Key recommendations include hybrid modeling (supervised + unsupervised), human-in-the-loop processes, rigorous model monitoring, data governance, and alignment with regulatory guidance.

1. Introduction

Fraud in corporate finance—ranging from internal accounting manipulation, invoice/expense fraud, to money laundering and payment fraud—causes direct monetary loss and undermines investor confidence. Traditional rule-based systems (thresholds, rules, manual audits) struggle with scale and evolving fraud patterns, motivating the adoption of AI/ML techniques that learn patterns from historical and streaming data. Recent literature demonstrates improved detection performance when ML methods are carefully applied and integrated into governance frameworks.

2. Literature review

1. Survey & Reviews: Systematic reviews (2012–2023/2024) find an explosion of ML applications across credit card, banking transactions, insurance claims, and AML;

reviews recommend combining supervised and unsupervised methods to detect both known and novel fraud patterns.

- 2. Deep learning advances:** Deep architectures (LSTM, transformers, CNNs for sequence and graph representations) have improved modeling of temporal and relational transaction patterns. However, gains often come at the cost of interpretability.
- 3. Industry deployment examples:** Large cloud vendors and banks have reported reduced false positives and improved true positives after deploying ML-powered AML/fraud detection pipelines (e.g., Google Cloud tool trials reported significant alert reduction with higher accuracy in pilot banks).
- 4. Regulatory and risk viewpoint:** Regulators and policy-makers warn about

E-COMMERCE GROWTH AND ITS IMPACT ON TRADITIONAL SHOPS

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ABSTRACT

The rapid expansion of e-commerce in recent years has reshaped the retail landscape. The convenience of online shopping, wide product variety, and competitive pricing have influenced consumer behavior, resulting in major challenges for traditional physical shops. This paper examines the impact of e-commerce growth on traditional retail stores using secondary data from journals, reports, articles, and industry statistics. The study highlights the advantages of e-commerce, the problems faced by traditional shops, changing consumer preferences, and the future scope of coexistence between online and offline business models. The findings indicate that while traditional shops are experiencing reduced footfall and lower sales, opportunities for integration through digital adoption and hybrid retail models still exist.

Introduction

E-commerce refers to the buying and selling of goods and services through online platforms. In the last decade, rapid technological development, rising internet access, digital payment systems, and delivery logistics have led to significant growth in the e-commerce sector. Companies like Amazon, Flipkart, Meesho, and other online marketplaces have created strong competition for conventional retailers. Traditional shops, often dependent on local customers and physical presence, are increasingly facing difficulty in retaining market share.

E-commerce Types

Understanding the different e-commerce models helps explain how online growth affects traditional shops differently:

1. **Business-to-Consumer (B2C):** Retailers sell directly to individual consumers through online storefronts or marketplaces.

This model most directly competes with local shops for consumer purchases of everyday and non-specialist goods.

2. **Business-to-Business (B2B):** Companies trade goods and services with other companies online. B2B platforms can reduce procurement costs for small retailers but also enable larger firms to access downstream markets more efficiently.
3. **Consumer-to-Consumer (C2C):** Peer-to-peer platforms enable individuals to sell used or new items to each other (e.g., classified sites, auction platforms). These platforms expand competition for second-hand and low-value item markets.
4. **Direct-to-Consumer (D2C):** Manufacturers sell directly to consumers, bypassing traditional retail intermediaries. This model can reduce retail margins for conventional shops that compete on price.

THE SOCIAL MEDIA FASHION CYCLE: UNDERSTANDING THE INFLUENCE OF TRENDS ON CONSUMER BEHAVIOUR

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ABSTRACT

This project was undertaken with the objective on the title of "A study on influence of social media trends on fashion consumer behaviour". This study used multi tools for collecting data, through questionnaire and interviews with fashion industry like consumer, retailer and designers. Social media profoundly impact purchasing behaviour, acting as a catalyst for consumer decision making. There are various platforms like instagram, Facebook, and you tube are used by fashion brands to connect with consumers and create awareness as well as promote their products. It also helps in decision making processes, brand perception, and purchasing pattern in individual aged 18-35.

Keywords: Consumer Behaviour, Influence, Brand Perception, Fashion Consumer, Purchasing Pattern.

Introduction

In traditional media, consumer exposure to marketing messages is limited, social media offers constant engagement with brands, influencer etc. Platforms like Instagram, Facebook, Tik Tok and pin interest influence by users to showcase their style preferences to wider audience. Celebrities and social media personalities hold significant sway, as their recommendations directly influence their buying behaviour. The constant exposure to fashion content influence purchasing decision, making the shopping process faster, more interactive and often drive by impulse. This builds a sense of community and make consumer more receptive to marketing messages.

Statement of Problem

Social media has given rise to new marketing strategies, including the widespread use of

influencers and targeted advertising but effectiveness and ethical implications of these methods are still evolving.

Objectives

1. Evaluate the impact of social media to access consumer reviews.
2. To examine the role of media in shaping consumer behaviour and fashion trends.
3. To analyse the overall impact of social media on consumer buying behaviour, particularly among young consumers.

Hypothesis

This study assumes that young generations purchasing decision are influenced by social media and spend a lot of time on media platforms which increase their probability by peer recommendations, influencer endorsements and ads.

MARKETING MANAGEMENT: PAST, PRESENT AND FUTURE

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ABSTRACT

The concept of market management is a degree with which organization is structured to deliver the product in market. It plays very important role to balance the profit and loss ratio. The marketing techniques are equipped with different components which are essential to make it more successful management system. There are large number of studies confining the process of marketing, based on which the present study is designed to provide the important role of marketing management strategies.

Keywords: Management, Marketing, Technology, IT, Information science

Introduction

Marketing is the method accustomed to verify what product or services could also be of interest to customers and also the strategy to use in sales, communications, and business development (Heimonen, 2018). Management is the method of obtaining things done in an organized and economical manner. Selling management aims at the economical operation of selling activities (Palaniammal, 2019). Marketing management can also be defined as the process of planning and executing the conception, pricing, promotion, and distribution of ideas to satisfy individual and organizational objectives. It depends heavily on planning the organizations giving in terms of the target markets wants and wishes and mistreatment effective valuation, communication, and distribution to tell, encourage and repair the market." promoting management are bothered with the chalking out of an exact program, once careful analysis and statement of the market things and also the final execution of those plans to attain the objectives of the organization (Kamthe and Verma, 2013).

Further, their sales plan to a larger level rest upon the necessities and motives of the shoppers within the market. To realize this objective, the organization has to be careful of the accurate evaluation, effective advertising and publicity, distribution, and stimulating the shoppers through the simplest services. Marketing management is each a Science as well as an associate degree of Art. Those answerable for promoting ought to have a sensible understanding of the varied ideas and practices in promoting, communication, and analytical skills and skill to take care of the effective relationship with customers, which can modify them to arrange and execute promoting plans. The marketing management process finds the opportunities and develops ways for exploring. It has to implement a promoting program and appraise unceasingly the effectiveness of marketing-mix. It's to get rid of the deficiencies determined within the actual execution of promoting plans, policies, and procedures. it's once the promoting system of the enterprise.

According to Kotler et al., 2006, the Knowledge of management and marketing science is expected to deliver the best business module and creates

A STUDY ON IMPORTANCE OF MSME IN INDIA

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ABSTRACT

This Research paper aims to investigate about the MSME importance and how to overcome from the difficulties of MSME in India. MSME (Micro, small and Medium Enterprises) are the backbone of the Indian economy in almost 8% of the country. GDP accounts for about 45 percent of total industrial production and about 40 percent of the country's exports. According to the Micro, Small and Medium Enterprises Development Act, 2006, the Government of India launched MSME or Micro, Small and Medium enterprises. These companies specialize in the production, processing or storage of products and goods. Micro, Small and Medium Enterprises are a very important part of the critical supply chain of products and services. This sector is seen as a job creator and plays a key role in providing large – scale Employment and industrialization of rural and backward areas. The MSME sector has regularly had a greater growth rate than the entire industrial sector in the current environment and has displayed commendable innovativeness. Additionally, the ability to adjust in the current economic crisis and recession. This industry is acknowledged as a global growth driver. Every economy recognizes the value of micro, small, and medium – sized enterprises (MSME) and the employment they provide for kitchen craze at comparable legal costs in industrializing the underdeveloped area. This research paper gives an outline to study about the MSME classification, features and loan schemes initiated by the Government and significance in this examination in order to aid your country in reducing regional imbalances.

Keywords: MSME, Importance, Financial Assistance, Employment Opportunities, Growth, Make in India and Government Initiatives.

I. Introduction

Small and medium – sized businesses (MSMEs) have grown to be one of India's most vibrant and active economic sectors over the past 50 years. By encouraging the most job opportunities at the second – lowest capital cost after agriculture, it significantly contributes to the economic and social growth of the country. MSMEs are thought of as the global growth engines since they can employ local and rural resources. MSMEs create native concepts and various business tactics. The development of small – scale enterprises, increasing the production

of commodities by small and medium – sized firms, and extending capital creation are only a few of the important national economic goals that MSMEs in India are essential for. MSME designs and manufactures a wide range of products for domestic and international markets. To enhance rural areas, they have encouraged the growth and development of the coir, khadi, and village industries. With the pertinent ministries, the state government, and stakeholder organizations, they have collaborated and worked. As rightly highlighted by Ahamed and Raju (2023) that these organization have many obstacles in terms of finance, quality, human

COMPARATIVE PERFORMANCE ANALYSIS OF ENSEMBLE LEARNING MODELS IN MACHINE LEARNING

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ABSTRACT

Ensemble learning is a crucial area of study within machine learning. Over the past few years, it has garnered significant attention in fields such as artificial intelligence, pattern recognition, machine learning, neural networks, and data mining. Ensemble learning has demonstrated its efficiency and effectiveness across a wide range of problem domains and real-world applications. The approach involves constructing multiple classifiers or sets of base learners and combining their outputs to reduce overall variance. By merging several classifiers or sets of base learners, ensemble learning significantly enhances accuracy compared to a single classifier or base learner. In this literature, we survey the various ensemble learning techniques prevalent in machine learning.

Keywords: Ensemble learning, Boosting, Bagging, Stacking, Mixture of Experts.

I. Introduction

Ensemble learning began its successful journey in the 1990s. Initially developed to reduce variance and thereby increase the accuracy of automated decision-making systems, ensemble learning effectively addresses a wide range of machine learning problems, including estimation, confidence, error correction, cumulative learning, and handling missing features. It works by constructing multiple classifiers or base learners and combining them to train the dataset. These base learners, often referred to as weak learners, are generated using base learning algorithms on the training data. In most cases, ensemble learning involves constructing single base learning algorithms, known as homogeneous ensembles, while in some cases, it employs different learning algorithms, referred to as heterogeneous ensembles

[1]. The goodness of the ensemble learning is that they are capable of boosting the weak learners so that overall accuracy of the learning algorithm on training data can be increased. There are many applications that use the ensemble learning techniques. Huang et.al [2] proposes the ensemble learning framework on post face recognition invariant and concludes that ensemble method it performs better than traditional method (single learner). Giacinto et.al [3] introduced ensemble approaches for intrusion detection system and came to conclusion that the ensemble method has excellent detection ability for known attacks. Fig. 1 shows the basic architecture of ensemble learning. The rest of the literature is organized as follows: Section II, it discovers the various reasons behind the development of ensemble learning. Section III, introduces Boosting, a crucial paradigm in

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A STUDY ON EMPLOYEE RETENTION STRATEGIES IN PRIVATE ENGINEERING COLLEGES WITH SPECIAL REFERENCE TO TAMIL NADU

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ABSTRACT

This study investigates employee retention strategies within private engineering colleges in Tamil Nadu, focusing on the effectiveness of career development, competitive salary, work-life balance, recognition, and job security. The research employed a mixed-methods design, incorporating quantitative surveys and statistical analyses to evaluate the impact of these strategies on employee satisfaction and turnover. Key findings reveal that competitive salary and career development opportunities are paramount in enhancing job satisfaction and reducing turnover intentions. Work-life balance also significantly contributes to retention, while the effectiveness of strategies varies based on demographic factors such as age, gender, and experience level. Regional and institutional characteristics in Tamil Nadu further influence the effectiveness of these strategies. The study concludes that tailored retention strategies addressing specific employee needs and regional contexts are essential for improving retention rates. Institutions should focus on implementing comprehensive and context-specific policies to effectively manage and retain their workforce.

Keywords: Employee Retention, Private Engineering Colleges, career development, competitive salary, Tamil Nadu

Introduction

Employee retention is a critical challenge for private engineering colleges in Tamil Nadu, a region where the educational sector is rapidly expanding and facing intense competition for skilled talent. The importance of effective employee retention strategies cannot be overstated, especially in an environment where the quality of education and institutional success are directly influenced by the commitment and performance of faculty and staff.

Retaining skilled employees is not only crucial for maintaining continuity and institutional knowledge but also for ensuring the delivery of high-quality education, which in turn affects the institution's reputation and growth.

In Tamil Nadu, private engineering colleges are pivotal in shaping the future of technology and engineering education. As these institutions strive to stay competitive and uphold academic excellence, they face significant challenges in

MANAGEMENT PRINCIPLES IN PRACTICE: A 21st-CENTURY REVIEW

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ABSTRACT

The practice of management in the 21st century has undergone profound transformation due to globalization, technological innovation, knowledge-based economies, and evolving workforce expectations. While classical management principles provided the structural foundation for organizational efficiency, contemporary management demands adaptability, ethical leadership, innovation, and human-centered practices. This paper critically reviews the evolution of management principles and evaluates their practical relevance in modern organizational contexts. Using a qualitative, descriptive-analytical approach grounded in secondary literature, the study integrates classical, behavioral, and contemporary management theories to examine their application in present-day organizations. The review highlights the shift from mechanistic control systems to flexible, participative, and sustainability-oriented management practices. The paper concludes that effective management in the 21st century requires a contextual synthesis of traditional principles and contemporary approaches to address complexity, uncertainty, and continuous change.

Keywords: Management Principles, Management Practice, Contemporary Management, 21st Century Organizations, Management Theory

1. Introduction

Management remains a central organizational function responsible for coordinating human and material resources to achieve predetermined objectives. Historically, management theory emerged during the industrial era, emphasizing efficiency, standardization, and hierarchical control. Thinkers such as Fayol, Taylor, and Weber developed principles that brought order and predictability to organizational operations. However, the contemporary business environment is markedly different, characterized by rapid technological change, global integration, competitive intensity, and increasing social responsibility.

In the 21st century, organizations operate in

complex and uncertain environments that require managers to go beyond rigid application of classical principles. Management today involves strategic thinking, innovation, ethical governance, and effective people management. This paper seeks to review management principles from a theoretical and practical perspective, examining how they have evolved and how they are applied in modern organizations. By linking theory with practice, the study contributes to a deeper understanding of management as a dynamic and adaptive discipline.

2. Objectives of the Study

The specific objectives of this study are to:

1. Examine the foundational principles of

CONSUMER PREFERENCE AND SATISFACTION TOWARDS HEALTH INSURANCE POLICIES

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Introduction

Over the last 50 years India has achieved a lot in terms of health improvement. But still India is way behind many fast developing countries such as China, Vietnam and Sri Lanka in health indicators (Satia et al 1999). In case of government funded health care system, the quality and access of services has always remained major concern. A very rapidly growing private health market has developed in India. This private sector bridges most of the gaps between what government offers and what people need. However, with proliferation of various health care technologies and general price rise, the cost of care has also become very expensive and unaffordable to large segment of population. The government and people have started exploring various health financing options to manage problems arising out of growing set of complexities of private sector growth, increasing cost of care and changing epidemiological pattern of diseases.

The new economic policy and liberalization process followed by the Government of India since 1991 paved the way for privatization of insurance sector in the country. Health insurance, which remained highly underdeveloped and a less significant segment of the product portfolios of the nationalized insurance companies in India, is now poised for a fundamental change in its approach and management. The Insurance Regulatory and Development Authority (IRDA) Bill, recently passed in the Indian Parliament, is important beginning of changes having significant implications for the health sector.

The privatization of insurance and constitution IRDA envisage to improve the performance of the state insurance sector in the country by increasing benefits from competition in terms of lowered costs and increased level of consumer satisfaction. However, the implications of the entry of private insurance companies in health sector are not very clear. The recent policy changes will have been far reaching and would have major implications for the growth and development of the health sector. There are several contentious issues pertaining to development in this sector and these need critical examination. These also highlight the critical need for policy formulation and assessment. Unless privatization and development of health insurance is managed well it may have negative impact of health care especially to a large segment of population in the country. If it is well managed then it can improve access to care and health status in the country very rapidly.

Health insurance as it is different from other segments of insurance business is more complex because of serious conflicts arising out of adverse selection, moral hazard, and information gap problems. For example, experiences from other countries suggest that the entry of private firms into the health insurance sector, if not properly regulated, does have adverse consequences for the costs of care, equity, consumer satisfaction, fraud and ethical standards. The IRDA would have a significant role in the regulation of this sector and responsibility to minimise the unintended consequences of this change.

HOW AI TOOLS INFLUENCE MANAGERIAL CHOICE QUALITY AND FIRM PERFORMANCE

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ABSTRACT

Artificial Intelligence (AI) is increasingly embedded in managerial decision-making processes across industries. Artificial Intelligence (AI) tools are transforming decision-making processes in modern organizations. This research paper explores how AI influences managerial choice quality and firm performance. The study integrates theoretical foundations, empirical observations, and practical implications to illustrate how AI enhances accuracy, speed, and strategic alignment in managerial decisions. It also discusses challenges and provides recommendations for effective implementation. The findings suggest that AI adoption positively correlates with improved managerial decisions, operational efficiency, and overall firm performance when properly integrated with human expertise.

Keywords: Artificial Intelligence, Managerial Decision Making, Choice Quality, Firm Performance, Operational efficiency.

1. Introduction

In an era where competitive advantage depends on information and rapid adaptation, Artificial Intelligence (AI) has become a strategic asset for firms. AI encompasses machine learning, natural language processing, predictive analytics, and automation technologies that assist managers in processing large data volumes and making timely decisions. While traditional managerial decision making relied heavily on experience and intuition, AI tools offer data-driven insights that enhance choice quality, guiding firms toward better performance outcomes. This paper examines the influence of AI tools on managerial choices and their impact on organizational performance.

2. Conceptual Background

2.1 Managerial Choice Quality

Managerial choice quality refers to the extent to which decisions made by managers lead to desired outcomes. High-quality choices align with

organizational objectives, optimize resource use, minimize risk, and create value. Traditional decision making often suffers from cognitive biases, limited information, and time constraints.

2.2 Firm Performance

Firm performance is a multidimensional construct encompassing financial metrics (such as profitability and return on investment), operational efficiency, customer satisfaction, and market share. Effective managerial decisions play a vital role in determining these performance outcomes.

2.3 Artificial Intelligence Tools

AI tools are computational systems capable of tasks that normally require human intelligence. These include pattern recognition, forecasting, recommendation systems, and automated decision support. Examples range from machine learning algorithms to advanced analytics platforms that can process structured and unstructured data.

THE SUSTAINABLE BRANDING SHIFT: CREATING ECO-CONSCIOUS BRANDS AND SHAPING CONSUMER BEHAVIOR

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ABSTRACT

Sustainable branding represents a modern, ethically driven approach that aligns corporate practices with social and environmental responsibility. This study explores how sustainable branding contributes to enhancing brand reputation and shaping consumer purchasing behavior. A literature review method is utilized to synthesize insights from diverse scholarly sources. The findings reveal a growing consumer awareness of environmental concerns, which has significantly boosted the demand for eco-friendly products. Implementing sustainable branding strategies helps companies build a strong and positive image, especially among environmentally conscious customers. Although businesses may face certain implementation challenges, innovation and ethical practices stand out as essential tools for overcoming these barriers. In summary, sustainable branding plays a pivotal role in fostering brand credibility and influencing buying decisions. To thrive in today's market, companies must respond to evolving consumer values and ecological priorities, ensuring long-term success while contributing positively to society and the planet.

Keywords: Sustainable Branding, Brand Image, Consumer Behavior, Environmental Awareness, Corporate Responsibility.

Introduction

In today's business landscape, sustainability and environmental challenges have become critical concerns. Issues such as climate change, pollution, resource depletion, biodiversity loss, excessive waste production, and socio-economic inequality demand urgent attention. As a result, businesses are increasingly expected to address their environmental and social impacts through sustainable branding efforts. According to Grubor and Milovanov (2016), understanding the concept of sustainable branding is essential to drive meaningful change. Research by Elistia E (2016) emphasizes that ethical marketing and corporate social responsibility

significantly influence brand image and enhance brand management. Likewise, Ayuningrum et al. (2020) found that environmentally and socially conscious branding improves customer perceptions. Sustainable branding serves as a strategic approach for companies to build a positive image among environmentally aware consumers. Integrating sustainability into branding practices not only strengthens reputation but also contributes positively to business performance. Mildawati (2018) suggests that branding strategies focused on sustainability have a favorable impact on corporate outcomes, particularly when companies disclose their environmental initiatives as part of a broader commitment to climate action.

EVALUATING THE EFFECTIVENESS OF PERFORMANCE APPRAISAL PRACTICES IN MANUFACTURING INDUSTRIES

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ABSTRACT

This study aims to examine the effectiveness of performance appraisal systems. Performance appraisal has increasingly evolved into a strategic tool that aligns human resource activities with organizational policies. It encompasses a range of processes through which organizations evaluate employee performance, develop competencies, enhance productivity, and allocate rewards. The primary objective of this study was to assess the performance appraisal system in practice. Data were collected from 80 respondents and analyzed using descriptive statistics and the chi-square test. The findings indicate that the overall performance appraisal system is highly rated by the respondents, with employees expressing considerable satisfaction with their work. Based on these findings, recommendations have been proposed to further improve the effectiveness of performance appraisal practices.

Introduction

Performance appraisal is a systematic and periodic process designed to evaluate an individual employee's job performance and productivity against pre-established criteria and organizational objectives. For organizations to be effective and achieve their goals, it is essential to monitor and measure employee performance on a regular basis. Effective performance monitoring involves providing timely feedback, reviewing performance according to predetermined standards, and recognizing accomplishments promptly, which motivates employees to perform better consistently. As the saying goes, "Encouraged people achieve the best; dominated people achieve second best; neglected people achieve the least," highlighting that timely recognition and rewards serve as strong motivators.

Employees differ in their abilities and aptitudes, resulting in variations in the quality and quantity

of work even when performing the same job. Performance appraisals are therefore necessary to assess each employee's skills, competencies, and relative contribution to the organization. They provide a structured method to rate employees based on their performance and potential.

According to experts in human resources, "Performance appraisal is the systematic, periodic, and impartial evaluation of an employee's effectiveness in current job responsibilities and potential for future roles." Performance appraisal serves as a powerful tool to measure, refine, and reward employee performance. It enables organizations to analyze individual achievements and assess contributions toward overall organizational objectives. Moreover, it helps both employees and management monitor progress toward desired goals and identify areas for improvement.

Performance appraisal has long been a central focus for human resource specialists. Over the

ENZYME TECHNOLOGY: PRINCIPLES, KINETICS, MECHANISMS AND INDUSTRIAL APPLICATIONS

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ABSTRACT

Enzymes are highly specific biological catalysts that accelerate biochemical reactions by lowering activation energy under physiological conditions. Their remarkable catalytic efficiency, substrate specificity, and environmental compatibility have established them as indispensable tools in biotechnology and industry. This research paper presents a comprehensive overview of enzyme structure, catalytic mechanisms, enzyme kinetics, inhibition, and regulatory behavior. Classical models such as the lock-and-key hypothesis and induced-fit model are examined alongside transition-state theory and Michaelis-Menten kinetics. Various inhibition mechanisms — including competitive, noncompetitive, uncompetitive, and irreversible inhibition — are discussed with kinetic interpretations. Environmental influences such as pH and temperature on enzymatic activity are analyzed. Furthermore, the industrial and biotechnological applications of enzymes in pharmaceuticals, food processing, diagnostics, biofuels, and environmental biotechnology are explored. Emerging trends in enzyme engineering, recombinant technology, and computational design are highlighted. The study emphasizes the growing importance of enzyme technology in sustainable development and green chemistry.

1. Introduction

Enzymes are biological macromolecules, primarily proteins, that catalyze chemical reactions essential for life. They function by reducing activation energy, thereby accelerating reaction rates without being consumed. The term enzyme was first introduced by Wilhelm Kühne in 1878, and the concept of cell-free fermentation was demonstrated by Eduard Buchner in 1897, establishing enzymes as functional biochemical entities independent of living cells.

Enzyme technology refers to the industrial and biotechnological application of enzymes for catalyzing chemical reactions efficiently under mild conditions. Enzymes demonstrate:

1. High specificity
2. High catalytic efficiency (kcat)
3. Biodegradability

4. Functionality under mild pH and temperature

With increasing demand for sustainable and eco-friendly processes, enzyme technology plays a critical role in pharmaceuticals, food industries, biofuels, diagnostics, and environmental remediation.

2. Chemical Nature and Structure of Enzymes

Enzymes are globular proteins composed of one or more polypeptide chains folded into unique three-dimensional conformations. Structural stability is maintained through:

1. Hydrogen bonds
2. Ionic interactions
3. Hydrophobic interactions
4. Disulfide bridges

PARASITIC CONTAMINATION OF RAW VEGETABLES CONSUMED IN MANSURPUR, MUZZAFARNAGAR (INDIA)

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ABSTRACT

Parasitic contamination of raw vegetables is an important public health issue worldwide, particularly in developing and low-income countries where sanitation infrastructure and wastewater treatment systems are inadequate. Raw vegetables such as lettuce, spinach, cabbage, coriander, carrots, and tomatoes are widely consumed due to their high nutritional value and health benefits. However, when consumed without proper washing or cooking, these vegetables may serve as vehicles for the transmission of intestinal parasites. Contamination commonly occurs during cultivation through the use of untreated wastewater for irrigation, application of inadequately composted manure, and exposure to contaminated soil. Additional contamination may take place during harvesting, transportation, and marketing due to poor hygiene practices.

*Several protozoan and helminth parasites, including *Giardia lamblia*, *Entamoeba histolytica*, *Ascaris lumbricoides*, and *Trichuris trichiura*, have been frequently detected on raw vegetables. Infection occurs through ingestion of parasite eggs, cysts, or larvae adhered to vegetable surfaces. These infections may result in gastrointestinal symptoms such as diarrhea, abdominal pain, nausea, anemia, malnutrition, and in severe cases, intestinal obstruction or systemic complications. Vulnerable populations such as children, pregnant women, elderly individuals, and immunocompromised patients are at increased risk of severe outcomes.*

1. Introduction

Vegetables are an indispensable component of a balanced diet and contribute significantly to human health by providing essential nutrients such as vitamins, minerals, antioxidants, and dietary fiber. In recent years, there has been a global increase in the consumption of raw vegetables due to growing awareness of healthy eating habits. Salads, fresh garnishes, and minimally processed vegetable products are widely consumed across different populations. However, while raw vegetables offer substantial nutritional benefits, they may also serve as vehicles for the transmission of foodborne pathogens, including intestinal parasites, when

proper hygiene and safety measures are not maintained.

Parasitic contamination of raw vegetables is primarily associated with fecal pollution of soil and water. In many developing countries, untreated or inadequately treated wastewater is commonly used for agricultural irrigation due to water scarcity and economic constraints. This practice introduces parasite eggs, cysts, and larvae into agricultural fields. Additionally, the use of improperly composted animal manure, open defecation near cultivation areas and poor sanitation infrastructure further increase the risk of contamination. Parasite infective stages can adhere to vegetable surfaces,

GREENHOUSE EFFECT AND ITS ENVIRONMENTAL IMPACTS: A STUDY FROM MUZAFFARNAGAR, UTTAR PRADESH, INDIA

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ABSTRACT

The greenhouse effect is a naturally occurring atmospheric phenomenon that regulates the Earth's temperature and supports life. However, anthropogenic activities such as fossil fuel combustion, industrial growth, deforestation, and modern agricultural practices have significantly increased greenhouse gas concentrations, intensifying the greenhouse effect. This enhanced greenhouse effect has resulted in global warming, climate variability, and long-term climate change. The present research paper provides a comprehensive analysis of the greenhouse effect, its mechanism, major greenhouse gases, environmental impacts, socio-economic consequences, and mitigation strategies, with a special focus on Muzaffarnagar district of Uttar Pradesh, India.

Introduction

Climate change is one of the most pressing global environmental challenges of the 21st century. The greenhouse effect plays a central role in Earth's climate system by trapping heat in the atmosphere. Without this natural process, the planet would be too cold to sustain life.

Since the Industrial Revolution, human activities have disrupted the natural balance of greenhouse gases. Rapid industrialization, urbanization, population growth, and energy demand have led to unprecedented emissions of greenhouse gases. Developing nations like India face greater risks due to high population density and reliance on climate-sensitive sectors. Muzaffarnagar, an agriculturally important district, is increasingly experiencing temperature rise, erratic rainfall, and extreme weather events.

Mechanism of the Greenhouse Effect

Solar radiation enters the Earth's atmosphere as short-wave radiation. Some of this radiation is

reflected back into space, while the rest is absorbed by land and water surfaces. The absorbed energy is converted into heat and re-emitted as long-wave infrared radiation.

Greenhouse gases absorb this infrared radiation and re-radiate it in all directions, including back toward the Earth's surface. This heat trapping mechanism warms the atmosphere and surface. Increased greenhouse gas concentrations enhance this effect, causing global warming and disrupting climatic patterns.

Major Greenhouse Gases

Carbon dioxide (CO₂) is the most abundant anthropogenic greenhouse gas, released primarily through fossil fuel combustion, cement production, and deforestation. Due to its long atmospheric lifetime, CO₂ significantly contributes to long-term climate change.

Methane (CH₄) has a much higher global warming potential than CO₂ over a short time scale. It is emitted from livestock digestion, rice

GREEN ENTREPRENEURSHIP PRACTICES IN INDIA

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ABSTRACT

Today everyone is admiring environmentally and socially conscious goods over their traditional counterparts. This research study highlights that there are low entry-level standards to become an entrepreneur for a variety of environmentally sensitive companies, making it one of the factors for youth unemployment and sustainability issues. It has been argued that green businesses are developed at a small scale and fit the needs of rural regions. These sustainable startups offer companies with new prospects not limited to the urban areas. Green entrepreneurship research in India focuses on coordinated promotion for green entrepreneurs. Financial and technological support is required for developing startups. The State has been able to encourage entrepreneurship through key businesses in the region.

Keywords: Green Entrepreneurship, Sustainability, Start ups, Green businesses, Green Marketing.

Introduction

The notion of green entrepreneurship is not only to respond to evolving market demands but also to engage in the procedure of sustainable development in the long way (N Kumar, 2015). Largely green companies are organizations that examine the relationship between innovation and sustainability and thus make a competitive advantage of their firms/businesses by selling environmentally friendly products and services. Some environment-friendly goods may be either environmentally or environmentally recycled (Khurana, S., Haleem, A., Mannan, 2019). Both the sustainable marketing tactics and the ones based on sustainability in this competitive climate. The idea of green entrepreneurship is highly important for contemporary and any entrepreneurs (Sarkar, 2012). Green management is now becoming a big problem in every field of life. The conception of green entrepreneurship is largely unknown, little known, and commonly overlooked compared to entrepreneurship (M. Dadhich et al., 2018).

A lot will still need to be achieved in the coming years of researching the issues of green entrepreneurship i.e., environmental quality, social welfare, creativity, the sustainability of resources, technological growth, and wholesome economic development (Thanki, S.J., Thakkar, J., 2018).



Figure 1: Components of Green Entrepreneurship

Review of Literature

The papers explore the notion of green entrepreneurship using secondary tools including scholarly papers, articles, and interviews on the

Fast Fashion Sustainability Marketing: A Qualitative Content Analysis

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Abstract: *The fast fashion industry has significantly reshaped global apparel consumption by prioritizing rapid production, low-cost garments, and ever-changing trends. While this model has democratized access to fashionable clothing, it has also resulted in extensive environmental degradation, labor exploitation, and ethical challenges. In response to increasing public concern over climate change and responsible consumption, fast fashion brands have begun incorporating sustainability and up cycling narratives into their marketing strategies.*

This study employs qualitative content analysis to critically examine how sustainability is represented in the marketing communications of leading global fast fashion brands. The analysis focuses on visual imagery, textual claims, and ethical messaging to identify key themes such as the use of eco-friendly materials, recycling initiatives, circular fashion concepts, and portrayals of fair labor practices. The findings reveal a notable gap between brands' sustainability messaging and their actual environmental performance, highlighting ongoing issues of green washing within the industry.

By uncovering these discrepancies, the research contributes to contemporary debates surrounding ethical branding, green marketing, and the evolution of genuinely sustainable fashion systems.

Keywords: Fast fashion, sustainability marketing, green washing, qualitative content analysis, ethical branding

I. INTRODUCTION

Fashion serves not only as a form of cultural and social expression but also as a major driver of the global economy. Over the past two decades, the fast fashion model has become dominant, defined by short design-to-retail cycles, frequent new product releases, and affordable pricing. This model allows brands to react quickly to changing trends, enabling consumers to access the latest styles faster and at lower costs than ever before.

However, the environmental and social consequences of fast fashion have become increasingly evident. The fashion industry is now recognized as one of the largest contributors to global pollution through its carbon emissions, high water use, toxic chemical discharge, and growing textile waste. Moreover, many workers in global supply chains face poor working conditions, low pay, and inadequate labor protections. As awareness of these issues grows, sustainability has moved from being a minor concern to becoming a central topic in fashion discussions.

In response, fast fashion brands have begun emphasizing sustainability and up cycling in their marketing. Many promote product lines described as "conscious," "eco-friendly," or "sustainable," often highlighting the use of recycled fabrics or water-saving technologies. Yet critics argue that these claims are often more symbolic than substantive, serving primarily to maintain a brand's image rather than reflecting real systemic change. This study aims to critically analyze these marketing narratives to understand how fast fashion brands construct and communicate ideas of sustainability in their promotional strategies





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The Iron Voice of Unity: Role of Sardar Vallabhbhai Patel as a Communicator in the Unification of Bharat

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Abstract

The unification of India after independence in 1947 stands as one of the most significant political achievements in modern history. While Sardar Vallabhbhai Patel is widely recognized for his administrative strength and political vision, this research paper focuses on an often-overlooked yet equally critical aspect of his success—his exceptional role as a communicator. At a time when over 560 princely states were technically free to accede to India, Pakistan, or remain independent, the challenge of preventing the balkanization of India required not only strategy and force but also persuasive communication, emotional intelligence, and diplomatic finesse. Patel excelled on all these fronts.

This paper explores how Sardar Patel used his words—spoken and written—with profound effect to forge national unity. As the head of the States Department, he approached each princely ruler with a tailored communication strategy that combined respectful dialogue with nationalistic fervor, and, when necessary, firmness with moral authority. His speeches to the public and appeals to Indian princes were characterized by clarity, conviction, and a powerful invocation of duty and shared heritage. He deliberately avoided abstract idealism and instead spoke in the language of realism, patriotism, and practical consequences.

Using a range of communication tools—public addresses, private letters, policy statements, and non-verbal symbolism—Patel created a persuasive narrative that resonated with both the masses and the elite. His insistence on transparency and directness, while ensuring respect for traditional Indian values and sensitivities, made him a trustworthy and credible negotiator. The paper presents case studies from the integration of Hyderabad, Junagadh, and other princely states, illustrating how Patel's communicative strategies helped navigate complex political terrains and hostile resistance.

In conclusion, Sardar Patel's success in unifying Bharat was not solely due to his position of power or administrative talent but was deeply rooted in his role as a master communicator. His legacy demonstrates that nation-building requires not only vision and action but also the power of persuasive, principled, and emotionally intelligent communication.

Keywords: Self-Confidence, Media, Youth, Empowerment

Green Synthesis of Silver Nanoparticles Using Neem Extract for Sewage Water Disinfection

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Abstract- The increasing generation of sewage water due to rapid urbanization and industrialization poses serious environmental and public health challenges. Conventional disinfection methods such as chlorination and ozonation suffer from limitations including toxic by-products and high operational costs. The present study explores an eco-friendly approach for sewage water disinfection using silver nanoparticles (AgNPs) synthesized via a green route using neem (*Azadirachta indica*) leaf extract. The biosynthesized nanoparticles were characterized using UV-Visible spectroscopy, showing a characteristic surface plasmon resonance peak around 420 nm, confirming nanoparticle formation. Sewage samples were treated with varying concentrations of AgNPs and analyzed for physicochemical parameters including pH, conductivity, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and ionic content. A significant reduction in BOD, COD, conductivity, and microbial load was observed. Maximum disinfection efficiency of approximately 99% was achieved at higher nanoparticle doses. The study demonstrates that neem-mediated AgNPs offer a cost-effective, sustainable, and highly efficient alternative for sewage water treatment.

Keywords— Silver nanoparticles, Green synthesis, Neem extract, Sewage treatment, BOD, COD, Antimicrobial activity

I. INTRODUCTION

Water pollution due to untreated sewage discharge is a major global concern. Sewage water contains organic matter, suspended solids, nutrients, and pathogenic microorganisms that pose serious environmental and health risks. Conventional treatment methods, although widely used, have several limitations such as incomplete microbial removal, high cost, and formation of harmful by-products.

Nanotechnology has emerged as a promising solution in wastewater treatment. Among nanomaterials, silver nanoparticles (AgNPs) are highly effective due to their strong antimicrobial properties and high surface area. Green synthesis of nanoparticles using plant extracts provides an eco-friendly alternative to chemical methods.

Neem (*Azadirachta indica*) is a medicinal plant rich in

Bioactive compounds such as flavonoids, terpenoids, and phenolics, which act as natural reducing and stabilizing agents. The present study focuses on the synthesis of AgNPs using neem extract and their application in sewage water disinfection.

II. MATERIALS AND METHODS

1. Materials

Analytical grade chemicals including silver nitrate (AgNO_3), distilled water, potassium dichromate, sulfuric acid, and other reagents were used.

2. Preparation of Neem Extract

Fresh neem leaves were washed, shade-dried, and crushed. About 20 g of leaves were boiled in 100 mL distilled water at 70°C for 20–30 minutes. The extract was filtered and stored for further use.

3. Synthesis of Silver Nanoparticles

- 80 mL of 1 mM AgNO_3 solution was taken
- 20 mL neem extract added dropwise



Synthesis of Natural pH Indicators from Flowers and Vegetables and Their Environmental Impact

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Abstract— Synthetic acid-base indicators, though widely used, present challenges such as toxicity, environmental hazards, and high cost. This study explores the preparation of eco-friendly pH indicator strips using natural sources including turmeric (*Curcuma longa*), rose (*Rosa indica*), beetroot (*Beta vulgaris*), and red cabbage (*Brassica oleracea*). Extracts were prepared by aqueous extraction and applied to paper strips to develop natural indicators. The prepared strips were tested on 59 household chemicals and 14 standard pH solutions (pH 1–14). The results demonstrated distinct color variations for acidic, neutral, and basic media. Red cabbage showed a wide color range comparable to universal pH paper, while turmeric, rose, and beetroot exhibited clear differentiation between acids and bases. The study confirms that natural indicators are cost-effective, biodegradable, non-toxic, and suitable alternatives to synthetic indicators for educational and analytical applications.

Keywords— Natural indicators, pH paper, Green chemistry, Turmeric, Red cabbage, Acid-base indicators.

I. INTRODUCTION

Acid-base indicators are essential tools in chemistry for determining the pH of solutions. Conventional synthetic indicators such as phenolphthalein and methyl orange are widely used but pose environmental and health concerns due to their toxicity and non-biodegradability.

Natural indicators derived from plant sources offer a sustainable alternative. Many plants contain pigments such as anthocyanins, curcumin, and betalains, which exhibit color changes with pH variation. These pigments are eco-friendly, inexpensive, and readily available.

This study focuses on the synthesis of natural pH indicator strips from commonly available flowers and vegetables and evaluates their performance in comparison with synthetic indicators.

II. MATERIALS AND METHODS

1. Plant Materials

- Turmeric (*Curcuma longa*)
- Rose (*Rosa indica*)
- Beetroot (*Beta vulgaris*)
- Red cabbage (*Brassica oleracea*)

2. Preparation of Extracts

- Plant materials were washed and cleaned
- Boiled in distilled water for ~10 minutes

- Cooled and filtered using filter paper

3. Preparation of Indicator Strips

- White paper dipped in extracts for 15 minutes
- Air-dried for 12 hours
- Cut into strips

4. Testing Procedure

Tested on:

- 59 household chemicals
- 14 standard pH solutions (1–14)
- Compared with commercial pH paper

III. RESULTS AND DISCUSSION

1. Prepared Natural Indicator Strips



Figure 1: Natural pH indicator strips from plant extracts (Turmeric, rose, beetroot, red cabbage)

2. Color Response of Indicators

Table 1: Color Change of Natural Indicators

Indicator	Acidic	Neutral	Basic
Turmeric	Yellow	No change	Red
Rose	Pink	Light purple	Green/Blue
Beetroot	Pink	Light pink	Purple
Red Cabbage	Red/Pink	Purple	Blue/Green/Yellow



Characterization of LED Emission Spectra Under Varying Thermal Conditions

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Abstract: This report investigates the electro-optical and thermodynamic mechanisms of light-emitting diodes (LEDs) under varying thermal conditions. It focuses on the impact of elevated junction temperatures (T_j) on LED emission spectra across different semiconductor materials, including Indium Gallium Nitride (InGaN) and Aluminum Gallium Indium Phosphide (AlGaInP). Utilizing a high-resolution optical spectrometer and a thermoelectric temperature control stage, the study finds that higher operating temperatures lead to a red shift in peak emission wavelengths and increased full-width at half-maximum, while reducing optical output power and internal quantum efficiency due to the activation of non-radiative recombination paths. Additionally, white LEDs experience significant thermal quenching effects, affecting color temperature and gamut. The study concludes with recommendations for high-efficiency micro-channel heat sinks and dual-junction measurement strategies to enhance reliability in optoelectronic systems.

I: INTRODUCTION

1.1 Introduction to Solid-State Lighting and LEDs: Over the past few decades, the global lighting paradigm has experienced a profound shift away from conventional incandescent and fluorescent systems toward Solid-State Lighting (SSL) frameworks driven by Light-Emitting Diodes (LEDs). This technological shift is largely a result of the fundamental physics governing electroluminescence in compound semiconductor materials. Unlike incandescent bulbs, which operate via thermal radiation (blackbody emission) requiring temperatures near 3000 K, or fluorescent tubes reliant on gas ionization and mercury excitation, LEDs convert electrical energy directly into narrow-band optical radiation through radiative recombination across a p-n junction active zone. The advantages of this mechanism are profound: high electrical-to-optical conversion efficiencies, operational lifespans exceeding 50,000 hours, instantaneous modulation capabilities, and the exclusion of environmentally hazardous elements like mercury. Consequently, LEDs have transcended standard ambient lighting to become primary components across highly specialized fields, including:

- High-definition multi-micro-LED display panels.
- Solid-state automotive optical assemblies.
- Precision horticultural photostimulation matrix systems.
- Deep-tissue photodynamic medical equipment.



Protecting India's Endangered and Threatened Plant Biodiversity

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ABSTRACT

India is one of 17 mega-diverse countries, hosting ~47,000 plant species, of which ~15,000 are flowering plants. However, rapid land-use change, habitat fragmentation, over-harvesting, and climate change have placed over 2,500 plant species in threatened categories as per IUCN Red List 2023. Among them, 960+ medicinal plant species face high trade pressure, with 70% of raw material still sourced from wild populations. This article reviews current conservation and domestication strategies for endangered and threatened plant species in India. It compares in-situ approaches such as protected areas, sacred groves, and community forests with ex-situ methods including seed banks, botanical gardens, and tissue culture. The concept of "conservation through domestication" is examined using case studies of *Rauwolfia serpentina*, *Santalum album*, and *Taxus wallichiana*. Data from field surveys 2022-2024 and institutional records from NBPGR, CIMAP, and FRLHT show that domestication can reduce wild harvest pressure by 60-70% while increasing farmer income 3-4 times compared to traditional crops. Key barriers include long gestation periods for trees, lack of market linkage, and weak implementation of the Biological Diversity Act 2002. The article concludes that an integrated model combining in-situ protection, ex-situ backup, and market-linked domestication is essential for meeting CBD targets and Sustainable Development Goal 15. Policy recommendations include a "Red List Cultivation Mission", community seed banks, DNA barcoding for traceability, and farmer-industry partnerships.

Keywords: Endangered plants, Threatened species, In-situ conservation, Ex-situ conservation, Domestication, Medicinal plants, Biodiversity, India

1. Introduction

India's geographic and climatic diversity has resulted in one of the richest plant diversities globally. The country holds 4 of 36 global biodiversity hotspots: Himalaya, Western Ghats, Northeast India, and Andaman-Nicobar Islands. Within this wealth, an estimated 7,000 species are used by traditional communities for food, fiber, timber, and medicine.

Despite this richness, India is also a center of plant endemism under threat. Botanical Survey of India reports that ~2,500 species are threatened: 212 Critically Endangered, 816 Endangered, and 1,487 Vulnerable. The situation is most acute for medicinal and aromatic plants. The trade volume exceeds 500,000 tons annually, valued at over ₹7,000 crore. Demand is growing at 15-20% per year due to herbal, nutraceutical, and pharmaceutical industries.

The core problem is sourcing. More than 70% of traded medicinal plants are still collected from wild habitats. Unsustainable harvesting of roots, bark, and whole plants kills the parent plant and reduces regeneration. *Taxus wallichiana* is a classic example. Its bark contains taxol, an anti-cancer compound. Bark stripping kills the tree, and wild populations in Himachal and Uttarakhand have declined 85% since 1990.

Two parallel responses exist: conservation and cultivation. Conservation focuses on protecting species in nature through protected areas. Cultivation focuses on growing species on farms. But the link between them is weak. "Conservation through domestication" argues that high-demand threatened species must be brought under cultivation so wild populations can recover. Without domestication, conservation becomes a museum exercise. Without conservation, domestication loses genetic diversity.

This article aims to 1) document major threats, 2) assess in-situ and ex-situ strategies, 3) evaluate domestication models, and 4) propose integrated policy pathways for India.

Major Threats to Endangered Plants

1 Habitat Loss and Fragmentation

From 2000-2020, India lost ~1.5 million hectares of forest cover to agriculture, infrastructure, and mining. Shifting cultivation in Northeast India destroys habitat for *Cycas pectinata* and *Rhododendron arboreum*. Fragmentation isolates populations, reducing pollination and seed set.

2 Over-exploitation for Trade



Mushroom Cultivation & Its Economic Importance

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Shri Ram College, Muzaffarnagar (U.P.) India

ABSTRACT:

Mushrooms are edible fungi that have gained significant importance worldwide due to their high nutritional value, medicinal properties, and economic benefits. They are considered a valuable source of food because they are rich in proteins, vitamins, minerals, dietary fiber, and bioactive compounds while being low in fat and calories. Often referred to as the "vegetable meat" or "poor man's meat," mushrooms provide a healthy alternative protein source, particularly for vegetarians. In addition to their nutritional significance, mushrooms play an important ecological role by decomposing organic matter and recycling nutrients, thereby contributing to environmental sustainability. Mushroom cultivation has emerged as a profitable agricultural enterprise that can be practiced on a small or large scale. The cultivation process involves the selection of suitable mushroom species, preparation and sterilization of substrates, spawning, incubation, fruiting, harvesting, and post-harvest management. Agricultural wastes such as wheat straw, paddy straw, sawdust, sugarcane bagasse, and other lignocellulosic materials are commonly used as substrates, making mushroom cultivation an eco-friendly method of converting waste into nutritious food. Proper environmental conditions, including temperature, humidity, ventilation, moisture, and cleanliness, are essential for successful production and higher yields. Several edible mushroom species are cultivated commercially, including Button Mushroom (*Agaricus bisporus*), Oyster Mushroom (*Pleurotus ostreatus*), Paddy Straw Mushroom (*Volvariella volvacea*), Shiitake Mushroom (*Lentinula edodes*), and Milky Mushroom (*Calocybe indica*). Each species possesses unique nutritional and medicinal characteristics and is adapted to specific environmental conditions. Oyster and Milky mushrooms are particularly suitable for tropical regions, while Button mushrooms are widely cultivated under controlled conditions. These mushrooms are increasingly used in various food products, functional foods, and dietary supplements due to their health-promoting properties. The nutritional composition of mushrooms makes them highly beneficial for human health. They contain essential amino acids, B-complex vitamins, vitamin D, potassium, phosphorus, iron, selenium, and other important minerals. Bioactive compounds such as β -glucans, phenolic compounds, and antioxidants contribute to immune enhancement, heart health, diabetes management, and potential anticancer effects. Medicinal mushrooms such as Reishi, Shiitake, Turkey Tail, Lion's Mane, Maitake, and Cordyceps have been widely recognized for their therapeutic applications in traditional and modern medicine. Economically, mushroom cultivation offers numerous advantages. It requires relatively low investment, limited land area, and simple infrastructure while providing quick returns. Mushroom farming creates employment opportunities in production, processing, packaging, marketing, and export sectors. It is particularly beneficial for small farmers, women, rural youth, and self-help groups. The mushroom industry also contributes to waste management by converting agricultural residues into valuable food products and organic manure. Furthermore, processed mushroom products such as dried mushrooms, powders, pickles, soups, and canned mushrooms add value and extend shelf life, increasing market opportunities. In India, mushroom cultivation has become one of the fastest-growing sectors of horticulture and agribusiness. Favorable climatic conditions, abundant agricultural residues, growing consumer awareness, and government support have accelerated the development of the mushroom industry. Various government schemes, including MIDH, NABARD assistance, PMFME, PMEGP, and MUDRA loans, provide financial aid, subsidies, training, and technical support to mushroom growers. These initiatives encourage entrepreneurship and sustainable agricultural development.

Keyword: Basidiospore, Germination, Primary Mycelium, Secondary Mycelium, Plasmogamy, Karyogamy, Meiosis, Basidium, Basidiocarp, Vegetative Reproduction, Asexual Reproduction, Sexual Reproduction.

Introduction:

Mushrooms are fleshy, spore-bearing fruiting bodies of fungi that generally grow above the ground on soil, wood, or other organic matter. In botanical classification, mushrooms belong to the Kingdom Fungi. Earlier, fungi were grouped under plants because they are non-motile and possess cell walls, but later they were separated into an independent kingdom due to their unique characteristics such as absence of chlorophyll, heterotrophic mode of nutrition, and different cell wall composition.



To Study Polyhouse and their Application

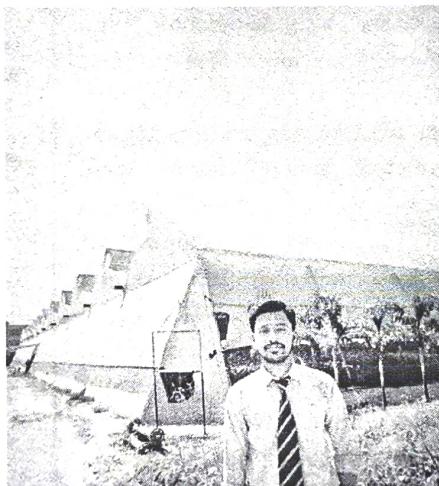
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ABSTRACT

Polyhouse farming is an advanced method of agriculture in which crops are grown inside a specially designed structure covered with transparent polyethylene sheets. The main purpose of a polyhouse is to create a controlled environment that protects plants from unfavourable climatic conditions such as excessive heat, heavy rainfall, frost, strong winds, and pests. This modern farming technique helps in improving crop growth, quality, and productivity throughout the year.

In recent years, polyhouse technology has become increasingly important in India because of rapid population growth, limited agricultural land, and changing climatic conditions. Traditional farming methods are often affected by unpredictable weather and low productivity, whereas polyhouse farming provides a suitable environment for healthy plant growth. By controlling temperature, humidity, light, ventilation, and irrigation, farmers can produce crops more efficiently and with better quality.



Polyhouses are used for the cultivation of vegetables, flowers, fruits, and medicinal plants. Crops such as tomato, cucumber, capsicum, rose, gerbera, strawberry, aloe vera, and many others are successfully grown under protected cultivation. Polyhouse farming also supports off-season crop production, which allows farmers to sell their produce at higher market prices and increase their income.

Keywords: Polyhouse, Polyhouse Farming, Climate Control, Yield High Quality Production, Nursery, Tissue Culture.

Introduction

Polyhouse farming is a modern agricultural technique in which crops are grown inside a structure covered with transparent polyethylene sheets. The polyhouse creates a controlled environment that protects plants from unfavourable weather conditions such as heavy rain, excessive heat, frost, and strong winds. This technology helps farmers grow crops throughout the year and improve both the quality and quantity of agricultural produce.



Experimental Study of Light Dependent Resistor (LDR) & Its Application in Energy Efficient Automation

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Abstract: *This research project presents an in-depth investigation into the photoconductive characteristics of the Light Dependent Resistor (LDR) and evaluates its vital role as a transducer in modern, energy-efficient automation frameworks. Operating on the fundamental principles of the photoelectric effect and bandgap transitions, the LDR exhibits a highly predictable, non-linear logarithmic drop in resistance when subjected to visible light photons. By establishing a direct sensory link between environmental light variations and electronic control logic, this passive semiconductor device introduces "ambient intelligence" into physical infrastructure. This study analyzes various real-world, high-impact applications of LDR technology, specifically focusing on Smart Street Lighting Systems (SSLs), dual-axis solar tracking setups, automotive safety interfaces, and smart home daylight harvesting mechanisms.*

Experimental evaluations demonstrate that integrating LDR-driven adaptive threshold and pulse width modulation dimming loops into public grids reduces municipal energy wastage by up to 60%. Furthermore, applying differential quad-sensor tracking arrays to photovoltaic installations optimizes the solar angle of incidence, expanding daily clean energy extraction yields by 40% to 55% compared to conventional fixed configurations. Although technical challenges such as physical material latency, hysteresis memory

effects, and RoHS heavy-metal restrictions regarding Cadmium Sulfide (CdS) usage exist, they can be reliably bypassed through software debouncing and ongoing developments in organic photoconductors. Ultimately, this project synthesizes physical characterization data with architectural performance metrics to confirm that the low-cost, ultra-low-power, non-polarized profile of the LDR makes it an essential engineering component for global net-zero initiatives and smart city grids.

Keywords: *Light Dependent Resistor (LDR), Photoconductivity, Bulk effect semiconductor, Electron-hole pair generation, Dark resistance, Resistance-Illumination (R-L) characteristic, Power-law relationship, Sensitivity slope, Rise time and decay time, Latency / Latency recovery rate, Memory effect (Hysteresis), Software debouncing algorithm, Energy-efficient automation, Smart Street Lighting Systems (SSLs), Dual-axis solar tracking arrays, Cosine Law of Irradiation optimization, Daylight harvesting, Constant Lux maintenance, Automated fenestration control (Motorized shading), Safety interlock etc.*



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A Study on Thanatosis (Playing Dead) Behaviour in Different Coleopteran Species

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Abstract-- Thanatosis, commonly known as “playing dead” or tonic immobility, is a widespread anti-predator behaviour observed in many insect groups, particularly within the order Coleoptera (beetles). This study investigates the occurrence, duration, and ecological significance of thanatosis among different coleopteran species collected from agricultural and semi-natural habitats. Behavioural observations were conducted under controlled laboratory conditions using standardized mechanical stimuli to induce tonic immobility. Species belonging to the families Coccinellidae, Tenebrionidae, Carabidae, and Curculionidae were examined. Significant interspecific variation was observed in the frequency and duration of thanatosis responses Coccinellidae (83%), Tenebrionidae (70%), Carabidae (63%), and Curculionidae (90%). Environmental factors such as temperature, light intensity, and handling stress also influenced behavioural expression. The findings suggest that thanatosis serves as an adaptive survival strategy and may vary according to ecological niche, predator pressure, and physiological condition. This study contributes to behavioural entomology by enhancing understanding of defensive adaptations in beetles and their evolutionary implications.

Keywords-- anti-predator behaviour, beetles, behavioural ecology, Coleoptera, Thanatosis, tonic immobility

I. INTRODUCTION

Behavioural adaptations are crucial for the survival of insects in predator-rich environments. Among these adaptations, thanatosis, or death-feigning behaviour, is one of the most fascinating and evolutionarily significant defensive mechanisms. Thanatosis refers to a temporary state of immobility induced by external threats, during which the organism mimics death to avoid predation. The order Coleoptera represents the largest insect order, exhibiting remarkable diversity in morphology, habitat preference, and defensive strategies. Several beetle species demonstrate thanatosis when exposed to predators or mechanical disturbances. The behaviour has been documented in ladybird beetles, ground beetles, darkling beetles, and weevils, among others.

Previous studies have indicated that the duration and effectiveness of thanatosis may depend on factors such as predator type, environmental conditions, age, sex, and physiological state. However, comparative studies involving multiple coleopteran species remain limited. Understanding these behavioural differences can provide insights into evolutionary ecology and species-specific survival strategies.

The present study aims to compare thanatosis behaviour among different beetle species and evaluate the factors influencing its expression.

Objectives

1. To observe thanatosis behaviour in selected coleopteran species.
2. To compare the duration and frequency of tonic immobility among species.
3. To determine the influence of environmental factors on thanatosis behaviour.
4. To analyze the ecological significance of death-feigning behaviour in beetles.

II. REVIEW OF LITERATURE

Charles Darwin first discussed anti-predator adaptations in animals as part of natural selection theory. Thanatosis has since been studied across various taxa including insects, reptiles, birds, and mammals. Jean Henri Fabre documented defensive immobility in several beetle species during his classical entomological observations. Akihisa Miyatake demonstrated genetic variation in tonic immobility duration in beetles, suggesting heritable behavioural traits. Takahisa Mayatake (2004) observed death-feigning in the red flour beetle *Tribolium castaneum*. Miyatake (2004) also studied the effect of starvation on death-feigning in adults of *Cylas formicarius*. Honma & Nishida (2006) studied the process of feigning death to avoid predation. Sugiura (2018) explained the anti-predator strategies of insects. Nishino and Sakai (1996) studied the behaviorally significant immobile state of thanatosis in *Gryllus bimaculatus*.



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Cocoon Reconstruction Behavior in *Spilosoma obliqua* (Walker) Under Semi-Controlled Rural Conditions in Western Uttar Pradesh, India

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Abstract-- This study presents an observational case study of larval development, cocoon formation and pupation in *Spilosoma obliqua* under semi-controlled rural conditions in Western Uttar Pradesh, India. A single larva was collected from a berseem (*Trifolium alexandrinum*) agricultural field and maintained under ambient environmental conditions (28–37°C) and relative humidity ranging from 40–55%. The larva exhibited normal feeding behavior followed by a pre-pupal phase characterized by reduced activity and substrate-seeking behavior. During cocoon formation, an unintended physical disturbance resulted in displacement of the larva from its initial cocooning site. Following this event, the larva subsequently resumed cocoon construction using silk soil particles, tissue fibers, and plant fragments. Cocoon formation was completed within approximately 15–16 hours.

Incomplete adult eclosion was observed during the late pupal stage with only partial emergence of anterior structures. The findings provide preliminary observational insight into developmental behavior and disturbance-associated cocoon reconstruction response under semi-natural conditions. However, interpretations remain limited due to the single-individual design and absence of replication.

Keywords-- behavioral observation, case study, cocoon reconstruction, larval development, pupation, *Spilosoma obliqua*

I. INTRODUCTION

Spilosoma obliqua is a polyphagous lepidopteran pest widely distributed in agricultural ecosystems. The species undergoes complete metamorphosis involving larval, pupal, and adult stages. Previous studies have documented larval growth, feeding behavior, and developmental biology under controlled laboratory conditions. However, field-based observational records under semi-natural rural conditions remain limited.

Cocoon formation and pupation represent critical developmental stages in Lepidoptera and may be influenced by environmental disturbance. General metamorphic and developmental processes in insects have been described extensively by Chapman (2013) and Gullan & Cranston (2014).

Environmental stress and developmental disturbance have been reported to influence insect pupation and emergence success (Nation, 2015). However, behavioral responses to cocoon disturbance and reconstruction in *S. obliqua* remain limited. The present study reports an individual-based observational account of larval development, cocoon formation, and disturbance-associated cocoon reconstruction behavior under semi-controlled rural conditions in Western Uttar Pradesh, India.

II. MATERIALS AND METHODS

A single larva of *Spilosoma obliqua* was collected on 2 April 2026 from a berseem (*Trifolium alexandrinum*) agricultural field in Western Uttar Pradesh, India. The specimen was maintained in a ventilated plastic container (~14 cm diameter) lined with soil and tissue substrate. A fine cotton mesh covering was used to permit ventilation while preventing escape. The larva was reared under natural day–night conditions without artificial environmental regulation. Ambient temperature ranged between 28–37°C and relative humidity ranged from approximately 40–55% under local rural environmental conditions.

Fresh *Trifolium alexandrinum* leaves were provided daily at approximately mid day and replaced once per day. Observations were recorded regularly throughout larval feeding, pre-pupal, pupal and cocooning stages. Body weight measurements were recorded periodically using a digital balance. Photographic documentation was performed at regular developmental intervals.

III. OBSERVATIONS

Developmental Timeline

- Collection: 2 April
- Cocoon initiation: 12 April (~3 PM, disturbed)
- Cocoon reconstruction: same day (~5 PM)
- Cocoon completion: 13 April (~8:00–9:00 h)
- pupal stage observed: after 4 days
- Cocoon formation duration: ~ 15–16 hours



Nature v/s Nurture: Contrasting Lives of Street and Domestic Dogs

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ABSTRACT:

Dogs have been living in human societies for a very long time. We have seen humans and dogs co-existing while providing benefits to each other in terms of protection, companionship, food, shelter etc. Nowadays, domestication of dogs has become an essential part of human society, this raises the question of whether it is truly beneficial or ethically appropriate for dogs?

The present study aims to critically examine whether the domestication is essential for dogs or if a natural free-ranging lifestyle is more suitable, by comparing a street dog and a domestic dog in semi-urban areas, focusing on their behavior, mental, health and survival instincts. This study explores the different issues of growing urbanization which has led to a shortage of food availability and natural habitat for dogs, this issue is further enhanced when some social human groups feeds them by packaged food items. Another issue is concerned with disease and health problems seen in domesticated dogs while coming in contact with mating centres. This study also consider the approach of relocating street dogs to shelters, highlighting the need to balance animal welfare with natural behaviour.

The findings suggest that instead of complete domestication, a balanced environment should be provided respecting their natural behaviour and ecological co-existence. Authorities and Institutional bodies should propose policies for welfare of dogs in modern society.

KEYWORDS: Dog domestication, Free-ranging dogs, Urbanization, Animal-welfare, Human-animal interaction, Behavioural adaptation.

INTRODUCTION:

Dogs have lived in close association with humans for thousands of years and are considered one of the earliest domesticated animals. Their origin is commonly linked to wolves, from which they have evolved through a long process that is domestication and adaptation to human environment.^[1] This long-standing relationship has developed into mutual association, where dogs provide protection, companionship, and assistance while humans offer food, shelter and care.

With the developing human civilization and leading urbanization this dog-human relationship has undergone many changes. Free-ranging dogs, which were surviving on their own independently in their natural habitat, are now increasingly influenced by human activities, availability of food resources and environmental modifications.^[2] This has led to the emergence of two distinct groups: domestic dogs that are dependent on humans, and free-ranging street dogs that continue to survive with varying degrees of independence.

Nowadays, the co-existence of free-ranging and domestic dogs has become a matter of concern, majorly in semi-urban and urban areas. Issues related to food scarcity, habitat loss, disease transmission and human intervention have raised important ethical questions regarding dog domestication. It becomes necessary to examine whether domestication is truly beneficial for dogs rather than letting them being in their own lifestyle.

Therefore, this study aims to examine the negative impact of dog domestication and to highlight the importance of a free-ranging lifestyle for natural well-being of dogs.

Behavioural comparisons of street and domestic dogs: Free-ranging dogs and domestic dogs show behavioural differences due to variation in environmental exposure and human dependence. Free-ranging dogs adapt themselves according to their surroundings, which enhance their survival skills. They adapt high learning ability and alertness, shows territorial behavior and have different impact regarding stress, freedom and behavioural expression than the domestic dogs. Studies have shown that free-ranging dogs are capable of complex decision-making and can effectively interpret human cues to enhance their survival in urban ecosystems.^[3] Additionally, recent research indicates that they can quickly learn and recognize humans based on reward-based interactions, demonstrating cognitive flexibility and adaptive behaviours.^[4]

In contrast, domestic dogs are hugely dependent on humans for feeding, shelter and protection. This limits their exposure to natural survival behaviour, reduce their independence and nature of expression. Their activities are often controlled by humans such as mating, walking in confined areas, type of diet etc., leading to restrict their behavioural development.



The Role of Floral Colour in Insect Pollinator Attraction in Urban Garden Plants.

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ABSTRACT

Pollinating insects play an important role in maintaining stability of ecosystem and plant reproduction through pollen transfer. In this conceptual study, the association between floral colour and pollinator attraction in selected urban garden plants is examined. Five flowering species were considered namely, marigold (*Tagetes* spp.), rose (*Rosa* spp.), white hibiscus (*Hibiscus rosa-sinensis*), dandelion (*Taraxacum* spp.) and Sada Bahaar (*Catharanthus roseus*). Pollinating insects are essential for the stability of ecosystems and for plant reproduction through the transfer of pollen. In this conceptual study, the association between floral colour and pollinator attraction in selected urban garden plants is examined. We considered five flowering species: marigold (*Tagetes* spp.), rose (*Rosa* spp.), white hibiscus (*Hibiscus rosa-sinensis*), dandelion (*Taraxacum* spp.), and Sada Bahaar (*Catharanthus roseus*).

It is also thought that colour has an effect on the visits of insects. I explored relationships between the floral colour of the plants studied and the relative activity levels of different groups of insects including: Honeybees, butterflies, moths, hover flies, and Diptera. The framework states that the yellow/orange flowers will attract bees and Diptera, pink/red flowers are favoured by butterflies and hover flies, and the white flowers will be most active when the moths are present.

The paper suggests theoretical concepts about vision and signalling in insects and flowers, in order to make a clear 20:80 restore approach to ecological restoration by use of keystone flowers.

Keywords: Pollinators, floral colour perception, insect vision, urban garden plants, honeybee (*Apis* spp.), butterfly interaction, conceptual ecological model.

Introduction:

Pollinators have a critical role in the structure and integrity of ecosystems by mediating the process of sexual reproduction in flowering plants through the transport of pollen. Insects such as the honeybees, butterflies, moths, hoverflies and dipterans are among the most important pollinating animals in the terrestrial environments^[1,2] This process with the flowering plants are mainly mediated through various ecologically relevant cues where floral colour is considered as one of the most prominent visually mediated cues^[3]. In urban environment the ongoing land fragmentation and the loss of natural vegetation can cause the depletion of the pollinator diversity and populations, the flowering ornamental plants are one of the essential source of the resource for sustaining pollinator populations in the garden ecosystems of urban landscapes^[4].

There is a wide variety of floral colours exhibited by these plants and can have differential impacts on visiting patterns based on the visual systems of the insects. Insects perceive and processes visual information based on their specialized visual systems that perceive range of colour that may fall outside of the range of human vision. These factors are critical to the process of differentiating the visual signals of flowers, and thus contribute to the selection of the plant for foraging. Different groups of pollinator may perceive different colour spectrum^[5,6]. It is not fully understood on how this colour diversity displayed in the common garden plant can determine the pollinator preference in a simpler conceptual framework^[8-10].

Thus, we develop a conceptual framework using selected flowers for investigate relationship between floral colour and insect pollinator preference and propose a theoretical **20:80 restorative model** in demonstrating the importance role of keystone flowering plant species in Ecological restoration.



Use of Neem-Based Biopesticides in Integrated Pest Management (IPM) Modules

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ABSTRACT

Integrated Pest Management (IPM) is a sustainable approach to pest control that combines biological, cultural, mechanical, and chemical methods to maintain pest populations below economic injury levels. Due to the adverse effects of synthetic pesticides, there is increasing interest in eco-friendly alternatives. Neem-based biopesticides derived from *Azadirachta indica* have emerged as an effective component of IPM due to their insecticidal, antifeedant, repellent, and growth-regulating properties. The present paper reviews and evaluates the role of neem-based formulations such as neem seed kernel extract (NSKE), neem oil, and commercial neem products in pest management systems. Field observations indicate that neem treatments significantly reduce pest populations, conserve beneficial insects, and improve crop yield compared to untreated control. Although chemical pesticides provide faster knockdown, neem-based biopesticides offer long-term ecological safety and sustainability. The study concludes that neem-based products are essential for sustainable agriculture and should be integrated into IPM modules to reduce chemical dependency and environmental risks.

Keywords: Neem, IPM, biopesticides, azadirachtin, sustainable agriculture, pest management, NSKE

Introduction

Agricultural production is continuously challenged by a wide range of insect pests, diseases, and weeds that significantly reduce crop yield and quality. To overcome these challenges, farmers have traditionally relied on synthetic chemical pesticides. Although these chemicals provide quick and effective pest control, their indiscriminate and excessive use has led to serious environmental and health concerns, including pesticide residues in food, contamination of soil and water resources, development of pest resistance, and the destruction of beneficial organisms. These issues have highlighted the urgent need for sustainable and environmentally safe pest management approaches.

Integrated Pest Management (IPM) has emerged as a promising alternative strategy that aims to maintain pest populations below economically damaging levels while minimizing ecological disruption. IPM is a holistic approach that integrates multiple pest control methods such as cultural practices, mechanical control, biological agents, host plant resistance, and the judicious use of chemical pesticides only when necessary. The primary objective of IPM is not to eliminate pests completely but to manage them in a way that is economically viable, environmentally safe, and socially acceptable.

In recent years, there has been a growing emphasis on the use of botanical pesticides as an important component of IPM systems. Botanical pesticides are derived from plants and are considered safer alternatives to synthetic chemicals due to their biodegradability, low toxicity to non-target organisms, and minimal environmental persistence. Among various plant-derived pesticides, neem-based products obtained from *Azadirachta indica* have gained global recognition for their broad-spectrum insecticidal properties and suitability in sustainable agriculture.

The neem tree is native to the Indian subcontinent and has been used in traditional agriculture and medicine for centuries. Every part of the neem tree, including leaves, seeds, bark, and oil, contains biologically active compounds. The most important among these is azadirachtin, along with nimbin, salannin, and meliantriol. These compounds exhibit a variety of effects on insect pests, including antifeedant action, growth regulation, repellency, and sterilization. Unlike conventional insecticides that kill insects immediately, neem-based products interfere with the physiological and hormonal processes of insects, leading to disrupted growth, reduced feeding, and impaired reproduction.

Objectives of the Study

The objectives of this research are:

1. To evaluate the effectiveness of neem-based biopesticides against major insect pests.
2. To compare neem formulations with chemical insecticides.



Economic Importance of Spices & their Contribution

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ABSTRACT

Spices is considered as one of the most essential elements of Indian household. India is among the world's leading producers, consumers, and exporters of spices. Besides enhancing the flavor and aroma of food, spices play an important role in employment generation, export earnings, industrial development, and rural livelihoods. This study examines the economic importance of major spices cultivated in India, including ginger, turmeric, coriander, cumin, chili, black pepper, cardamom, and clove. The research consist of data on two aspects. Primary information was collected through observations and discussions with spice traders in Muzaffarnagar, Uttar Pradesh, while secondary information was gathered from government reports, books, and research publications. The findings reveal that the spice sector contributes significantly to agricultural income, foreign exchange earnings, and value-added industries such as food processing, pharmaceuticals, and cosmetics. The study also highlights market trends, consumer preferences, and future challenges affecting the spice industry. The paper concludes that strengthening quality standards, improving market infrastructure, and promoting value-added products can further enhance the contribution of spices to India's economy.

Keywords: Spices, Indian Economy, Agriculture, Export Trade, Rural Development, Spice Industry, Employment Generation

1. Introduction

Spices are natural products obtained from different parts of plants such as seeds, roots, rhizomes, bark, fruits, flowers, and leaves. They are mainly used to improve the taste, aroma, color, and shelf life of food. Apart from culinary applications, spices possess medicinal, preservative, and nutritional properties that make them valuable in several industries.

India has historically been known as the "Land of Spices." Favorable climatic conditions, diverse agro-ecological regions, and a rich agricultural tradition enable the cultivation of a large number of spice crops. Major Indian spices include turmeric, ginger, cumin, coriander, chili, black pepper, cardamom, and clove.

The history of spice trade has greatly influenced economic and political developments across the world. Ancient trade routes connected India with Europe, Africa, and Asia. The global demand for Indian spices encouraged exploration and international trade, making spices one of the most valuable commodities in history.

Today, the spice industry remains an important component of the Indian economy. It supports millions of farmers and workers, contributes to exports, and supplies raw materials to food processing, pharmaceutical, cosmetic, and beverage industries. Growing consumer preference for natural products and traditional remedies has further increased demand for spices in domestic and international markets.

2. Objectives of the Study

The objectives of this study are:

1. To examine the economic importance of major spices cultivated in India.
2. To analyze the contribution of spices to agriculture and rural employment.
3. To study the role of spices in domestic and international trade.
4. To understand consumer preferences and market demand.
5. To identify challenges and opportunities in the spice sector.



Biofuel Plants and Renewable Energy Resources: A Sustainable Approach for Future Energy Security

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ABSTRACT :

The increasing global demand for energy and the environmental problems associated with fossil fuels have created an urgent need for sustainable energy alternatives. Biofuel plants convert biomass such as agricultural residues, food waste, animal manure, and energy crops into renewable fuels including bioethanol, biodiesel, and biogas. Renewable energy resources such as solar, wind, hydropower, geothermal energy, and biomass play a significant role in reducing greenhouse gas emissions and promoting sustainable development. This paper reviews the importance of biofuel plants, their production processes, environmental benefits, challenges, and future prospects. The study concludes that biofuel plants can contribute substantially to energy security, waste management, and environmental protection when integrated with other renewable energy technologies.

Keywords: Biofuel, Biomass, Renewable Energy, Biodiesel, Bioethanol, Biogas, Sustainability

INTRODUCTION

Energy is essential for economic growth and human development. Excessive dependence on fossil fuels has resulted in environmental degradation and climate change. Renewable energy resources have emerged as sustainable alternatives. Among these, biomass-based biofuels provide a unique opportunity to generate energy while utilizing organic waste materials.

OBJECTIVES OF THE STUDY

- To understand the concept and functioning of biofuel plants.
- To study different types of biofuels and their production methods.
- To evaluate the environmental and economic benefits of biofuel production.
- To identify challenges associated with biofuel technologies.
- To assess future prospects of renewable energy resources.

BIOFUEL PLANTS AND THEIR WORKING

Biofuel plants are industrial facilities that convert biomass into renewable fuels. Biomass feedstock includes crop residues, forestry waste, food waste, animal manure, and energy crops. The process generally involves biomass collection, pretreatment, conversion, purification, and distribution.

Major biofuels include:

- Bioethanol
- Biodiesel
- Biogas

RENEWABLE ENERGY RESOURCES

Renewable energy resources are naturally replenished sources of energy. Major renewable energy resources include:



Protecting India's Endangered and Threatened Plant Biodiversity

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ABSTRACT

India is one of 17 mega-diverse countries, hosting ~47,000 plant species, of which ~15,000 are flowering plants. However, rapid land-use change, habitat fragmentation, over-harvesting, and climate change have placed over 2,500 plant species in threatened categories as per IUCN Red List 2023. Among them, 960+ medicinal plant species face high trade pressure, with 70% of raw material still sourced from wild populations. This article reviews current conservation and domestication strategies for endangered and threatened plant species in India. It compares in-situ approaches such as protected areas, sacred groves, and community forests with ex-situ methods including seed banks, botanical gardens, and tissue culture. The concept of "conservation through domestication" is examined using case studies of *Rauwolfia serpentina*, *Santalum album*, and *Taxus wallichiana*. Data from field surveys 2022-2024 and institutional records from NBPGR, CIMAP, and FRLHT show that domestication can reduce wild harvest pressure by 60-70% while increasing farmer income 3-4 times compared to traditional crops. Key barriers include long gestation periods for trees, lack of market linkage, and weak implementation of the Biological Diversity Act 2002. The article concludes that an integrated model combining in-situ protection, ex-situ backup, and market-linked domestication is essential for meeting CBD targets and Sustainable Development Goal 15. Policy recommendations include a "Red List Cultivation Mission", community seed banks, DNA barcoding for traceability, and farmer-industry partnerships.

Keywords: Endangered plants, Threatened species, In-situ conservation, Ex-situ conservation, Domestication, Medicinal plants, Biodiversity, India

1. Introduction

India's geographic and climatic diversity has resulted in one of the richest plant diversities globally. The country holds 4 of 36 global biodiversity hotspots: Himalaya, Western Ghats, Northeast India, and Andaman-Nicobar Islands. Within this wealth, an estimated 7,000 species are used by traditional communities for food, fiber, timber, and medicine.

Despite this richness, India is also a center of plant endemism under threat. Botanical Survey of India reports that ~2,500 species are threatened: 212 Critically Endangered, 816 Endangered, and 1,487 Vulnerable. The situation is most acute for medicinal and aromatic plants. The trade volume exceeds 500,000 tons annually, valued at over ₹7,000 crore. Demand is growing at 15-20% per year due to herbal, nutraceutical, and pharmaceutical industries.

The core problem is sourcing. More than 70% of traded medicinal plants are still collected from wild habitats. Unsustainable harvesting of roots, bark, and whole plants kills the parent plant and reduces regeneration. *Taxus wallichiana* is a classic example. Its bark contains taxol, an anti-cancer compound. Bark stripping kills the tree, and wild populations in Himachal and Uttarakhand have declined 85% since 1990.

Two parallel responses exist: conservation and cultivation. Conservation focuses on protecting species in nature through protected areas. Cultivation focuses on growing species on farms. But the link between them is weak. "Conservation through domestication" argues that high-demand threatened species must be brought under cultivation so wild populations can recover. Without domestication, conservation becomes a museum exercise. Without conservation, domestication loses genetic diversity.

This article aims to 1) document major threats, 2) assess in-situ and ex-situ strategies, 3) evaluate domestication models, and 4) propose integrated policy pathways for India.

Major Threats to Endangered Plants

1 Habitat Loss and Fragmentation

From 2000-2020, India lost ~1.5 million hectares of forest cover to agriculture, infrastructure, and mining. Shifting cultivation in Northeast India destroys habitat for *Cycas pectinata* and *Rhododendron arboreum*. Fragmentation isolates populations, reducing pollination and seed set.

2 Over-exploitation for Trade



Mushroom Cultivation & Its Economic Importance

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ABSTRACT:

Mushrooms are edible fungi that have gained significant importance worldwide due to their high nutritional value, medicinal properties, and economic benefits. They are considered a valuable source of food because they are rich in proteins, vitamins, minerals, dietary fiber, and bioactive compounds while being low in fat and calories. Often referred to as the "vegetable meat" or "poor man's meat," mushrooms provide a healthy alternative protein source, particularly for vegetarians. In addition to their nutritional significance, mushrooms play an important ecological role by decomposing organic matter and recycling nutrients, thereby contributing to environmental sustainability. Mushroom cultivation has emerged as a profitable agricultural enterprise that can be practiced on a small or large scale. The cultivation process involves the selection of suitable mushroom species, preparation and sterilization of substrates, spawning, incubation, fruiting, harvesting, and post-harvest management. Agricultural wastes such as wheat straw, paddy straw, sawdust, sugarcane bagasse, and other lignocellulosic materials are commonly used as substrates, making mushroom cultivation an eco-friendly method of converting waste into nutritious food. Proper environmental conditions, including temperature, humidity, ventilation, moisture, and cleanliness, are essential for successful production and higher yields. Several edible mushroom species are cultivated commercially, including Button Mushroom (*Agaricus bisporus*), Oyster Mushroom (*Pleurotus ostreatus*), Paddy Straw Mushroom (*Volvariella volvacea*), Shiitake Mushroom (*Lentinula edodes*), and Milky Mushroom (*Calocybe indica*). Each species possesses unique nutritional and medicinal characteristics and is adapted to specific environmental conditions. Oyster and Milky mushrooms are particularly suitable for tropical regions, while Button mushrooms are widely cultivated under controlled conditions. These mushrooms are increasingly used in various food products, functional foods, and dietary supplements due to their health-promoting properties. The nutritional composition of mushrooms makes them highly beneficial for human health. They contain essential amino acids, B-complex vitamins, vitamin D, potassium, phosphorus, iron, selenium, and other important minerals. Bioactive compounds such as β -glucans, phenolic compounds, and antioxidants contribute to immune enhancement, heart health, diabetes management, and potential anticancer effects. Medicinal mushrooms such as Reishi, Shiitake, Turkey Tail, Lion's Mane, Maitake, and Cordyceps have been widely recognized for their therapeutic applications in traditional and modern medicine. Economically, mushroom cultivation offers numerous advantages. It requires relatively low investment, limited land area, and simple infrastructure while providing quick returns. Mushroom farming creates employment opportunities in production, processing, packaging, marketing, and export sectors. It is particularly beneficial for small farmers, women, rural youth, and self-help groups. The mushroom industry also contributes to waste management by converting agricultural residues into valuable food products and organic manure. Furthermore, processed mushroom products such as dried mushrooms, powders, pickles, soups, and canned mushrooms add value and extend shelf life, increasing market opportunities. In India, mushroom cultivation has become one of the fastest-growing sectors of horticulture and agribusiness. Favorable climatic conditions, abundant agricultural residues, growing consumer awareness, and government support have accelerated the development of the mushroom industry. Various government schemes, including MIDH, NABARD assistance, PMFME, PMEGP, and MUDRA loans, provide financial aid, subsidies, training, and technical support to mushroom growers. These initiatives encourage entrepreneurship and sustainable agricultural development.

Keyword: Basidiospore, Germination, Primary Mycelium, Secondary Mycelium, Plasmogamy, Karyogamy, Meiosis, Basidium, Basidiocarp, Vegetative Reproduction, Asexual Reproduction, Sexual Reproduction.

Introduction:

Mushrooms are fleshy, spore-bearing fruiting bodies of fungi that generally grow above the ground on soil, wood, or other organic matter. In botanical classification, mushrooms belong to the Kingdom Fungi. Earlier, fungi were grouped under plants because they are non-motile and possess cell walls, but later they were separated into an independent kingdom due to their unique characteristics such as absence of chlorophyll, heterotrophic mode of nutrition, and different cell wall composition.



HERBAL PRODUCTS AND THEIR ECONOMIC IMPORTANCE: AN OVERVIEW

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ABSTRACT :

The increasing preference for natural and plant-derived products has enhanced the significance of the herbal sector across the world. Herbal products, prepared from medicinal and aromatic plants, are widely utilized in healthcare, nutrition, cosmetics, and wellness industries. Apart from their therapeutic value, these products contribute substantially to economic development by supporting medicinal plant cultivation, generating employment, promoting rural enterprises, and strengthening trade activities. Countries possessing rich plant biodiversity and traditional medicinal knowledge have gained considerable advantages in the expanding herbal market. India represents one such country where medicinal plants form an important component of both traditional healthcare and commercial production systems. This paper reviews the economic contribution of herbal products, their market potential, and the major challenges influencing sustainable industry growth.

Keywords: Herbal products, medicinal plants, herbal economy, traditional medicine, rural development.

INTRODUCTION

Medicinal plants have been associated with human civilization since ancient times. Communities across different regions traditionally relied on plant resources for maintaining health and managing diseases. Over time, this knowledge developed into organized medical systems and contributed to the foundation of numerous modern therapeutic discoveries.

In recent decades, consumer attitudes toward health and wellness have changed considerably. Growing awareness regarding natural ingredients and preventive healthcare has encouraged the use of herbal products in everyday life. These products are now available in diverse forms, including medicines, dietary supplements, personal care products, herbal beverages, and essential oils.

The commercial importance of herbal products extends beyond healthcare. The sector has become an important source of income generation, employment creation, and export development. Consequently, the herbal industry occupies a significant position within both agricultural and industrial economies.

ECONOMIC SIGNIFICANCE OF HERBAL PRODUCTS

The economic contribution of herbal products begins at the cultivation stage. Medicinal plant farming offers farmers opportunities to diversify agricultural production and reduce dependence on conventional crops. Several medicinal species can be cultivated under varied environmental conditions, providing flexibility to farming communities.

The processing and manufacturing sectors further increase economic value. Activities such as drying, extraction, packaging, transportation, and marketing create employment opportunities for skilled and unskilled workers. Small-scale enterprises and community-based industries often participate actively in herbal product production, thereby strengthening local economies.

International trade has also expanded the importance of the herbal sector. Demand for plant-based medicines, natural cosmetics, and wellness products has increased in many countries. As a result, medicinal plant raw materials and value-added herbal formulations contribute to export earnings and industrial growth.

ROLE IN RURAL DEVELOPMENT

The herbal industry provides important livelihood opportunities in rural regions. Farmers, collectors, processors, and local entrepreneurs benefit from activities related to medicinal plants. In several areas, cultivation of herbal crops has improved household income and encouraged self-employment.



To STUDY ON MEDICINAL PLANTS AND THEIR USES IN RURAL AREAS

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ABSTRACT :

For centuries, humanity has relied on plants for its basic necessities and primary healthcare. Traditional medicine systems, particularly Ayurveda, Siddha, and Unani, are deeply rooted in the Indian subcontinent. The Rigveda (5000 BC) and Atharvaveda (4500-2500 BC) contain ancient records of utilizing medicinal plants to treat various ailments.

A floristic survey of ethnomedicinal plants occurring in the rural areas of (Ambehta Shekha, Rankhandi, Kulsat, Jakhwala, and Bhayla are interconnected villages and towns located in the Deoband tehsil of the Saharanpur district, Uttar Pradesh), India was conducted during 2025-2026 to document important flora and information from local community about their medicinal uses. The indigenous knowledge of local traditional uses was collected through open interviews and group discussions with local people of study area during the field trips.

The local inhabitants mostly depend upon their indigenous knowledge to treat their various common health problems people collect useful plants from their surrounding plant communities in wild, semi-wild and some are cultivated as well. Various medicinal plants such as Tulsi (*Ocimum sanctum*), Neem (*Azadirachta indica*), Aloe vera (*Aloe barbadensis*), Giloy (*Tinospora cordifolia*), Amla (*Phyllanthus emblica*), Ashwagandha (*Withania somnifera*), Bael (*Aegle marmelos*), also known as the stone apple and Turmeric (*Curcuma longa*) are commonly used in the study area.

The main objective of the study was to explore traditional knowledge regarding uses of these plants for various medicinal purposes by the rural people of this area from time immemorial. It is evident from the present investigation that the most widely used plant part was leaves, followed by root, seed, whole plant, fruit, bark, stem, wood and flower used for preparing Herbal remedies.

These plants are widely used to treat various ailments such as fever, cough, cold, stomach disorders, skin infections, urinary infection, asthma, paralysis, kidney stones, snake bite, eye infection, skin disorders, fever, cough, cold, bronchitis, viral infections, allergic reactions, diabetes, immunity, anxiety, muscle recovery, neurologic health, diarrhea, dysentery, gastritis, and other digestive disorders, alleviate digestive discomfort, wounds, digestive disorders, joint pain and many other illnesses by the local people of the study area.

The project also discusses the methods of preparation of medicines such as decoction, paste, powder, juice, and infusion. It examines the role of medicinal plants in rural healthcare, their economic importance, and their contribution towards sustainable living. The study reveals that traditional medicinal knowledge is mainly preserved among older generations, but modernization and urbanization are causing gradual decline in this knowledge System.

Introduction

Medicinal plants have been used since ancient times for the treatment of various human diseases and health problems. Medicinal plants are plants that contain natural chemicals useful for treating diseases and maintaining health. Medicinal plants form an important component of traditional healthcare systems throughout the world. India is known for its rich biodiversity and ancient systems of medicine such as Ayurveda, Unani, and Siddha. Nature has always been a valuable source of medicine for human civilization. Long before the development of modern medical science, people relied on plants and herbs for healing and maintaining health. Even today, medicinal plants continue to play an important role in the lives of rural people living in villages near Deoband in Saharanpur district where traditional herbal practices are still common among villagers & where traditional herbal practices are still common among villagers. Due to limited medical facilities and economic conditions, rural populations often depend on plant-based remedies for treatment. Several medicinal plants found in this area possess therapeutic and pharmacological properties.



ORGANIC FARMING AND BIO FERTILIZER

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ABSTRACT:

Organic farming and biofertilizers have emerged as important components of sustainable agriculture, offering environmentally friendly alternatives to conventional farming practices that rely heavily on synthetic fertilizers and pesticides. The increasing concerns regarding soil degradation, environmental pollution, loss of biodiversity, and adverse health effects associated with chemical-intensive agriculture have accelerated the global shift toward organic farming systems. This study examines the principles, practices, advantages, limitations, and economic significance of organic farming and biofertilizers in modern agriculture. Organic farming is a holistic agricultural system that promotes ecological balance, soil fertility, and biodiversity through the use of natural inputs such as compost, farmyard manure, green manure, crop rotation, and biological pest management. It aims to produce healthy and chemical-free food while minimizing environmental impacts. The study highlights the major objectives of organic farming, including soil conservation, sustainable resource utilization, environmental protection, and enhancement of human health. Various forms of organic farming, such as pure organic farming, integrated organic farming, natural farming, biodynamic farming, and vermicomposting-based systems, are discussed in relation to their role in sustainable agricultural development. Biofertilizers are living microbial formulations containing beneficial microorganisms such as *Rhizobium*, *Azotobacter*, *Azospirillum*, phosphate-solubilizing bacteria, mycorrhizae, and blue-green algae. These microorganisms enhance nutrient availability through biological nitrogen fixation, phosphate solubilization, nutrient recycling, and production of plant growth-promoting substances. The application of biofertilizers improves soil fertility, increases crop productivity, enhances soil microbial activity, and reduces dependence on chemical fertilizers. Their role in maintaining long-term soil health and supporting environmentally sustainable farming systems is particularly significant. The study further evaluates the economic importance of organic farming and biofertilizers, emphasizing reduced input costs, improved soil productivity, enhanced market value of organic products, and increased opportunities for rural employment. Despite their numerous benefits, challenges such as lower initial yields, slow nutrient release, certification costs, limited availability of quality biofertilizers, and the need for technical knowledge remain important constraints to widespread adoption. The findings indicate that organic farming and biofertilizers collectively contribute to sustainable agricultural development by improving soil health, conserving natural resources, reducing environmental pollution, and ensuring food safety. With increasing consumer awareness, government support, and demand for organic products, these practices have significant potential to strengthen food security and environmental sustainability. Therefore, the integration of organic farming and biofertilizer technology represents a promising approach for achieving long-term agricultural productivity while safeguarding ecological integrity and human well-being.

Keywords: Organic Farming, Biofertilizers, Sustainable Agriculture, Soil Fertility, Environmental Protection, Nutrient Management, Organic Manure, Crop Productivity, Biodiversity, Eco-friendly Farming.

Introduction to Organic Farming:

Organic farming is a sustainable agricultural practice that relies on natural resources and biological processes for crop production. It avoids the use of synthetic fertilizers, pesticides, and genetically modified organisms (GMOs). Instead, farmers use compost, green manure, crop rotation, and biofertilizers to maintain soil fertility and plant health. This method protects the environment, improves soil quality, conserves biodiversity, and produces safe and nutritious food. Organic farming is considered an important approach for achieving sustainable agriculture and environmental conservation.

Meaning and Definition of Organic Farming:

Organic farming is a natural and eco-friendly system of agriculture that avoids the use of chemical fertilizers, pesticides, herbicides, genetically modified organisms (GMOs), and synthetic growth regulators. It aims to maintain the health of soil, plants, animals, humans, and the environment. Organic farmers use natural inputs such as compost, farmyard manure, green manure, crop rotation, biofertilizers, and biological pest control to improve soil fertility and manage pests. This farming method promotes ecological balance, biodiversity, and sustainable use of natural resources. Organic farming is based on the principle that healthy soil produces healthy plants, which in turn provide safe and nutritious food. It supports sustainable agriculture by conserving soil, water, and air while reducing environmental pollution.



DNA Fingerprinting Using Gel electrophoresis

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ABSTRACT

DNA fingerprinting using Gel electrophoresis is a forensic and molecular biology technique that identifies individuals based on their unique genetic sequence. DNA fingerprinting relies on the analysis of highly variable, repetitive DNA regions, such as Short Tandem Repeats (STRs) and Variable Number Tandem Repeats (VNTRs). 99.9% of human DNA is identical, these specific variable regions are targeted to distinguish one individual from another. In this method, DNA is first extracted from a biological sample such as Blood, Saliva, or Hair. The DNA is then cut into fragments using restriction enzymes or amplified by Polymerase Chain Reaction (PCR). These DNA fragments are separated according to their size by gel electrophoresis, where an electric current moves the negatively charged DNA through an agarose gel. Smaller DNA fragments travel faster and farther than larger ones, producing a distinct banding pattern.

Keywords: Short Tandem Repeats (STRs) and Variable Number Tandem Repeats (VNTRs), Biological sample, Restriction enzymes, Polymerase Chain Reaction (PCR), Gel electrophoresis, Agarose gel.

INTRODUCTION

A technique used to distinguish between individuals of the same species using only sample of their DNA. The process of DNA fingerprinting was invented by Alec Jeffrey, a British geneticist at the University of Leicester, UK in 1984. DNA fingerprinting is also known as DNA Profiling or DNA typing.

OBJECTIVES OF THE STUDY

- # To identify individuals based on their unique DNA pattern.
- # To compare DNA sample from different individuals.
- # To study genetic similarities and differences.
- # To help in forensic investigations by identifying criminals or victims.
- # To establish biological relationships, such as paternity and maternity.
- # To support research in genetics, evolution, and biodiversity.

WORKING PRINCIPLE OF DNA FINGERPRINTING

DNA fingerprinting is based on the principle that every individual has a unique DNA sequence, except identical twins. Certain regions of DNA, called Variable Number Tandem Repeats (VNTRs) or Short Tandem Repeats (STRs), vary from person to person. These variable regions produce a unique pattern of DNA fragments.

In DNA fingerprinting, DNA is extracted, cut into fragments (or STRs are amplified by PCR), and separated by gel electrophoresis according to their size. The resulting band pattern is unique for each individual and can be used for identification, paternity testing, forensic investigations, and genetic studies.



Climate Change: A Rising Global Concern and its Impacts on India

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ABSTRACT

Climate change has emerged as one of the most critical global crises of the modern era, driven primarily by anthropogenic activities such as fossil fuel combustion, industrialization, and rapid deforestation. This paper synthesizes data from the Intergovernmental Panel on Climate Change (IPCC) assessments to evaluate the global and localized impacts of rising temperatures, shifting precipitation patterns, and extreme weather events. Special focus is directed toward India, analyzing its socio-economic vulnerability through unpredictable monsoons, deadly wet-bulb heatwaves, and accelerated Himalayan glacial melt. Additionally, the paper examines India's mitigation strategies via the National Action Plan on Climate Change (NAPCC), including the National Solar Mission, Sustainable Habitat, and Green India Mission. The findings emphasize that while current trends project severe ecological and socio-economic imbalances, timely multi-sectoral cooperation and sustainable policies remain vital to mitigating long-term global destruction.

KEYWORDS : Climate Change, IPCC, Global Warming, Monsoon Variability, Sustainable Development, NAPCC, Extreme Weather Events.

INTRODUCTION

Climate change has emerged as one of the most serious challenges facing our planet today. It refers to long term changes in temperature, weather patterns, and environmental conditions, mainly caused by humans activities deforestation, industrialization and the burning of fossil fuels.

A Climate change is not just an environmental issue but a rising concern that demands immediate attention and collection action. In a 2018 assesment on the efforts of 1.5 degree Celsius global warming, the IPCC conclude that drastic, quick and unprecedented changes in every facet of the global mean temperature will rise by less than 1.8 to 5.4 degree F (1 – 3 degree Celsius) over 1990. Levels will have positive effects in certain areas and negative effects in others. As the global temperature rises, net yearly expenses will eventually rise as well. The increase in global temperature from the middle of the 20th century to the present in frequently referred to as climate change.

THE UN INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC)

:- In 2013, the IPCC in its 6th assessment report has estimated that global warming is expected to reach or exceed 1.5 degree Celsius from 2021 to 2040

1. The average global temperature will increase by 1.5 degree Celsius from 2021 to 2040.
2. The 6th assessment report offers a through analysis that there is an immediate need in the reduction of the green house gas this decade.
3. The emission caused by the humans are responsible for nearly 1.1 degree Celsius of global warming since 1850 -- 1900. To limit this global warming caused by human emission we need to cut the emission by 48% till 2030.
4. Average annual GHG emission during 2010-2019 were higher than in any previous decade, but the rate of growth between 2010 and 2019 (13 % per year) was lower than that between 2000 and 2009 (2.1% per year).

IMPACT OF CLIMATE CHANGE :-

It is unequivocal that human influence has warmed the atmosphere, ocean and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred.

Green Synthesis of Aspirin Using Plant Extracts as Eco-Friendly Catalysts

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Abstract- Green chemistry promotes environmentally sustainable chemical processes by minimizing hazardous substances and waste generation. Aspirin (acetylsalicylic acid), a widely used pharmaceutical drug, is traditionally synthesized using strong acids and non-renewable catalysts, which pose environmental and safety concerns. This study investigates the green synthesis of aspirin using plant extracts such as curry leaves (*Murraya koenigii*), clove (*Syzygium aromaticum*), and neem (*Azadirachta indica*) as natural catalysts. The phytochemicals present in these extracts, including flavonoids, phenols, and alkaloids, facilitate the acetylation reaction under mild conditions. The synthesized aspirin was characterized using UV-Visible spectroscopy, pH measurement, conductivity analysis, viscosity studies, and flame photometry. The results confirmed successful synthesis with satisfactory yield and purity, with clove extract showing the highest efficiency. The study demonstrates that plant-mediated synthesis is a cost-effective, safe, and environmentally benign alternative to conventional aspirin production methods.

Keywords— Green synthesis, Aspirin, Plant extract, Sustainable chemistry, Phytochemicals, Eco-friendly catalysis

I. INTRODUCTION

Aspirin (acetylsalicylic acid) is one of the most widely used drugs due to its analgesic, antipyretic, and anti-inflammatory properties. Conventional synthesis methods involve strong acids and chemical catalysts that are hazardous and environmentally damaging. Green chemistry offers an alternative approach by utilizing renewable resources and minimizing toxic by-products. Plant extracts are rich in bioactive compounds such as flavonoids, tannins, phenols, and alkaloids, which can act as natural catalysts and reducing agents.

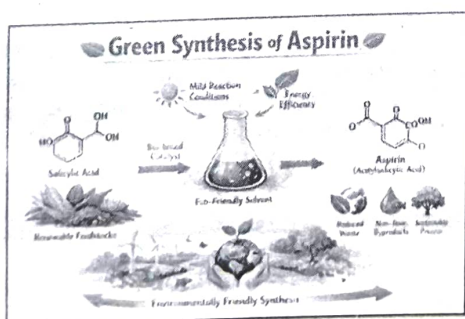


Figure 1: Green Synthesis of Aspirin (Acetylsalicylic Acid)

This study focuses on the synthesis of aspirin using plant extracts and evaluates their effectiveness as eco-friendly catalysts.

II. MATERIALS AND METHODS

1. Materials

- Salicylic acid
- Acetic anhydride
- Plant extracts (clove, curry leaves, neem)
- Distilled water

2. Preparation of Plant Extracts

- Leaves/spices washed and cleaned
- Crushed or powdered
- Boiled in distilled water
- Filtered for use

3. Green Synthesis of Aspirin

- Salicylic acid mixed with acetic anhydride
- Plant extract added as catalyst
- Heated using hot plate (controlled temperature)
- Reaction monitored
- No use of strong mineral acids (eco-friendly approach)



Quantitative Analysis of Heavy Metals in Agricultural Soil

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Abstract— Heavy metal contamination in agricultural soils has become a major environmental concern due to its adverse effects on soil quality, crop productivity, and human health. The present study focuses on the quantitative analysis of heavy metals in agricultural soil samples collected from selected locations. Metals such as lead (Pb), cadmium (Cd), chromium (Cr), nickel (Ni), zinc (Zn), and copper (Cu) were analyzed using standard analytical techniques. Soil samples were collected, air-dried, sieved, and subjected to acid digestion followed by analysis using Atomic Absorption Spectroscopy (AAS). The results indicated variation in heavy metal concentrations across different sampling sites, reflecting the influence of anthropogenic activities such as fertilizer use, wastewater irrigation, and industrial emissions. Some metals were found near or above permissible limits, indicating localized contamination. Statistical analysis revealed correlations among metals, suggesting common sources. The study highlights potential environmental and health risks associated with heavy metal accumulation and emphasizes the need for sustainable soil management and regular monitoring.

Keywords— Heavy metals, Agricultural soil, AAS, Soil contamination, Environmental pollution, Food safety.

I. INTRODUCTION

Agricultural soil plays a crucial role in food production and environmental sustainability. However, increasing industrialization, urbanization, and intensive agricultural practices have led to the accumulation of heavy metals in soils. Heavy metals such as Pb, Cd, Cr, Ni, Zn, and Cu are persistent, non-biodegradable, and toxic at higher concentrations.

These metals enter the soil through natural processes as well as anthropogenic activities including industrial discharge, agrochemicals, wastewater irrigation, and vehicular emissions. Once present in soil, they accumulate and may enter the food chain through plant uptake, posing serious risks to human health.

Quantitative analysis of heavy metals is essential for assessing soil quality, identifying contamination sources, and ensuring food safety. This study aims to evaluate heavy metal concentrations in agricultural soil and assess associated environmental risks.

II. MATERIALS AND METHODS

1. Soil Sampling

Soil samples were collected from agricultural fields using standard sampling techniques. Surface soil (0–15 cm) was collected from multiple locations to ensure representativeness.

2. Sample Preparation

- Samples were air-dried
- Crushed and sieved
- Stored in clean containers

3. Digestion Procedure

Soil samples were subjected to acid digestion using:

- Nitric acid (HNO₃)
- Hydrochloric acid (HCl)

This ensured complete extraction of heavy metals.

4. Heavy Metal Analysis

Quantitative analysis was performed using:

- Atomic Absorption Spectroscopy (AAS)

Metals analyzed

- Lead (Pb)
- Cadmium (Cd)
- Chromium (Cr)
- Nickel (Ni)
- Zinc (Zn)
- Copper (Cu)

5. Statistical Analysis

- Mean and standard deviation calculated
- Correlation analysis performed
- Compared with permissible limits

Green Synthesis of Copper Oxalate Nanopowder Using Plant Extract for Sustainable Nanomaterial Applications

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Abstract— The development of eco-friendly nanomaterials has gained significant attention due to increasing environmental concerns associated with conventional chemical synthesis. This study focuses on the green synthesis of copper oxalate nanopowder using plant extracts as natural reducing and stabilizing agents. Plant-derived phytochemicals such as flavonoids, phenolics, and proteins facilitate nanoparticle formation under mild conditions. The synthesized nanopowder was characterized using basic analytical techniques including UV–Visible spectroscopy, pH measurement, conductivity analysis, viscosity studies, and flame photometry. The results confirmed successful formation of copper oxalate nanoparticles, indicated by characteristic spectral features and stable physicochemical properties. The green synthesis approach proved to be cost-effective, safe, and environmentally benign. The study highlights the potential of plant-mediated synthesis for developing sustainable nanomaterials and their possible applications in catalysis, environmental remediation, and material science.

Keywords— Copper oxalate, Nanopowder, Green synthesis, Plant extract, Nanotechnology, Sustainable chemistry.

I. INTRODUCTION

Nanotechnology has emerged as a transformative field with applications in material science, medicine, and environmental engineering. Metal-based nanoparticles, including copper compounds, are widely studied due to their unique physicochemical properties.

Conventional synthesis methods often involve toxic chemicals, high energy consumption, and hazardous by-products. These limitations have led to the adoption of green chemistry approaches that utilize plant extracts for nanoparticle synthesis. Plant extracts contain bioactive compounds such as flavonoids, alkaloids, and phenolic acids, which act as reducing and stabilizing agents. This study focuses on the green synthesis of copper oxalate nanopowder using plant extract and evaluation of its physicochemical properties.

II. MATERIALS AND METHODS

1. Materials

- Copper salt (Cu^{2+} source)
- Oxalic acid
- Plant extract
- Distilled water

2. Preparation of Plant Extract

- Fresh plant material collected and washed
- Dried and crushed

- Boiled in distilled water
- Filtered to obtain extract

3. Synthesis of Copper Oxalate Nanopowder

- Copper solution mixed with plant extract
- Oxalic acid added gradually
- Reaction maintained under controlled temperature
- Formation of precipitate observed

4. Characterization Techniques

- UV–Visible Spectroscopy
- pH Measurement
- Conductivity Measurement
- Redwood Viscometer
- Flame Photometry

III. RESULTS AND DISCUSSION

1. Formation of Nanopowder

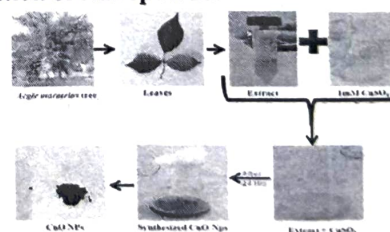


Figure 1: Green synthesis mechanism of copper oxalate nanopowder



A Study On Diophantine Equations

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Abstract- Diophantine equations are polynomial equations in two or more variables whose solutions are restricted to integers. These equations are named after the ancient Greek mathematician Diophantus of Alexandria, who made significant contributions to number theory through his work Arithmetica. Diophantine equations play an important role in modern mathematics, cryptography, computer science, optimization, and algebraic geometry. Although Diophantine equations are a branch of pure number theory concerned with integer solutions of equations, they have several practical applications that affect everyday human life, often indirectly through technology and optimization.

Keywords- Diophantine, lattice, cryptography, Hilbert's problem etc.

I. INTRODUCTION

Historical Background

The study of Diophantine equations dates back to ancient civilizations. The Greek mathematician Diophantus investigated equations with rational solutions, while later mathematicians such as Pierre de Fermat, Leonhard Euler, and Joseph Louis Lagrange expanded the theory significantly. Fermat's famous statement known as Fermat's Last Theorem remained unsolved for more than 350 years.

Definition

A Diophantine equation is an equation of the form $P(x_1, x_2, x_3, \dots, x_n) = 0$ where P is a polynomial with integer coefficients and the solutions sought are integers.

Examples:

$$2x + 3y = 12$$

$$x^n + y^n = z^n \text{ where } n \in \mathbb{N}$$

Types of Diophantine Equations

1. Linear Diophantine Equations

General form:

$$ax + by = c \text{ where } a, b, c \in \mathbb{Z}.$$

Theorem

The equation $ax + by = c$ has integer solutions if and only if $\gcd(a, b) | c$ i.e. gcd of a and b should be divisible by c .

Example

$$\text{Solve: } 3x + 5y = 17$$

One solution is: $x=4, y=1$

Applications include resource allocation, scheduling, and network flow problems.

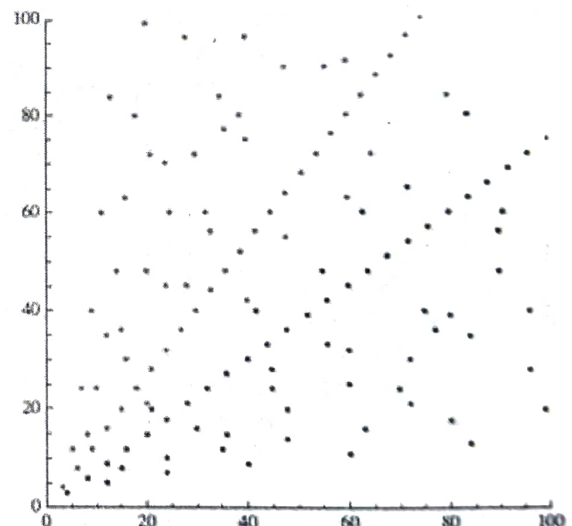
2. Quadratic Diophantine Equations

These involve second-degree terms.

$$\text{Example: } x^2 + y^2 = z^2$$

The solutions are known as Pythagorean triples: $(3, 4, 5), (5, 12, 13), (8, 15, 17)$

Graphical Representation





Relationship Between Graph Theory and Network Analysis: Foundations, Applications, and Future Directions

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Abstract- Graph theory and network analysis are closely interconnected disciplines that play a crucial role in understanding complex systems. Graph theory provides the mathematical framework for representing entities and relationships, while network analysis applies these concepts to investigate structural and functional properties of real-world networks. This paper explores the relationship between graph theory and network analysis, discusses key graph-theoretic measures, examines applications across multiple domains, and identifies emerging research directions including graph neural networks and temporal networks. The study demonstrates that graph theory serves as the theoretical backbone of network analysis and continues to drive innovations in modern data science and artificial intelligence.

Keywords- Graph Theory, Network Analysis, Complex Networks, Centrality Measures, Graph Neural Networks, Network Science.

I. INTRODUCTION

In the modern digital era, the rapid growth of interconnected systems has increased the importance of understanding complex networks. From social media platforms and communication systems to biological interactions and transportation infrastructures, networks are present in almost every aspect of science, technology, and society. The study of these interconnected structures requires robust mathematical tools and analytical techniques capable of representing and examining relationships among entities. Graph theory, a branch of discrete mathematics, provides the fundamental framework for modeling networks through vertices (nodes) and edges (connections). It offers a wide range of concepts, including connectivity, paths, cycles, centrality measures, and graph structures, which enable the representation and analysis of complex systems.

Network analysis, on the other hand, applies these graph-theoretic principles to investigate the structural and functional properties of real-world networks. By utilizing mathematical models derived from graph theory, network analysis helps identify influential nodes, detect communities, evaluate network robustness, and understand information flow within interconnected systems. The relationship between graph theory and network analysis is both foundational and complementary.

While graph theory establishes the theoretical basis for representing relationships, network analysis transforms these mathematical concepts into practical tools for solving real-world problems. This synergy has led to significant advancements in fields such as computer science, artificial intelligence, telecommunications, social sciences, biology, and transportation engineering.

This paper explores the relationship between graph theory and network analysis by examining their fundamental concepts, key graph-theoretic measures, and major application areas. Furthermore, it discusses recent developments, including graph neural networks, dynamic networks, and large-scale graph analytics, highlighting future research directions and emerging opportunities in network science. The rapid growth of interconnected systems such as social media platforms, transportation networks, biological systems, and communication infrastructures has increased the need for advanced network analysis techniques. Network analysis helps researchers understand relationships among entities, whereas graph theory provides the mathematical foundation necessary for such investigations.

Here are some important graphs used in actual life, along with their significance.



To STUDY ON MEDICINAL PLANTS AND THEIR USES IN RURAL AREAS

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ABSTRACT :

For centuries, humanity has relied on plants for its basic necessities and primary healthcare. Traditional medicine systems, particularly Ayurveda, Siddha, and Unani, are deeply rooted in the Indian subcontinent. The Rigveda (5000 BC) and Atharvaveda (4500-2500 BC) contain ancient records of utilizing medicinal plants to treat various ailments.

A floristic survey of ethnomedicinal plants occurring in the rural areas of (Ambehta Shekha, Rankhandi, Kulsat, Jakhwala, and Bhayla are interconnected villages and towns located in the Deoband tehsil of the Saharanpur district, Uttar Pradesh), India was conducted during 2025-2026 to document important flora and information from local community about their medicinal uses. The indigenous knowledge of local traditional uses was collected through open interviews and group discussions with local people of study area during the field trips.

The local inhabitants mostly depend upon their indigenous knowledge to treat their various common health problems people collect useful plants from their surrounding plant communities in wild, semi-wild and some are cultivated as well. Various medicinal plants such as Tulsi (*Ocimum sanctum*), Neem (*Azadirachta indica*), Aloe vera (*Aloe barbadensis*), Giloy (*Tinospora cordifolia*), Amla (*Phyllanthus emblica*), Ashwagandha (*Withania somnifera*), Bacl (*Aegle marmelos*), also known as the stone apple and Turmeric (*Curcuma longa*) are commonly used in the study area.

The main objective of the study was to explore traditional knowledge regarding uses of these plants for various medicinal purposes by the rural people of this area from time immemorial. It is evident from the present investigation that the most widely used plant part was leaves, followed by root, seed, whole plant, fruit, bark, stem, wood and flower used for preparing Herbal remedies.

These plants are widely used to treat various ailments such as fever, cough, cold, stomach disorders, skin infections, urinary infection, asthma, paralysis, kidney stones, snake bite, eye infection, skin disorders, fever, cough, cold, bronchitis, viral infections, allergic reactions, diabetes, immunity, anxiety, muscle recovery, neurologic health, diarrhea, dysentery, gastritis, and other digestive disorders, alleviate digestive discomfort, wounds, digestive disorders, joint pain and many other illnesses by the local people of the study area.

The project also discusses the methods of preparation of medicines such as decoction, paste, powder, juice, and infusion. It examines the role of medicinal plants in rural healthcare, their economic importance, and their contribution towards sustainable living. The study reveals that traditional medicinal knowledge is mainly preserved among older generations, but modernization and urbanization are causing gradual decline in this knowledge System.

Introduction

Medicinal plants have been used since ancient times for the treatment of various human diseases and health problems. Medicinal plants are plants that contain natural chemicals useful for treating diseases and maintaining health. Medicinal plants form an important component of traditional healthcare systems throughout the world. India is known for its rich biodiversity and ancient systems of medicine such as Ayurveda, Unani, and Siddha. Nature has always been a valuable source of medicine for human civilization. Long before the development of modern medical science, people relied on plants and herbs for healing and maintaining health. Even today, medicinal plants continue to play an important role in the lives of rural people living in villages near Deoband in Saharanpur district where traditional herbal practices are still common among villagers & where traditional herbal practices are still common among villagers. Due to limited medical facilities and economic conditions, rural populations often depend on plant-based remedies for treatment. Several medicinal plants found in this area possess therapeutic and pharmacological properties.



HERBAL PRODUCTS AND THEIR ECONOMIC IMPORTANCE: AN OVERVIEW

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ABSTRACT :

The increasing preference for natural and plant-derived products has enhanced the significance of the herbal sector across the world. Herbal products, prepared from medicinal and aromatic plants, are widely utilized in healthcare, nutrition, cosmetics, and wellness industries. Apart from their therapeutic value, these products contribute substantially to economic development by supporting medicinal plant cultivation, generating employment, promoting rural enterprises, and strengthening trade activities. Countries possessing rich plant biodiversity and traditional medicinal knowledge have gained considerable advantages in the expanding herbal market. India represents one such country where medicinal plants form an important component of both traditional healthcare and commercial production systems. This paper reviews the economic contribution of herbal products, their market potential, and the major challenges influencing sustainable industry growth.

Keywords: Herbal products, medicinal plants, herbal economy, traditional medicine, rural development.

INTRODUCTION

Medicinal plants have been associated with human civilization since ancient times. Communities across different regions traditionally relied on plant resources for maintaining health and managing diseases. Over time, this knowledge developed into organized medical systems and contributed to the foundation of numerous modern therapeutic discoveries.

In recent decades, consumer attitudes toward health and wellness have changed considerably. Growing awareness regarding natural ingredients and preventive healthcare has encouraged the use of herbal products in everyday life. These products are now available in diverse forms, including medicines, dietary supplements, personal care products, herbal beverages, and essential oils.

The commercial importance of herbal products extends beyond healthcare. The sector has become an important source of income generation, employment creation, and export development. Consequently, the herbal industry occupies a significant position within both agricultural and industrial economies.

ECONOMIC SIGNIFICANCE OF HERBAL PRODUCTS

The economic contribution of herbal products begins at the cultivation stage. Medicinal plant farming offers farmers opportunities to diversify agricultural production and reduce dependence on conventional crops. Several medicinal species can be cultivated under varied environmental conditions, providing flexibility to farming communities.

The processing and manufacturing sectors further increase economic value. Activities such as drying, extraction, packaging, transportation, and marketing create employment opportunities for skilled and unskilled workers. Small-scale enterprises and community-based industries often participate actively in herbal product production, thereby strengthening local economies.

International trade has also expanded the importance of the herbal sector. Demand for plant-based medicines, natural cosmetics, and wellness products has increased in many countries. As a result, medicinal plant raw materials and value-added herbal formulations contribute to export earnings and industrial growth.

ROLE IN RURAL DEVELOPMENT

The herbal industry provides important livelihood opportunities in rural regions. Farmers, collectors, processors, and local entrepreneurs benefit from activities related to medicinal plants. In several areas, cultivation of herbal crops has improved household income and encouraged self-employment.



Green Synthesis and Characterization of Silver Nanoparticles Incorporated Nanohydroxyapatite for Antimicrobial Applications

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DOI: <https://doi.org/10.63680/ijstate0626107.109>

Abstract

Nanotechnology has emerged as a powerful interdisciplinary field with extensive applications in chemistry, medicine, and materials science. In the present study, a cost-effective and eco-friendly green synthesis route was employed to prepare silver nanoparticle-incorporated nanohydroxyapatite (nHA-AgNP) intended for biomedical applications. Nanohydroxyapatite was synthesized from waste eggshells using a wet precipitation method, while silver nanoparticles were prepared using *Ocimum sanctum* (Tulsi) leaf extract as a biological reducing and capping agent. The synthesized materials were characterized using X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), and scanning electron microscopy (SEM). XRD analysis confirmed the crystalline nature of AgNP, nHA, and nHA-AgNP with average particle sizes of 29.69 nm, 45.32 nm, and 36.83 nm, respectively. FTIR spectra revealed characteristic functional groups and strong interaction between silver nanoparticles and hydroxyapatite. SEM images showed agglomerated nanostructures with porous morphology favorable for biomedical applications. Antimicrobial studies against *Escherichia coli* and *Staphylococcus aureus* demonstrated enhanced antibacterial activity of the nHA-AgNP composite compared to individual components. The results indicate that the synthesized nHA-AgNP nanocomposite has potential applications in orthopedic and dental implants due to its biocompatibility and antibacterial properties.

1. Introduction

Nanotechnology deals with the manipulation of matter at dimensions between 1–100 nm, where materials exhibit unique physicochemical properties distinct from their bulk counterparts.

Nanochemistry, an important branch of nanotechnology, focuses on the synthesis, characterization, and application of nanomaterials in chemical, biological, and medical fields. Among various nanomaterials, metal nanoparticles and bioceramics have gained considerable attention due to their multifunctional properties.

Hydroxyapatite ($\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$) is a naturally occurring calcium phosphate mineral and the principal inorganic constituent of human bone and teeth. Due to its excellent biocompatibility, bioactivity, and osteoconductivity, hydroxyapatite has been widely used in bone tissue engineering, dental implants, and



The Chemistry of Biofuels: Sources, Conversion Technologies and Indian Perspective

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DOI: <https://doi.org/10.63680/ijstate0626108.110>

Abstract

The rapid increase in global energy demand, depletion of fossil fuel reserves, and growing environmental concerns have intensified the need for sustainable and renewable energy alternatives. Biofuels, derived from biological resources such as agricultural crops, forestry residues, algae, and organic wastes, have emerged as promising substitutes for conventional fossil fuels. This research paper provides a comprehensive overview of the chemistry of biofuels, emphasizing their classification into first-, second-, and third-generation biofuels based on feedstock type and conversion technology. The study critically examines the fundamental chemical processes involved in biofuel production, including transesterification in biodiesel synthesis and fermentation in bioethanol production. In addition, advanced thermochemical and biochemical conversion pathways such as pyrolysis, gasification, and enzymatic hydrolysis are discussed with respect to their efficiency and technological challenges. The physicochemical properties of biofuels and their environmental advantages, particularly reductions in greenhouse gas emissions and air pollutants, are also analyzed. Furthermore, the paper evaluates the current status of biofuel development in India, highlighting government initiatives, availability of nonedible feedstocks, and barriers to large-scale commercialization. The study concludes that biofuels represent a viable and environmentally sustainable energy option, provided that existing technological, economic, and policy challenges are effectively addressed through continued research and strategic implementation.

1. Introduction

The global energy landscape is undergoing a transformative shift driven by the twin challenges of fossil fuel depletion and climate change. Conventional energy sources such as coal, petroleum, and natural gas have powered industrial growth for over a century, yet their continued use has led to alarming levels of greenhouse gas emissions, environmental degradation, and geopolitical dependence on finite reserves. In this context, biofuels have emerged as a promising renewable alternative capable of bridging the gap between energy demand and environmental sustainability.



Role Of Antioxidants In Food Preservation

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Abstract: Enzymatic browning represents one of the most significant post-harvest challenges affecting fresh fruits and vegetables, leading to rapid deterioration in visual appeal, flavor, texture, and nutritional quality. This phenomenon primarily occurs due to the activity of polyphenol oxidase (PPO), which catalyzes the oxidation of phenolic compounds into quinones that subsequently polymerize into brown pigments. Such changes not only reduce consumer acceptability but also contribute to substantial economic losses in the food industry. In recent years, increasing consumer awareness regarding food safety and the demand for clean-label products have led to a shift away from synthetic antioxidants such as BHA and BHT toward natural alternatives. Natural antioxidants derived from plant sources are considered safer, environmentally friendly, and beneficial for health due to their additional bioactive properties. The present study focuses on evaluating the comparative effectiveness of selected natural antioxidants—ascorbic acid, citric acid, fresh lemon juice, sodium chloride, and calcium chloride—in inhibiting enzymatic browning in fresh-cut apple slices (cv. Fuji). The samples were treated with different concentrations of these agents and monitored over a period of 120 minutes under controlled conditions. Browning intensity was assessed using a standardized visual scale, and percentage inhibition was calculated relative to untreated controls. Additionally, in-vitro antioxidant assays such as DPPH and ABTS were performed to validate the radical scavenging capacity of the tested compounds. The results demonstrated that ascorbic acid exhibited the highest efficacy, completely inhibiting browning at higher concentrations. Lemon juice also showed strong antioxidant activity due to the synergistic presence of ascorbic acid, citric acid, and flavonoids. Citric acid displayed moderate effectiveness by reducing pH and chelating metal ions, while sodium chloride and calcium chloride showed comparatively lower inhibitory effects.

Keywords: Flavor, Texture, Lemon Juice, Sodium Chloride, Metal Ion, Antioxidant, BHA

I. INTRODUCTION

A. History Of Food Preservation

Food preservation has evolved from traditional methods like drying and fermentation to modern techniques such as refrigeration, irradiation, and smart packaging. These advancements have significantly improved food safety and shelf life.

B. Need For Food Preservation

In modern society, food preservation ensures food security, reduces waste, and maintains nutritional quality during storage and transportation.

C. Role Of Oxidation In Food Spoilage

Oxidation causes rancidity, color changes, and nutrient loss. It significantly reduces the quality and safety of food products.

D. Introduction To Antioxidants

Antioxidants neutralize free radicals and prevent oxidative damage. They play a crucial role in maintaining food quality and human health.

E. Types Of Food Spoilage

- Microbial spoilage
- Enzymatic spoilage
- Chemical spoilage

F. Enzymatic And Non-Enzymatic Oxidation

Enzymatic oxidation occurs due to enzymes like polyphenol oxidase, while non-enzymatic oxidation involves environmental factors like oxygen and light.

G. Factors Affecting Oxidation

- Temperature
- Light
- Oxygen
- Metal ions



Eco-Friendly Synthesis of Aspirin Nanoparticles using Plant Extracts for Enhanced Solubility and Bioavailability

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Abstract

Aspirin (acetylsalicylic acid) is a widely used therapeutic agent; however, its clinical effectiveness is often limited by poor aqueous solubility and moderate bioavailability. The present study reports an eco-friendly and sustainable approach for the synthesis of aspirin nanoparticles using plant extracts as natural reducing, capping, and stabilizing agents. The synthesis was carried out via a modified esterification process involving salicylic acid and acetic anhydride in the presence of phytochemical-rich plant extracts under controlled conditions of temperature and pH. Bioactive compounds such as flavonoids, phenolics, and tannins play a crucial role in regulating nucleation, minimizing particle size, and preventing aggregation, thereby enabling the formation of stable nanoparticles.

The synthesized nanoparticles were characterized using UV-Visible spectroscopy, pH measurement, conductivity analysis, viscosity studies, and flame photometry. A hypsochromic shift in the UV-Visible spectrum confirmed the formation of nanoscale aspirin particles. The nanoparticles exhibited improved dispersion behavior, enhanced viscosity, and stable physicochemical properties compared to bulk aspirin. These modifications contribute to increased solubility and are expected to enhance bioavailability.

This study demonstrates that plant-mediated green synthesis is a cost-effective, environmentally benign, and scalable method for producing aspirin nanoparticles with superior pharmaceutical properties. The findings highlight the potential of this approach in advancing sustainable nanopharmaceutical development and improving drug delivery performance.

Keywords

Aspirin nanoparticles, Green synthesis, Plant extract-mediated synthesis, Phytochemicals
Nano pharmaceuticals, Drug solubility enhancement, Bioavailability improvement, Sustainable chemistry

1. Introduction

Aspirin (acetylsalicylic acid) is one of the most widely used pharmaceutical agents, possessing analgesic, antipyretic, anti-inflammatory, and antiplatelet properties. Despite its broad therapeutic applications, aspirin exhibits limitations such as poor aqueous solubility, reduced dissolution rate, and moderate bioavailability, which can affect its overall clinical efficacy and may lead to gastrointestinal side effects at higher doses.

Recent advances in nanotechnology have provided promising strategies to overcome these limitations by reducing drug particles to the nanoscale. Nanoparticles offer increased surface area, improved dissolution rate, enhanced solubility, and better bioavailability. However, conventional methods for nanoparticle synthesis often involve toxic chemicals, high energy consumption, and environmentally hazardous conditions, making them unsuitable for sustainable pharmaceutical development.

In this context, green synthesis has emerged as an eco-friendly and cost-effective alternative. Plant extracts, rich in bioactive phytochemicals such as flavonoids, phenolics, tannins, and terpenoids, can act as natural reducing, capping, and stabilizing agents. These compounds facilitate controlled nucleation and growth of nanoparticles while preventing aggregation, thereby producing stable and biocompatible nanostructures.

The present study focuses on the eco-friendly synthesis of aspirin nanoparticles using plant extracts and investigates their physicochemical properties. Special emphasis has been placed on understanding the role of phytochemicals in nanoparticle formation and evaluating improvements in solubility and bioavailability-related parameters. This approach aims to contribute toward the development of sustainable nanopharmaceutical systems with enhanced therapeutic performance.

2. Materials and Methods

2.1 Materials

- Salicylic acid (analytical grade)
- Acetic anhydride
- Fresh neem/tulsi leaves
- Distilled water
- Ice bath setup



Analysis of Organic Pollutants in the Kali River of Muzaffarnagar Region: Sources, Environmental Impact and Remediation Strategies

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Abstract- The Kali River, originating from Antwada village in Muzaffarnagar district, Uttar Pradesh, is one of the most polluted river systems in northern India. Rapid industrialization, urbanization, and intensive agricultural practices have significantly increased the discharge of organic pollutants into the river. The present study reviews the occurrence, sources, environmental impacts, and remediation strategies associated with organic pollutants in the Kali River of the Muzaffarnagar region. Major pollution sources include untreated industrial effluents from sugar mills, paper mills, distilleries, textile units, domestic sewage, and agricultural runoff. Elevated levels of Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), pesticides, phenolic compounds, surfactants, and other organic contaminants have severely degraded water quality. The study highlights ecological consequences such as dissolved oxygen depletion, biodiversity loss, eutrophication, and contamination of agricultural soils and groundwater. Advanced remediation approaches including wastewater treatment technologies, bioremediation, phytoremediation, constructed wetlands, and integrated river basin management are discussed. Sustainable implementation of these measures is essential for restoring the ecological integrity of the Kali River and safeguarding public health.

Keywords- Kali River, Organic Pollutants, Water Quality, Muzaffarnagar, Industrial Effluents, Bioremediation, River Restoration.

I. INTRODUCTION

Freshwater ecosystems are vital for sustaining biodiversity, agriculture, industry, and human well-being. However, increasing anthropogenic activities have led to significant deterioration of river water quality worldwide. In India, rivers located in densely populated and industrialized regions are particularly vulnerable to pollution.

The Kali River originates from Antwada village in Muzaffarnagar district of Uttar Pradesh and traverses several districts before joining the Ganga River near Kannauj. The river receives substantial loads of untreated industrial wastewater, municipal sewage, and agricultural runoff, making it one of the most polluted rivers in western Uttar Pradesh.

Studies have reported severe deterioration in water quality, oxygen depletion, and accumulation of pollutants due to continuous discharge of untreated wastes. Industrial sectors

including sugar processing, paper manufacturing, distilleries, slaughterhouses, and textile units contribute significantly to organic pollution loading.

Organic pollutants are of particular concern because of their persistence, toxicity, bioaccumulation potential, and adverse effects on aquatic ecosystems and human health. Therefore, understanding their sources, environmental impacts, and mitigation strategies is essential for effective river restoration. The present study aims to analyze the occurrence of organic pollutants in the Kali River of Muzaffarnagar and evaluate potential remediation strategies for sustainable water resource management.

II. STUDY AREA

The Kali River originates in Muzaffarnagar district and flows approximately 300 km through western Uttar Pradesh before joining the Ganga River. The river basin supports intensive agriculture and numerous industrial establishments.



Sustainable Practices in Laboratory: Laboratory Waste Management

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Abstract- Laboratories are significant generators of diverse hazardous waste streams including chemical, biological, radioactive, sharps, and electronic waste. Improper management of such waste endangers human health, occupational safety, and environmental integrity. This study examines sustainable laboratory waste management practices through the framework of Green Chemistry, as established by Anastas and Warner (1998). The study reviews the classification of laboratory waste, current segregation and treatment protocols, and the effectiveness of sustainability interventions including microscale experimentation, green solvent substitution, solvent recovery, and digital laboratory management. Data analysis from published institutional case studies reveals that laboratories implementing green chemistry principles achieve waste reductions of 50–70%, E-factor improvements of 60–90%, and annual cost savings of approximately 50%. Key challenges including institutional inertia, cost barriers, and inadequate training are identified, alongside evidence-based recommendations for overcoming them. The study concludes that sustainable laboratory practice is simultaneously an environmental imperative, a safety strategy, and an economic advantage.

Keywords- Green Chemistry, Laboratory Waste Management, Waste Segregation, E-Factor, Microscale Chemistry, Sustainable Practices, Solvent Recovery, Hazardous Waste, 3R Hierarchy.

I. INTRODUCTION

Laboratories — whether academic, pharmaceutical, environmental, or clinical — generate substantial volumes of hazardous and non-hazardous waste as a consequence of routine operations. A single undergraduate chemistry practical can produce hundreds of millilitres of solvent waste per student per session; a research laboratory may generate kilograms of chemical waste weekly. Without structured and scientifically sound management, these waste streams pose serious risks to laboratory personnel, surrounding communities, and the broader environment.

The global scientific community has increasingly recognized that effective waste management cannot be limited to end-of-pipe treatment — that is, managing waste after it has been created. The most robust and sustainable approach is to prevent waste generation in the first place, by redesigning experimental protocols, selecting safer reagents and solvents, and embedding environmental considerations into the planning stage of every procedure. This philosophy is articulated most comprehensively through the Twelve Principles of Green

Chemistry, formulated by Paul T. Anastas and John C. Warner in 1998.

Green Chemistry represents a transformative shift in how chemical science approaches the relationship between human activity and ecological health. Rather than treating pollution and waste as inevitable by-products of scientific progress, Green Chemistry positions them as design failures — problems to be eliminated through better chemistry, not managed after the fact. In the laboratory context, these principles guide researchers and educators toward experimental designs that minimise waste, reduce hazard, conserve energy, and lower costs simultaneously.

This paper presents a comprehensive review and analysis of sustainable laboratory waste management, structured around the Green Chemistry framework. It examines the classification of laboratory waste, current and emerging management strategies, quantitative outcomes of sustainable practices, and the challenges and future directions of green laboratory science. The study draws on published academic literature, institutional case studies, and regulatory frameworks to present an evidence-based picture of the state of sustainable laboratory practice.



Fumigation Efficacy of Phosphine Against Major Stored-Grain Insect Pests

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ABSTRACT

Stored-grain insect pests cause significant quantitative and qualitative losses worldwide, threatening food security and economic stability. Fumigation remains one of the most effective methods for managing insect infestations in stored commodities. Among available fumigants, phosphine (PH₃) has emerged as the predominant choice due to its effectiveness, low residue levels, and ability to penetrate bulk grain. This review examines the efficacy of phosphine against major stored-grain pests including *Sitophilus oryzae*, *Rhyzopertha dominica*, *Tribolium castaneum*, *Cryptolestes ferrugineus*, and *Oryzaephilus surinamensis*. The mode of action, factors influencing fumigation success, resistance development, and management strategies are discussed. Although phosphine remains highly effective when applied correctly, increasing resistance among pest populations necessitates improved monitoring and integrated pest management approaches. This review highlights the importance of maintaining effective phosphine fumigation protocols for sustainable grain protection.

Keywords: Phosphine, fumigation, stored-grain pests, phosphine resistance, grain storage, insect control.

1. Introduction

Post-harvest losses caused by insect pests represent a major challenge in grain storage systems worldwide. In developing countries, losses may range from 10–30% depending on storage conditions and pest infestation levels. Stored-product insects not only reduce grain quantity through feeding but also deteriorate grain quality by contamination with excreta, webbing, cast skins, and dead insects. Fumigation is a widely adopted method for controlling insect infestations in stored commodities because fumigants can penetrate deep into grain masses where contact insecticides cannot reach. Among various fumigants, phosphine has become the most important after the gradual withdrawal of methyl bromide due to environmental concerns. However, repeated and improper use has led to the development of phosphine-resistant insect populations, threatening the sustainability of fumigation programs. Understanding phosphine efficacy against major pests and factors affecting fumigation performance is therefore essential for effective pest management.

2. Objectives of the Study

1. To examine the efficacy of phosphine fumigation against major stored-grain insect pests.
2. To discuss the mode of action of phosphine.
3. To evaluate factors affecting fumigation success.
4. To assess phosphine resistance in stored-product insects.
5. To suggest strategies for improving phosphine-based pest management.

3. Major Stored-Grain Pests Controlled by Phosphine

Pest Species	Common Name	Order
<i>Sitophilus oryzae</i>	Rice weevil	Coleoptera
<i>Rhyzopertha dominica</i>	Lesser grain borer	Coleoptera
<i>Tribolium castaneum</i>	Red flour beetle	Coleoptera



Comprehensive Analysis Of Heavy Metal Contamination In Groundwater: A Case Study Of Muzaffarnagar And Shamli Districts, Uttar Pradesh, India

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Abstract: Heavy metal contamination in groundwater represents a critical environmental and public health challenge globally. This study assessed the concentrations and spatial distribution of four priority heavy metals—Nickel (Ni), Arsenic (As), Mercury (Hg), and Uranium (U)—in water sources across Muzaffarnagar and Shamli districts of western Uttar Pradesh, India. Water samples were collected from diverse sources including residential borewells, hand pumps in agricultural areas, and surface water bodies during 2025-26. Physicochemical parameters (pH, hardness, dissolved organic carbon, chemical oxygen demand) and heavy metal concentrations were analyzed using standardized methods including EDTA titration, UV-persulfate oxidation, and atomic absorption spectroscopy. Results revealed that Nickel concentrations ranged from 0.12 to 0.35 mg/L (50% exceeding WHO limit of 0.07 mg/L), Arsenic from 0.005 to 0.030 mg/L (75% exceeding 0.01 mg/L limit), Mercury from 0.003 to 0.007 mg/L, and Uranium from 0.01 to 0.05 mg/L (50% exceeding 0.03 mg/L limit). Surface water and urban groundwater showed the highest contamination levels. The findings indicate significant anthropogenic influence from industrial effluents, agricultural runoff, and domestic sewage, compounded by natural geogenic sources. Statistical analysis revealed moderate correlations between metals, suggesting common mobilization mechanisms. This study provides critical baseline data for water resource management and highlights the urgent need for monitoring, treatment infrastructure, and public health interventions in the study region.

Keywords: Heavy metals, Groundwater contamination, Arsenic, Nickel, Uranium, Mercury, Muzaffarnagar, Shamli, Water quality, Public health

I. INTRODUCTION

A. Background

Water is fundamental to life, yet freshwater scarcity and quality degradation pose mounting global challenges. While water covers 71% of Earth's surface, only 2.5% is freshwater, with less than 1% readily accessible for human use (Gleick, 2014). Rapid population growth, urbanization, and industrialization have intensified both water demand and contamination, particularly in developing nations where regulatory frameworks and treatment infrastructure remain inadequate (UNESCO, 2019).

Heavy metals—metallic elements with high atomic weights ($>5 \text{ g/cm}^3$)—are of particular concern due to their persistence, non-biodegradability, and propensity for bioaccumulation (Tchounwou et al., 2012). Unlike organic pollutants that undergo microbial degradation, heavy metals accumulate in sediments and biological tissues,

posing long-term ecological and human health risks (Ali & Khan, 2018). Common heavy metals in aquatic systems include nickel (Ni), arsenic (As), mercury (Hg), lead (Pb), cadmium (Cd), chromium (Cr), and uranium (U).

B. Heavy Metal Contamination Sources

Heavy metals enter aquatic environments through both natural geogenic processes and anthropogenic activities. Natural sources include weathering and erosion of rocks, volcanic activity, and leaching from mineral deposits (Smedley & Kinniburgh, 2002). However, human activities have dramatically increased heavy metal concentrations beyond natural background levels (Nriagu, 1996).



Plant-Based Remediation of Contaminated Soil

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ABSTRACT

Spices have played an important role in human civilization for centuries because of their culinary, medicinal, and economic value. India is one of the leading producers and exporters of spices and contributes significantly to the global spice market. The present study examines the classification, economic importance, health benefits, medicinal value, and industrial applications of major spices including black pepper, turmeric, cardamom, cinnamon, ginger, and clove. The study is based on secondary information collected from published literature and a field survey conducted in the local spice market of Gass Mandi, Muzaffarnagar. Findings indicate that spices contribute significantly to agriculture, employment generation, export earnings, food processing industries, pharmaceutical production, and traditional healthcare systems. The growing consumer preference for natural and health-promoting products has increased the commercial importance of spices in domestic and international markets. The study concludes that spices remain valuable agricultural commodities that support economic growth, public health, and sustainable livelihood opportunities.

Keywords: Spices, Indian Economy, Black Pepper, Turmeric, Cardamom, Agriculture, Export Trade, Medicinal Plants

1. Introduction

Spices are naturally occurring plant products obtained from seeds, fruits, roots, rhizomes, bark, flower buds, and leaves. They are widely used to improve the flavor, aroma, color, and taste of food products. Besides culinary applications, spices are valued for their medicinal, nutritional, preservative, and industrial uses. India is recognized as one of the world's largest producers of spices and supplies a wide range of products to both domestic and international markets.

The significance of spices extends beyond cooking. Many spices contain bioactive compounds with antioxidant, antimicrobial, and anti-inflammatory properties. These compounds support human health and contribute to disease prevention. Spices also serve as important raw materials for pharmaceutical, cosmetic, food processing, and beverage industries.

Historically, spices influenced international trade and cultural exchange. The demand for Indian spices encouraged commercial interactions between different regions of the world. Today, spice cultivation continues to support millions of farmers and contributes significantly to agricultural development and foreign exchange earnings.

2. Objectives of the Study

1. To study the classification and significance of spices.
2. To examine the economic importance of major spices.
3. To understand the role of spices in agriculture and trade.
4. To analyze the medicinal and health benefits of spices.
5. To evaluate the contribution of spices to the Indian economy.
6. To assess consumer preferences through a local market survey.

3. Research Methodology

The study is descriptive in nature and is based on both primary and secondary sources of information.



Organic Farming and Food Security

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ABSTRACT

Organic farming is increasingly recognized as a sustainable agricultural approach that promotes environmental conservation, soil fertility, and food safety. Unlike conventional agriculture, it relies on natural inputs and ecological processes rather than synthetic fertilizers and pesticides. Food security remains a global concern due to population growth, climate change, and resource limitations. This study explores the role of organic farming in enhancing food security through sustainable food production systems. The paper discusses the benefits of organic agriculture, including improved soil health, biodiversity conservation, reduced environmental pollution, and climate resilience. It also examines challenges such as lower yields during transition periods, certification barriers, and limited market access. The study concludes that organic farming can significantly contribute to long-term food security when supported by effective policies, farmer education, and technological innovation.

Keywords: Organic Farming, Food Security, Sustainable Agriculture, Soil Health, Biodiversity, Climate Resilience.

Introduction

Food security and environmental sustainability are among the most significant challenges facing modern agriculture. While conventional farming has successfully increased food production, excessive dependence on chemical fertilizers and pesticides has resulted in environmental degradation, declining soil quality, and biodiversity loss.

Organic farming offers a sustainable alternative by emphasizing natural nutrient management, ecological balance, and resource conservation. Practices such as composting, crop rotation, green manuring, and biological pest control help maintain soil productivity while reducing environmental impacts.

As global food demand continues to rise, there is growing interest in understanding how organic farming can contribute to food security. This paper evaluates the relationship between organic agriculture and food security and examines both its opportunities and limitations.

Objectives of the Study

1. To understand the principles and practices of organic farming.
2. To examine the concept and dimensions of food security.
3. To assess the contribution of organic farming to sustainable agricultural development.
4. To identify the major benefits and constraints of organic agriculture.
5. To propose recommendations for improving the adoption of organic farming.

Role of Organic Farming in Food Security

Organic farming contributes to food security by improving soil health and enhancing long-term agricultural productivity. The use of organic manures and crop diversification improves nutrient cycling and soil structure, resulting in sustainable crop production.

The system also supports biodiversity by encouraging beneficial insects, pollinators, and soil microorganisms. This ecological balance reduces dependence on chemical pesticides and contributes to environmental protection.

Furthermore, organic farming increases resilience to climate-related stresses. Improved soil organic matter enhances water retention capacity, helping crops withstand drought conditions and irregular rainfall patterns.

Organic food products are generally associated with lower chemical residues, contributing to improved food quality and consumer confidence.



Economic Importance of Spices & their Contribution

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ABSTRACT

Spices is considered as one of the most essential elements of Indian household. India is among the world's leading producers, consumers, and exporters of spices. Besides enhancing the flavor and aroma of food, spices play an important role in employment generation, export earnings, industrial development, and rural livelihoods. This study examines the economic importance of major spices cultivated in India, including ginger, turmeric, coriander, cumin, chili, black pepper, cardamom, and clove. The research consist of data on two aspects. Primary information was collected through observations and discussions with spice traders in Muzaffarnagar, Uttar Pradesh, while secondary information was gathered from government reports, books, and research publications. The findings reveal that the spice sector contributes significantly to agricultural income, foreign exchange earnings, and value-added industries such as food processing, pharmaceuticals, and cosmetics. The study also highlights market trends, consumer preferences, and future challenges affecting the spice industry. The paper concludes that strengthening quality standards, improving market infrastructure, and promoting value-added products can further enhance the contribution of spices to India's economy.

Keywords: Spices, Indian Economy, Agriculture, Export Trade, Rural Development, Spice Industry, Employment Generation

1. Introduction

Spices are natural products obtained from different parts of plants such as seeds, roots, rhizomes, bark, fruits, flowers, and leaves. They are mainly used to improve the taste, aroma, color, and shelf life of food. Apart from culinary applications, spices possess medicinal, preservative, and nutritional properties that make them valuable in several industries.

India has historically been known as the "Land of Spices." Favorable climatic conditions, diverse agro-ecological regions, and a rich agricultural tradition enable the cultivation of a large number of spice crops. Major Indian spices include turmeric, ginger, cumin, coriander, chili, black pepper, cardamom, and clove.

The history of spice trade has greatly influenced economic and political developments across the world. Ancient trade routes connected India with Europe, Africa, and Asia. The global demand for Indian spices encouraged exploration and international trade, making spices one of the most valuable commodities in history.

Today, the spice industry remains an important component of the Indian economy. It supports millions of farmers and workers, contributes to exports, and supplies raw materials to food processing, pharmaceutical, cosmetic, and beverage industries. Growing consumer preference for natural products and traditional remedies has further increased demand for spices in domestic and international markets.

2. Objectives of the Study

The objectives of this study are:

1. To examine the economic importance of major spices cultivated in India.
2. To analyze the contribution of spices to agriculture and rural employment.
3. To study the role of spices in domestic and international trade.
4. To understand consumer preferences and market demand.
5. To identify challenges and opportunities in the spice sector.



Study of Illumination in LDR with Power Variation

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Abstract : Light-dependent resistors, commonly known as LDR sensors, have revolutionized the way we interact with light in various electronic applications. These simple yet powerful components have an influence on numerous devices you encounter in your daily life. LDR sensors work on the principle of photoconductivity, changing their resistance based on the intensity of light they're exposed to. This unique property makes them invaluable in applications ranging from street lighting systems to camera exposure controls.

In this project, we'll discover the illumination response of light dependent resistors (LDRs) under varying power condition to analyze their behavior, inner workings of LDR sensors and explore their diverse applications. We'll break down the LDR working principle, delve into different types of LDR sensors, and examine their sensitivity to various wavelengths of light. Experimental data were collected using a controlled setup involving adjustable light sources, LDR sensors, and measurement circuits to record voltage and resistance variations. We'll also learn about common LDR circuits and how these sensors are put into action in real-world scenarios.

By the end, we'll have a solid understanding of why LDR sensors continue to be a go-to choice for light detection in many electronic design.



Study of Semiconductor & Their Applications

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ABSTRACT: Semiconductors serve as the definitive cornerstone of modern electronics, bridging the operational gap between electrical conductors and insulators. This project report presents a comprehensive study of semiconductor physics, fundamental material properties, and their widespread engineering applications. The foundational principles of energy band theory are analyzed, detailing the critical distinctions between intrinsic and extrinsic semiconductors, alongside the mechanics of charge carrier concentration and mobility.

The structural and operational behaviors of core electronic components are explored, emphasizing the unilateral current conduction of p-n junction diodes, the amplification and switching capabilities of Bipolar Junction Transistors (BJTs) in both NPN and PNP configurations, and the unique physics governing metal-semiconductor Schottky barriers. Furthermore, this report examines optoelectronic advancements, analyzing the mechanism of electroluminescence in Light-Emitting Diodes (LEDs), light detection in photodiodes, and the conversion of solar irradiance via photovoltaic cells. Finally, the operational physics, advantages, and limitations of semiconductor lasers (laser diodes) are discussed in the context of high-speed optical telecommunications and advanced manufacturing. By synthesizing key historical milestones alongside emerging nanoscale frontiers, this work underlines the indispensable role of semiconductor technologies in driving future scientific innovation.

KEYWORDS: Semiconductors, Band Theory & Band Gap, Intrinsic & Extrinsic Doping, P-N Junction Diode, Bipolar Junction Transistor (BJT), Optoelectronics (LED, Photodiode, Solar Cell), Schottky Barrier, Semiconductor Laser (Laser Diode), Carrier Mobility.

I. Introduction: The Backbone of Modern Technology

In the vast landscape of technology, semiconductors stand as the unsung heroes, quietly powering the devices that have become indispensable in our daily lives. From smartphones to laptops, from cars to satellites, semiconductors form the bedrock upon which our modern world is built. In this introduction, we'll delve into what semiconductors are, their significance, and their role in shaping the projects of today and tomorrow.



Study of Thermoelectric Effect Using a Peltier Module

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ABSTRACT:

This study investigates the performance characteristics and thermodynamic limitations of a TEC1-12706 thermoelectric cooler (Peltier module) through experimental analysis. The research validates the governing equations of thermoelectricity, specifically exploring the relationship between electrical power input and the achieved temperature gradient (ΔT). By utilizing a controlled "thermal stack" assembly, the study evaluates the performance of the module under varying current levels and assesses the critical impact of thermal management on overall cooling efficiency. The findings demonstrate that while the Peltier effect provides a reliable, solid-state solution for localized cooling, the system is fundamentally constrained by the quadratic increase in Joule heating and the efficiency of heat rejection at the hot junction. The experimental results align with theoretical predictions, identifying an optimal operating current that maximizes the coefficient of performance (CoP) before the onset of thermal saturation.

KEYWORDS: Peltier Effect, Seebeck Effect, Figure of Merit (ZT), Joule Heating, TEC1-12706 Bismuth Telluride, Phonon-Glass Electron-Crystal (PGEC), Thermal Gradient, Thermal Back-Conduction, Coefficient of Performance (CoP), Thermal Saturation, Thermal Interface Material (TIM), Thermal Stack, Doping.

I. INTRODUCTION:

1.1 Background of the Study: The quest for efficient, solid-state energy conversion technologies has become a cornerstone of modern materials science and engineering. As the global demand for sustainable energy solutions and precise temperature control grows, thermoelectric devices—specifically Peltier modules—have emerged as a vital technology. Thermoelectricity refers to the direct conversion of temperature differences to electric voltage (the Seebeck effect) and the direct conversion of electric current to temperature differences (the Peltier effect).

A Peltier module, or Thermoelectric Cooler (TEC), is a solid-state active heat pump that transfers heat from one side of the device to the other when an electric current is passed through it. Unlike traditional refrigeration systems that rely on mechanical compressors, chemical refrigerants (such as chlorofluorocarbons), and moving parts, Peltier modules operate purely through electronic phenomena at the semiconductor junction level. This unique characteristic makes them silent, vibration-free, highly reliable, and environmentally friendly, as they do not contribute to the depletion of the ozone layer or the production of greenhouse gases associated with conventional refrigeration cycles.



Biofuel Plants and Renewable Energy Resources: A Sustainable Approach for Future Energy Security

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ABSTRACT :

The increasing global demand for energy and the environmental problems associated with fossil fuels have created an urgent need for sustainable energy alternatives. Biofuel plants convert biomass such as agricultural residues, food waste, animal manure, and energy crops into renewable fuels including bioethanol, biodiesel, and biogas. Renewable energy resources such as solar, wind, hydropower, geothermal energy, and biomass play a significant role in reducing greenhouse gas emissions and promoting sustainable development. This paper reviews the importance of biofuel plants, their production processes, environmental benefits, challenges, and future prospects. The study concludes that biofuel plants can contribute substantially to energy security, waste management, and environmental protection when integrated with other renewable energy technologies.

Keywords: Biofuel, Biomass, Renewable Energy, Biodiesel, Bioethanol, Biogas, Sustainability

INTRODUCTION

Energy is essential for economic growth and human development. Excessive dependence on fossil fuels has resulted in environmental degradation and climate change. Renewable energy resources have emerged as sustainable alternatives. Among these, biomass-based biofuels provide a unique opportunity to generate energy while utilizing organic waste materials.

OBJECTIVES OF THE STUDY

- To understand the concept and functioning of biofuel plants.
- To study different types of biofuels and their production methods.
- To evaluate the environmental and economic benefits of biofuel production.
- To identify challenges associated with biofuel technologies.
- To assess future prospects of renewable energy resources.

BIOFUEL PLANTS AND THEIR WORKING

Biofuel plants are industrial facilities that convert biomass into renewable fuels. Biomass feedstock includes crop residues, forestry waste, food waste, animal manure, and energy crops. The process generally involves biomass collection, pretreatment, conversion, purification, and distribution.

Major biofuels include:

- Bioethanol
- Biodiesel
- Biogas

RENEWABLE ENERGY RESOURCES

Renewable energy resources are naturally replenished sources of energy. Major renewable energy resources include:

A Study of Group Theory with Various Properties

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Abstract- Group Theory is one of the fundamental branches of modern algebra and provides the mathematical framework for studying symmetry, transformations, and algebraic structures. This paper presents a comprehensive study of groups and their fundamental properties, including closure, associativity, identity, inverses, commutativity, cyclicity, normality, solvability, and nilpotency. The paper examines finite and infinite groups, discusses important classification theorems, and highlights applications in cryptography, coding theory, physics, and computer science. A graphical analysis is presented to compare major classes of groups according to their structural complexity. Recent developments in finite group classification and graph-theoretic approaches to group theory are also reviewed.

Keywords- Group Theory, Cyclic Groups, Abelian Groups, Normal Subgroups, Solvable Groups, Nilpotent Groups, Finite Groups.

I. INTRODUCTION

Group theory originated from the work of Évariste Galois in the study of polynomial equations and has become a central area of mathematics. A group is an algebraic structure consisting of a set equipped with a binary operation satisfying four axioms:

1. Closure
2. Associativity
3. Identity
4. Inverse Property

Modern research extends beyond finite groups to infinite groups, geometric groups, Lie groups, and graph-theoretic representations of groups.

II. LITERATURE REVIEW

Recent investigations focus on:

1. Classification of finite groups and finite simple groups.
2. Prime graph analysis in finite groups.
3. Graph-theoretic structures such as power graphs and commuting graphs.
4. Infinite group theory and generalized nilpotency.
5. Geometric group theory and topology.

These studies demonstrate that group theory remains an active and expanding research area.

III. GROUP

A non-empty set G with binary operation $*$ is a group if $\{G, *\}$ satisfy the following properties

Closure Property $(a*b) \in G \quad \forall a, b \in G$,

Associative Property $(a*b)*c = a*(b*c) \quad \forall a, b, c \in G$,

Identity Element $\exists e \in G, ae = ea = a \quad \forall a \in G$,

Inverse Property $\forall a \in G, \exists a^{-1} \in G$

IV. CLASSIFICATION OF GROUPS

Type of Group	Property
Cyclic Group	Generated by one element
Abelian Group	Commutative
Non-Abelian Group	Not commutative
Finite Group	Finite number of elements
Infinite Group	Infinite number of elements
Nilpotent Group	Upper central series terminates
Solvable Group	Derived series terminates
Simple Group	No nontrivial normal subgroup
Lie Group	Continuous symmetry group

V. THEORETICAL RESULTS

Theorem 1: Every cyclic group is abelian.

Proof: Let $G = \langle a \rangle$ Then $x = a^m, y = a^n$



ORGANIC FARMING AND BIO FERTILIZER

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ABSTRACT:

Organic farming and biofertilizers have emerged as important components of sustainable agriculture, offering environmentally friendly alternatives to conventional farming practices that rely heavily on synthetic fertilizers and pesticides. The increasing concerns regarding soil degradation, environmental pollution, loss of biodiversity, and adverse health effects associated with chemical-intensive agriculture have accelerated the global shift toward organic farming systems. This study examines the principles, practices, advantages, limitations, and economic significance of organic farming and biofertilizers in modern agriculture. Organic farming is a holistic agricultural system that promotes ecological balance, soil fertility, and biodiversity through the use of natural inputs such as compost, farmyard manure, green manure, crop rotation, and biological pest management. It aims to produce healthy and chemical-free food while minimizing environmental impacts. The study highlights the major objectives of organic farming, including soil conservation, sustainable resource utilization, environmental protection, and enhancement of human health. Various forms of organic farming, such as pure organic farming, integrated organic farming, natural farming, biodynamic farming, and vermicomposting-based systems, are discussed in relation to their role in sustainable agricultural development. Biofertilizers are living microbial formulations containing beneficial microorganisms such as *Rhizobium*, *Azotobacter*, *Azospirillum*, phosphate-solubilizing bacteria, mycorrhizae, and blue-green algae. These microorganisms enhance nutrient availability through biological nitrogen fixation, phosphate solubilization, nutrient recycling, and production of plant growth-promoting substances. The application of biofertilizers improves soil fertility, increases crop productivity, enhances soil microbial activity, and reduces dependence on chemical fertilizers. Their role in maintaining long-term soil health and supporting environmentally sustainable farming systems is particularly significant. The study further evaluates the economic importance of organic farming and biofertilizers, emphasizing reduced input costs, improved soil productivity, enhanced market value of organic products, and increased opportunities for rural employment. Despite their numerous benefits, challenges such as lower initial yields, slow nutrient release, certification costs, limited availability of quality biofertilizers, and the need for technical knowledge remain important constraints to widespread adoption. The findings indicate that organic farming and biofertilizers collectively contribute to sustainable agricultural development by improving soil health, conserving natural resources, reducing environmental pollution, and ensuring food safety. With increasing consumer awareness, government support, and demand for organic products, these practices have significant potential to strengthen food security and environmental sustainability. Therefore, the integration of organic farming and biofertilizer technology represents a promising approach for achieving long-term agricultural productivity while safeguarding ecological integrity and human well-being.

Keywords: Organic Farming, Biofertilizers, Sustainable Agriculture, Soil Fertility, Environmental Protection, Nutrient Management, Organic Manure, Crop Productivity, Biodiversity, Eco-friendly Farming.

Introduction to Organic Farming:

Organic farming is a sustainable agricultural practice that relies on natural resources and biological processes for crop production. It avoids the use of synthetic fertilizers, pesticides, and genetically modified organisms (GMOs). Instead, farmers use compost, green manure, crop rotation, and biofertilizers to maintain soil fertility and plant health. This method protects the environment, improves soil quality, conserves biodiversity, and produces safe and nutritious food. Organic farming is considered an important approach for achieving sustainable agriculture and environmental conservation.

Meaning and Definition of Organic Farming:

Organic farming is a natural and eco-friendly system of agriculture that avoids the use of chemical fertilizers, pesticides, herbicides, genetically modified organisms (GMOs), and synthetic growth regulators. It aims to maintain the health of soil, plants, animals, humans, and the environment. Organic farmers use natural inputs such as compost, farmyard manure, green manure, crop rotation, biofertilizers, and biological pest control to improve soil fertility and manage pests. This farming method promotes ecological balance, biodiversity, and sustainable use of natural resources. Organic farming is based on the principle that healthy soil produces healthy plants, which in turn provide safe and nutritious food. It supports sustainable agriculture by conserving soil, water, and air while reducing environmental pollution.



Economic Importance of Spices & their Contribution

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ABSTRACT

Spices is considered as one of the most essential elements of Indian household. India is among the world's leading producers, consumers, and exporters of spices. Besides enhancing the flavor and aroma of food, spices play an important role in employment generation, export earnings, industrial development, and rural livelihoods. This study examines the economic importance of major spices cultivated in India, including ginger, turmeric, coriander, cumin, chili, black pepper, cardamom, and clove. The research consist of data on two aspects. Primary information was collected through observations and discussions with spice traders in Muzaffarnagar, Uttar Pradesh, while secondary information was gathered from government reports, books, and research publications. The findings reveal that the spice sector contributes significantly to agricultural income, foreign exchange earnings, and value-added industries such as food processing, pharmaceuticals, and cosmetics. The study also highlights market trends, consumer preferences, and future challenges affecting the spice industry. The paper concludes that strengthening quality standards, improving market infrastructure, and promoting value-added products can further enhance the contribution of spices to India's economy.

Keywords: Spices, Indian Economy, Agriculture, Export Trade, Rural Development, Spice Industry, Employment Generation

1. Introduction

Spices are natural products obtained from different parts of plants such as seeds, roots, rhizomes, bark, fruits, flowers, and leaves. They are mainly used to improve the taste, aroma, color, and shelf life of food. Apart from culinary applications, spices possess medicinal, preservative, and nutritional properties that make them valuable in several industries.

India has historically been known as the "Land of Spices." Favorable climatic conditions, diverse agro-ecological regions, and a rich agricultural tradition enable the cultivation of a large number of spice crops. Major Indian spices include turmeric, ginger, cumin, coriander, chili, black pepper, cardamom, and clove.

The history of spice trade has greatly influenced economic and political developments across the world. Ancient trade routes connected India with Europe, Africa, and Asia. The global demand for Indian spices encouraged exploration and international trade, making spices one of the most valuable commodities in history.

Today, the spice industry remains an important component of the Indian economy. It supports millions of farmers and workers, contributes to exports, and supplies raw materials to food processing, pharmaceutical, cosmetic, and beverage industries. Growing consumer preference for natural products and traditional remedies has further increased demand for spices in domestic and international markets.

2. Objectives of the Study

The objectives of this study are:

1. To examine the economic importance of major spices cultivated in India.
2. To analyze the contribution of spices to agriculture and rural employment.
3. To study the role of spices in domestic and international trade.
4. To understand consumer preferences and market demand.
5. To identify challenges and opportunities in the spice sector.



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Phytochemical Profiling and Antimicrobial Efficacy of *Parthenium Hysterophorus*: Transforming an Invasive Weed into A Pharmacological Resource

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Abstract— The escalating global burden of antimicrobial resistance (AMR) among clinically significant bacterial pathogens represents a profound challenge to modern pharmacotherapy, necessitating the urgent identification and characterization of structurally novel antimicrobial agents. Phytochemicals derived from botanical sources constitute a diverse and largely underexplored chemical library with considerable potential for the development of multi-target therapeutics. *Parthenium hysterophorus* L., a notoriously invasive annual weed belonging to the family Asteraceae, is globally recognized for its aggressive ecological colonization, allelopathic suppression of agricultural crops, and toxicological effects on mammalian health, including the induction of contact dermatitis and respiratory distress. However, a pharmacological paradox exists: the secondary metabolites principally responsible for the plant's ecological dominance—namely, sesquiterpene lactones, phenolic acids, flavonoids, and alkaloids—concomitantly exhibit considerable antimicrobial potential. This study details the quantitative extraction, qualitative phytochemical screening, and empirical antimicrobial evaluation of *P. hysterophorus* aerial tissue extracts against a panel of clinically relevant Gram-positive and Gram-negative bacterial pathogens, including *Escherichia coli*, *Streptococcus pyogenes*, *Streptococcus* spp., and *Bacillus subtilis*. Employing standardized agar well diffusion methodology, the investigation demonstrates that methanolic and ethanolic extracts of the plant's aerial tissues possess broad-spectrum bactericidal activity, with inhibitory zones frequently rivaling or surpassing those of conventional commercial antibiotics. The methanolic extract, in particular, produced zones of inhibition of 18.0 mm against *E. coli* and 16.0 mm against *Streptococcus* spp. The study further elucidates the biochemical mechanisms underlying microbial suppression, including irreversible alkylation of bacterial enzymes via the α -methylene- γ -lactone ring of parthenin and disruption of cellular membrane homeostasis by low-molecular-weight phenolic acids. Critical translational barriers—specifically systemic cytotoxicity and allergenicity—are addressed, with advanced interventions such as chromatographic fractionation and plant-mediated biosynthesis of metallic nanoparticles (AgNPs and AuNPs) proposed to widen the therapeutic window. This manuscript advocates for a “management by utilization” framework, in which the industrial-scale pharmacological valorization of *P. hysterophorus* serves the dual purpose of yielding potent antimicrobial agents and biologically suppressing a major ecological invader.

Keywords— *Parthenium hysterophorus*, Antimicrobial Resistance (AMR), Phytochemicals, Sesquiterpene Lactones, Parthenin, Agar Well Diffusion, Green Nanotechnology.

I. INTRODUCTION

The global proliferation of invasive alien plant species constitutes an escalating threat to biodiversity, ecosystem stability, and agricultural sustainability. Among the most aggressive botanical invaders currently documented is *Parthenium hysterophorus* L., an annual or short-lived herbaceous plant belonging to the tribe Heliantheae within the Asteraceae family. Native to the subtropical regions of North and South America, particularly the Gulf of Mexico and the Caribbean basin, the species has undergone extensive transcontinental spread. Over the past century, facilitated largely by the inadvertent contamination of international grain shipments—including the historically documented introduction into the Indian subcontinent via the United States PL 480 “Food for Peace” program—*P. hysterophorus* has successfully naturalized across more than fifty countries spanning Asia, Africa, and Oceania [1, 10]. The plant demonstrates exceptional reproductive adaptability, characterized by a deep taproot system, rapid vegetative maturation, and the capacity to produce tens of thousands of lightweight, wind-dispersed cypselas (achenes) per individual specimen.

The ecological and economic damage attributable to *P. hysterophorus* is multidimensional. In agricultural systems, the weed competes aggressively with staple crops including sorghum, maize, rice, and sunflower, frequently causing significant reductions in yield [5, 3]. This competitive advantage is partly attributable to chemical allelopathy; the plant continuously exudes phytotoxic secondary metabolites into the rhizosphere, thereby inhibiting the germination of neighboring seeds, suppressing radicle elongation, and disrupting symbiotic relationships with nitrogen-fixing soil bacteria [6]. Such interference fundamentally alters soil nitrogen dynamics and microbial biomass in invaded areas.

Enhancing the Nutritional and Functional Quality of Bovine and Bubaline Milk Via Enzymatic Lactose Hydrolysis: Reaction Kinetics, Methodological Limitations, and Physicochemical Implications

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Abstract— The global prevalence of primary adult-type hypolactasia (lactose intolerance), affecting an estimated 65–70% of the world population, necessitates the development of nutritionally complete lactose-free or low-lactose dairy alternatives. Enzymatic hydrolysis of lactose using exogenous β -galactosidase (EC 3.2.1.23) represents the current industrial gold standard for this purpose. The present study systematically evaluated the kinetic efficacy of a commercial, food-grade microbial β -galactosidase preparation applied to both bovine (*Bos taurus*) and bubaline (*Bubalus bubalis*) milk matrices at two enzyme concentrations (0.2% and 0.6% w/v) across a three-hour incubation period at 37°C. The generation of reducing monosaccharides was quantified via the 3,5-dinitrosalicylic acid (DNS) colorimetric assay. Raw spectrophotometric data indicated substantially elevated absorbance readings and calculated glucose concentrations in the bubaline milk matrix compared to the bovine matrix. However, a rigorous critical evaluation reveals that this apparent disparity is primarily a severe methodological artifact attributable to the non-specific reactivity of the DNS reagent with the considerably higher protein and lipid content of the bubaline matrix, compounded by turbidity-induced light scattering during spectrophotometry. Compositional data from peer-reviewed literature confirms that the absolute lactose content of bovine and bubaline milk is statistically comparable (approximately 4.7–5.2% vs. 4.7–4.98%, respectively), refuting substrate availability as an explanation for the apparent kinetic divergence. A critical analysis further identifies a significant unaddressed variable in the experimental protocol: the thermal enzyme inactivation step (80°C, 5–10 min) applied to lactose-hydrolyzed milk — now enriched with highly reactive free glucose and galactose — initiates an accelerated Maillard reaction cascade. This non-enzymatic browning generates advanced glycation end-products (AGEs), including furosine and 5-hydroxymethylfurfural (HMF), with demonstrable implications for product safety, sensory quality, and amino acid bioavailability. Analytical, toxicological, and industrial scale-up perspectives are synthesized, and evidence-based recommendations for superior methodologies — including HPLC, HPAEC-PAD, and GOD-POD assays, alongside immobilized enzyme bioreactor processing — are presented.

Keywords— β -Galactosidase; lactose hydrolysis; lactose intolerance; bovine milk; bubaline milk; DNS assay; Maillard reaction; 5-hydroxymethylfurfural (HMF); immobilized enzyme bioreactor; HPLC; enzyme kinetics

I. INTRODUCTION

Mammalian milk is one of the most biologically complex and nutritionally complete dietary fluids in nature, providing an indispensable matrix of high-quality proteins (micellar caseins and soluble whey proteins), essential lipids, bioavailable calcium and phosphorus, and critical micronutrients including Vitamin D, Vitamin B₁₂, and riboflavin. These constituents support skeletal mineralization, neurological transmission, muscular function, and immunological maintenance across multiple stages of human development [18]. Despite this exceptional nutritional density, global dairy consumption is severely constrained by the high prevalence of primary adult-type hypolactasia.

Lactose — chemically designated as β -D-galactopyranosyl-(1 $\rightarrow$ 4)-D-glucose — constitutes approximately 4.5% to 5.2% of the total solids content of both bovine and bubaline milk matrices. In individuals exhibiting lactase persistence, this disaccharide is efficiently cleaved by lactase-phlorizin hydrolase (LPH), expressed in the brush-border microvilli of the small intestinal epithelium, into the constituent monosaccharides D-glucose and D-galactose, which are rapidly absorbed into systemic circulation. In lactase-deficient individuals — an estimated 65–70% of the global adult population, with prevalences exceeding 90% in parts of East Asia, Sub-Saharan Africa, and Latin America — unhydrolyzed lactose transits intact to the large intestine [12, 2]. There it serves as a fermentable substrate for the colonic microbiome, generating short-chain fatty acids (SCFAs) and substantial volumes of intestinal gases (H₂, CO₂, CH₄) [1].

Isolation And Screening of Cellulolytic Bacteria From Cow Dung for Enhanced Cellulase Production

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Abstract— The present study reports the isolation, selective screening, and biochemical characterization of cellulase-producing bacteria from cow dung, an abundant and economically accessible lignocellulosic waste substrate. Fresh cow dung samples were collected aseptically, serially diluted, and cultivated aerobically on nutrient agar. Primary screening on Carboxymethyl Cellulose (CMC) agar, followed by Congo red dye displacement, confirmed extracellular endoglucanase production through the formation of distinct hydrolysis halos around active colonies. Gram staining identified the dominant cellulolytic isolates as Gram-positive, rod-shaped bacteria. Among twenty isolates evaluated, SRCMBK28 (1.2 cm), SRCMBK110 (1.1 cm), SRCMBK23 (1.1 cm), SRCMBK11 (1.0 cm), and SRCMBK22 (1.0 cm) demonstrated the largest hydrolysis zones and were selected for further characterization. Secondary screening in liquid mineral salt medium quantified endoglucanase activity using the 3,5-dinitrosalicylic acid (DNS) colorimetric method. The resulting enzyme production profile followed a typical growth-associated pattern, with peak cellulase activity recorded during the late exponential to early stationary phase. Comprehensive biochemical characterization — encompassing oxidase, catalase, indole, methyl red, Voges-Proskauer, citrate utilization, triple sugar iron, sugar fermentation, urease, and hydrogen sulfide production assays — confirmed the broad metabolic versatility of the selected isolates. These findings establish cow dung as a rich and economically viable source of robust cellulolytic bacteria with significant potential for biofuel production, industrial enzyme applications, and sustainable waste valorization.

Keywords— Cellulase; cow dung; Carboxymethyl Cellulose (CMC); cellulolytic bacteria; Congo red assay; DNS method; biochemical characterization; lignocellulosic biomass; bioethanol; *Bacillus*

1. INTRODUCTION

The accelerating global demand for sustainable energy and environmentally responsible industrial processes has intensified research interest in lignocellulosic biomass as a renewable carbon feedstock. Among its principal structural components, cellulose is the most abundant natural biopolymer on Earth, constituting the primary load-bearing framework of plant cell walls.

It is a linear homopolysaccharide composed of β -(1 $\rightarrow$ 4)-linked D-glucose units arranged in a highly ordered, crystalline structure, rendering it exceptionally resistant to both enzymatic hydrolysis and chemical depolymerization (Bhardwaj et al., 2021). Despite its near-unlimited global availability in agricultural residues and forestry by-products, efficient bioconversion of cellulose into fermentable sugars remains a major scientific and economic challenge. The complete depolymerization of cellulose requires the synergistic action of a tripartite cellulase system. Endoglucanases (EC 3.2.1.4) randomly cleave internal β -1,4 glycosidic bonds within amorphous regions of the cellulose chain, generating new chain ends. Cellobiohydrolases, or exoglucanases (EC 3.2.1.91), act processively from these termini to liberate the disaccharide cellobiose. β -Glucosidases (EC 3.2.1.21) subsequently convert cellobiose and short-chain cello-oligosaccharides into fermentable glucose, simultaneously relieving end-product inhibition of the upstream enzymes (Ezea, 2025). The coordinated output of this tripartite system enables the saccharification of pretreated biomass into substrates suitable for bioethanol and other bioproduct synthesis (Ali et al., 2026).

Microorganisms are the principal biological agents of natural cellulose recycling. Bacterial genera including *Bacillus*, *Clostridium*, *Pseudomonas*, *Aspergillus*, and *Trichoderma* are widely reported as prolific cellulase producers with demonstrated industrial relevance (Bhardwaj et al., 2021; Zhang et al., 2024). Recent advances in metagenomics and strain engineering have further accelerated the discovery of novel, high-performance cellulases (Adab et al., 2024; Meng et al., 2025). Despite this progress, the high cost of enzyme production, low volumetric yields, and insufficient thermostability continue to restrict large-scale commercialization. Current strategies therefore focus on cost reduction through the exploitation of agro-industrial waste substrates, combined with systematic fermentation optimization and molecular strain improvement (Xiang et al., 2025).

Screening and Identification of Cellulolytic Bacteria from Goat Gastrointestinal Tract for Enhanced Enzyme Production

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Abstract— The present study reports the isolation, selective screening, and biochemical characterization of cellulase-producing bacteria sourced from the gastrointestinal tract (rumen) of goats (*Capra hircus*). The ruminant rumen constitutes one of the most evolutionarily refined, lignocellulose-degrading ecosystems known to biology, harboring a dense and diverse microbial consortium. Rumen contents were collected under strict aseptic conditions, subjected to serial dilution, and cultivated on nutrient agar medium under aerobic conditions. Resulting bacterial colonies were screened for cellulolytic activity on Carboxymethyl Cellulose (CMC) agar using a Congo red dye displacement assay. Clear zones of hydrolysis around colonies confirmed the extracellular secretion of endoglucanases. Gram staining revealed that the dominant cellulolytic isolates were Gram-positive, rod-shaped bacteria. Quantitative analysis of hydrolysis zones across sixteen isolates identified strains SRCMBA23, SRCMBA18, and SRCMBA19 as the most active producers, with zone diameters of 1.3 cm, 1.2 cm, and 1.1 cm, respectively. A comprehensive battery of standardized biochemical assays confirmed the metabolic versatility of these elite strains, including positive results for oxidase, catalase, indole production, methyl red, citrate utilization, urease activity, carbohydrate fermentation, and hydrogen sulfide production. The taxonomic profile strongly suggests affiliation with the genus *Bacillus*. The study acknowledges the inherent methodological limitation of aerobic cultivation applied to an obligate anaerobic ecosystem, and discusses the advantage this confers for industrial scale-up. The findings establish the caprine rumen as a promising biological reservoir of robust cellulolytic bacteria with significant potential for biofuel production, lignocellulosic waste valorization, and industrial enzyme applications. Molecular identification and fermentation optimization are recommended as essential next steps.

Keywords—Cellulase; goat rumen; Carboxymethyl Cellulose (CMC); cellulolytic bacteria; Congo red assay; biochemical characterization; lignocellulosic biomass; *Bacillus*; bioethanol

I. INTRODUCTION

Lignocellulosic biomass, derived principally from agricultural residues, forestry by-products, and dedicated bioenergy crops, represents the most abundant and renewable organic substrate on Earth.

Global annual production is estimated to exceed 120 billion metric tons, presenting a substantial opportunity to advance the transition from fossil-fuel-dependent economies toward sustainable, bio-based production systems (Bhardwaj et al., 2021). However, the structural recalcitrance of lignocellulose severely limits its direct bioconversion. The material comprises an interwoven matrix of three primary macromolecules—cellulose, hemicellulose, and lignin. Cellulose itself is a linear homopolymer of β -(1 $\rightarrow$ 4)-linked D-glucopyranose units; extensive intra- and intermolecular hydrogen bonding confers a highly ordered crystalline architecture that renders the substrate exceptionally resistant to both chemical depolymerization and biological degradation.

Efficient hydrolysis of cellulose requires the synergistic action of a tripartite enzyme system collectively designated as cellulases. Endoglucanases (EC 3.2.1.4) randomly cleave internal β -1,4 glycosidic bonds within amorphous regions of cellulose chains, generating numerous new reducing and non-reducing chain ends. Cellobiohydrolases (exoglucanases; EC 3.2.1.91) act processively from these chain ends to liberate the disaccharide cellobiose. β -Glucosidases (EC 3.2.1.21) subsequently hydrolyze cellobiose and short cello-oligosaccharides into fermentable glucose, thereby relieving end-product inhibition of the upstream enzymes. Many cellulases feature a bipartite architecture comprising a catalytic domain connected via a flexible, glycosylated linker peptide to a carbohydrate-binding module (CBM), which maintains enzyme proximity to the insoluble substrate and dramatically enhances catalytic efficiency (Zhang et al., 2024). Cellulase systems are broadly classified as non-complexed, freely secreted systems (typical of aerobic fungi and bacteria) or multi-enzyme cellulosomes (characteristic of anaerobic bacteria) (Bhardwaj et al., 2021). The global industrial demand for thermostable and efficient microbial cellulases has grown considerably over the past decade. In the bioenergy sector, cellulases are central to second-generation bioethanol production, enabling saccharification of pretreated agricultural residues into fermentable sugars.

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VAGINAL MICROBIOME DYNAMICS AND THEIR IMPACT ON WOMEN'S REPRODUCTIVE HEALTH: A REVIEW

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ABSTRACT

The vaginal micro- biome plays a vital position in maintaining women's reproductive health through its complex and dynamic microbial community, generally composed of Lactobacillus species. These bacteria help maintain vaginal homeostasis by producing lactic acid, hydrogen peroxide, and bacteriocins, thereby creating a defensive low pH context that prevents infections similar as bacterial vaginosis(BV), sexually transmitted infections(STIs), and urinary tract infections. Arising confirmation also links microbiome composition with fertility, IVF success, and gestation issues, including preterm birth. dislocations in microbial balance known as dysbiosis can lead to reproductive complications and increase vulnerability to complaint. While recent studies have expanded our understanding of microbiome associated health outcomes, critical gaps remain, including high inter-individual variability, lack of longitudinal data, and limited standardization. Continued research is essential to refine diagnostic tools and develop microbiome based interventions such as probiotics and vaginal microbiota transplantation. Future directions emphasize personalized, culturally sensitive, and ethically sound approaches to enhance women's reproductive well-being.

Keywords: Lactobacillus, Vaginal Microbiome, Reproductive health.

Introduction

The vaginal microbiome refers to the complex and dynamic community of microorganisms primarily bacteria that colonize the vaginal epithelium. Unlike other microbial ecosystems within the human body, the vaginal microbiota is predominantly composed of *Lactobacillus* species, which play a vital role in preserving vaginal health by maintaining an acidic environment (pH 3.5–4.5) through the production of lactic acid, hydrogen peroxide, and bacteriocins. This acidic milieu acts as a natural barrier against opportunistic and pathogenic microorganisms, thereby reducing the risk of infections and promoting mucosal integrity (Fettweis et al., 2019;

France et al., 2022). The balance and composition of the vaginal microbiota are intricately linked to various aspects of women's reproductive health, including menstruation, fertility, pregnancy, and menopause. Disruption of this microbial balance, known as dysbiosis, has been associated with several adverse reproductive health outcomes such as bacterial vaginosis (BV), heightened susceptibility to sexually transmitted infections (STIs), adverse pregnancy outcomes including preterm birth, and infertility (Balle et al., 2020; Anahtar et al., 2021). Furthermore, the vaginal microbiome is not a static entity; it is shaped by a multitude of internal and external factors, including hormonal

MICROBIAL FUEL CELLS AND THEIR APPLICATIONS IN SUSTAINABLE ENERGY GENERATION

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ABSTRACT

Microbial Fuel Cells (MFCs) represent sophisticated bioelectrochemical systems that transform organic waste directly into electricity through the metabolic processes of electroactive microorganisms. This technology provides a sustainable and environmentally friendly method for renewable energy generation while concurrently treating wastewater and mitigating environmental pollution. Recent developments in MFC research have concentrated on enhancing electrode materials, optimizing microbial communities, and creating efficient reactor designs to improve power output and system stability. MFCs have shown promising applications in wastewater treatment, bioelectricity generation, biosensing, desalination, and powering remote devices. For example, they can process municipal and industrial wastewater while producing electricity, thus contributing to both energy recovery and environmental remediation. Furthermore, MFC-based biosensors facilitate real-time monitoring of pollutants, and microbial desalination cells integrate energy production with salt water treatment. Despite their advantages, challenges similar as low power viscosity, high material costs, and scalability issues presently limit large scale perpetration. Still, ongoing exploration integrating nanotechnology, synthetic biology, and smart system designs is addressing these walls. The significance of MFCs lies in their capability to support indirect frugality principles by converting waste into precious energy and minimizing hothouse gas emigrations. As global demand for clean and renewable energy grows, MFC technology holds pledge as a reciprocal result in sustainable energy systems, particularly in decentralized and out- grid operations. Continued interdisciplinary sweats and policy support will be pivotal for rephrasing laboratory advances into practical, large- scale operation.

Keywords: Microbial Fuel Cells, Bioenergy, Waste-to-Energy, Sustainable Technology, Renewable Energy, Biocatalysis, Green Energy

Introduction

The global demand for energy continues to escalate hastily due to industrialization, urbanization, and technological advancements, which pose significant difficulties for both energy security and environmental sustainability. Archconservative fuels, presently dominating the global energy matrix, are not only finite but also major contributors to hothouse gas emigrations

and climate change (International Energy Agency, 2023).

This growing zero hour has boosted the global pursuit of clean, renewable, and sustainable energy druthers. In this medium, microbial energy cells (MFCs) have surfaced as a promising bioelectrochemical technology that addresses the double challenges of energy generation and waste charge. MFCs harness the metabolic exertion of

ISOLATION AND BIOCHEMICAL CHARACTERIZATION OF A PHARMACEUTICALLY RELEVANT AMYLASE FROM SOIL MICROORGANISMS

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ABSTRACT

The breakdown of starch into simpler sugars like glucose and maltose is catalyzed by amylases, which are significant enzymes in both industry and medicine. The current study's objectives were to separate strong amylase-producing bacteria from soil, maximize enzyme production under ideal cultural conditions, and describe the enzyme for possible use in medicinal formulations and treatments. Samples of soil were taken from the nursery area of Shri Ram College in Muzaffarnagar. They were then serially diluted and plated on nutrient agar that contained starch. Two of the ten bacterial isolates (SAR I and SAR V) showed noticeable starch hydrolysis zones when stained with iodine.

Both isolates were recognized as Gram-positive rods from the genus Bacillus by morphological and biochemical analysis. Using starch and yeast extract as the preferred carbon and nitrogen sources, respectively, optimization studies showed that maximum amylase production happened at 37°C and pH 6.8. After being largely purified and described, the crude enzyme had favorable kinetic characteristics ($K_m = 3.2$ mg/ml; $V_{max} = 420$ U/ml), good thermal and pH stability, optimal activity at physiological temperature and pH, and a molecular weight of roughly 55 kDa. The enzyme's appropriateness for pharmaceutical uses, such as starch-based drug delivery systems, enzyme replacement therapy, and digestive assistance therapy, was shown by functional evaluation. The results demonstrate the isolated Bacillus strain's potential as a viable source of amylase with medicinal applications.

Keywords: Amylase, Bacillus spp., Enzyme optimization, Starch hydrolysis, Pharmaceutical applications

1. Introduction

Amylases are hydrolytic enzymes that break down starch and similar polysaccharides into oligosaccharides and simple sugars like glucose and maltose. The pancreas and salivary glands release α -amylase, which is essential for the digestion of carbohydrates in humans (Beg et al., 2001; Sun et al., 2016). Amylases are divided into α -amylase, β -amylase, and γ -amylase (glucoamylase) according to how they work. β -amylase acts from the non-

reducing ends, α -amylase randomly cleaves internal α -1,4-glycosidic bonds, and γ -amylase releases free glucose units to complete starch hydrolysis (Jayani et al., 2005).

Because of their wide commercial relevance, ease of manufacture, and suitability for process optimization, microbial amylases—especially those made by bacteria and fungi—have attracted a lot of attention. Extracellular amylases are known to be produced by fungi like Aspergillus and Rhizopus as well as Bacillus species like B. subtilis,

CONVERSION OF AGRICULTURAL WASTE INTO FUEL: COMPREHENSIVE REVIEW OF TECHNOLOGIES, CHALLENGES, AND FUTURE DIRECTIONS

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ABSTRACT

Agricultural leftovers are an important renewable resource that is still mostly unused and frequently causes environmental issues when improperly disposed of. Converting agricultural waste into sustainable fuels presents an appealing alternative for waste management, greenhouse gas reduction, and energy security in light of the growing global energy demand and climate change concerns. Demirbas (2009) and McKendry (2002) claim that biomass-based fuels encourage waste valorization while offering a low-carbon substitute for fossil fuels. The main biochemical and thermochemical methods for turning agricultural waste into biofuels—such as biogas, bioethanol, biodiesel, biohydrogen, and bio-oil—are reviewed in this study along with their effects on the environment, economic feasibility, difficulties, and prospects for widespread application.

1. Introduction

Large amounts of waste, such as straw, stalks, husks, bagasse, fruit and vegetable wastes, and manure, are produced worldwide by agricultural activities. These residues are primarily lignocellulosic biomass, which is made up of cellulose, hemicellulose, and lignin. As such, they are rich in potential chemical energy yet difficult to break down. According to McKendry (2002) and Sims et al. (2010), inappropriate disposal methods like open-field burning greatly increase greenhouse gas emissions and air pollution. By converting trash into high-value fuels and chemicals, biofuel production from agricultural wastes has been acknowledged as a sustainable alternative that improves energy security and promotes the concepts of the circular economy (Cherubini, 2010).

Agricultural waste can greatly lessen trash accumulation and environmental degradation without competing with food resources (Naik et al.,

2010). In addition to discussing the environmental and socioeconomic ramifications of waste-to-fuel conversion, this paper highlights the main obstacles and potential directions for further research.

2. Characteristics of Agricultural Waste

Lignocellulosic biomass, which is physically stiff and resistant to breakdown without pretreatment, makes up the majority of agricultural waste. According to Sun and Cheng (2002), lignin serves as a significant obstacle to enzymatic accessibility, although cellulose and hemicellulose can be degraded into fermentable sugars. Therefore, pretreatment procedures to overcome biomass recalcitrance prior to subsequent fuel generating steps are necessary for efficient conversion.

Rice straw, wheat straw, maize stalks, sugarcane bagasse, banana peels, oilseed cakes, and fruit processing waste are examples of common agricultural wastes. Depending on their moisture