

48th
ANNUAL CONFERENCE OF
ORISSA BOTANICAL SOCIETY
&
NATIONAL CONFERENCE
ON
ADVANCES IN MEDICINAL PLANT
RESEARCH AND INNOVATIONS
(AMPRI-2026)

1st & 2nd February, 2026

Organized by
DEPARTMENT OF BOTANY
School of Applied Sciences
Centurion University of Technology and Management
Bhubaneswar, Odisha, India



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No: 97/2026

January 28, 2026

MESSAGE

I am glad to know that Centurion University of Technology and Management, Bhubaneswar is organising the National Conference on Advances in Medicinal Plant Research and Innovations- 2026 along with 48th Annual Conference of the Orissa Botanical Society on February 01-02, 2026. An abstract-cum-souvenir is also being released to commemorate the event.

I am hopeful that this event will serve as a vital platform for sharing cutting-edge research, fostering interdisciplinary dialogue and advancing innovations in medicinal plant sciences, contributing significantly to sustainable healthcare, biodiversity conservation and traditional knowledge integration. This initiative reflects the growing commitment of Odisha's academic institutions to excellence in botanical research and applied plant sciences through enriching discussions and meaningful outcomes.

I wish the conference and publication every success.

(Hari Babu Kambhampati)

SURYABANSHI SURAJ
MINISTER OF STATE (IND.)
Higher Education, Sports & Youth Services
Odia Language, Literature & Culture, Odisha



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Message

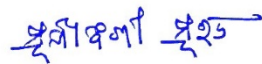
I am pleased to know that the National Conference on “Advances in Medicinal Plant Research and Innovation” along with the 48th Annual Conference of the Orissa Botanical Society is being organised on 1st and 2nd February at Centurion University of Technology and Management. I extend my warm greetings and best wishes to the organisers, delegates, researchers, academicians and students participating in this important academic event.

India has a rich legacy of traditional knowledge systems rooted in medicinal plants, which continue to play a vital role in healthcare, biodiversity conservation and sustainable development. In the present era, scientific research and innovation in medicinal plant studies are crucial for bridging traditional wisdom with modern science, leading to novel discoveries and applications for the benefit of society.

This conference provides an excellent platform for scholars and researchers to exchange ideas, share research findings and deliberate on emerging trends in medicinal plant research. I am confident that the deliberations will contribute significantly to academic excellence, interdisciplinary collaboration and innovation in botanical sciences.

I appreciate the efforts of Centurion University of Technology and Management and the Orissa Botanical Society in organising this prestigious conference and for bringing out this souvenir, which I am sure will serve as a valuable academic resource.

I wish the conference every success and hope it inspires meaningful research and collaboration in the field of botanical and medicinal plant sciences.


(Suryabanshi Suraj)



केंद्रीय आयुर्वेदीय विज्ञान अनुसंधान परिषद्
आयुष मंत्रालय, भारत सरकार
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Ministry of Ayush, Govt. of India

प्रो. (वैद्य) रविनारायण आचार्य, पीएचडी, डीएससी
Prof. (Vaidya) Rabinarayan Acharya, PhD, DSc
महानिदेशक / Director General

Dated the 28th January 2026



MESSAGE

It gives me immense pleasure to extend my warm congratulations to the Orissa Botanical Society for organizing the National Conference on "Advances in Medicinal Plant Research and Innovations (AMPRI-2026)" along with the 48th Annual Conference of the Orissa Botanical Society, scheduled to be held on 1st and 2nd February 2026 at Centurion University, Bhubaneswar, Odisha. The theme of this national conference is both timely and scientifically significant, reflecting the growing convergence of classical botanical knowledge with modern research and innovation.

Ayurveda, one of the oldest organized systems of medicine, is firmly rooted in systematic medicinal plant research, where precise identification, quality assessment, and rational use of plant resources formed the backbone of healthcare. Today, this rich historical foundation is being strengthened by contemporary advances in botany, molecular authentication, phytochemistry, and pharmacological validation, positioning medicinal plant research at the core of evidence-based, future-oriented Ayurveda.

This conference provides an excellent platform for botanists, researchers, teachers, and students to deliberate on recent scientific advances, foster interdisciplinary collaboration, and align medicinal plant research with emerging healthcare needs, sustainability, and innovation. I am confident that the scientific deliberations and academic exchanges during AMPRI-2026 will significantly advance medicinal plant sciences in the country.

I wish the conference every success and extend my best wishes to the organizers and all participants for fruitful and enriching deliberations.

(Prof. Vd. Rabinarayan Acharya)

Prof. Supriya Pattnayak

Vice-Chancellor

CUTM, Odisha



Message

It gives me immense pleasure to convey my warm greetings to all the delegates, researchers, academicians, and students participating in the **National Conference on “Advances in Medicinal Plant Research and Innovation”**, being organized along with the **48th Annual Conference of the Orissa Botanical Society** on **1st and 2nd February** at **Centurion University of Technology and Management**.

Medicinal plants have played a vital role in traditional healthcare systems and continue to offer immense potential for modern drug discovery, sustainable healthcare, and biodiversity conservation. This conference provides a meaningful platform for scientists, scholars, and young researchers to deliberate on recent advances, exchange innovative ideas, and explore interdisciplinary approaches in medicinal plant research. I sincerely appreciate the efforts of the organizing committee and the Orissa Botanical Society for taking this academic initiative and bringing together eminent experts and researchers from across the country. Such conferences significantly contribute to strengthening research culture, fostering collaboration, and translating scientific knowledge for societal benefit.

I am confident that the deliberations and interactions during this conference will be intellectually enriching and will inspire future research and innovation in the field of medicinal plant sciences. I wish the conference a grand success and all participants a fruitful and memorable academic experience. With best wishes to the organisers, exhibitors, delegates who are associated with such a wonderful Programme

Prof Supriya Pattanayak

Dr. Kunja Bihari Satapathy
President
Orissa Botanical Society, Bhubaneswar



Message

It gives me great pleasure to extend my warm greetings and best wishes to the organizers, participants, and contributors of the National Seminar on “*Advances in Medicinal Plant Research and Innovations*”. The publication of this souvenir marks a significant milestone in our collective pursuit of academic excellence and scientific progress.

Medicinal plants have long been recognized as a keystone of traditional medicine and as a promising resource for modern therapeutic development. In an era of growing interest in natural and sustainable healthcare solutions, the exploration of medicinal plants through rigorous scientific inquiry has assumed renewed importance. This seminar provides an excellent platform for scholars, researchers, and students to share their knowledge, present innovative findings, and foster meaningful collaboration in this evolving field.

I take this opportunity to commend the organizing committee for their vision, dedication, and tireless efforts in bringing together experts and enthusiasts from diverse disciplines. The deliberations and insights shared during this event, as well as the scholarly contributions featured in this souvenir, will undoubtedly enrich our understanding and stimulate further research in medicinal plant science.

I extend my best wishes for the grand success of the seminar and hope that this souvenir serves as a lasting record of the intellectual exchange and inspiration generated through this meaningful academic endeavor.

A handwritten signature in blue ink, which appears to read 'Kunja Bihari Satapathy'.

Dr. Kunja Bihari Satapathy

Prof. (Dr.) Susanta Kumar Biswal
School of Applied Sciences
Centurion University of Technology and Management
Odisha



Message

It gives me immense pleasure to extend my warm greetings to all the delegates, researchers, academicians, and students participating in the National Conference on “Advances in Medicinal Plant Research and Innovations (AMPRI-2026)”, being organized by the department of Botany, School of Applied Sciences (SoAS), Centurion University of Technology and Management (CUTM), Odisha in conjunction with the 48th Annual Conference of the Orissa Botanical Society.

Medicinal plants have played a vital role in traditional and modern healthcare systems. In recent years, scientific research and technological innovations have significantly expanded the scope of medicinal plant studies, contributing to drug discovery, sustainable healthcare, and biodiversity conservation. This conference provides an excellent platform for the exchange of ideas, presentation of research findings, and fostering collaborations among experts from academia, research institutions, and industry.

I am confident that the deliberations, technical sessions, and interactions during this conference will enrich knowledge, inspire innovative research, and promote sustainable utilization of medicinal plant resources. I sincerely appreciate the efforts of the organizing committee for bringing together this prestigious academic event.

I wish the conference every success and hope that all participants have a fruitful and memorable experience.

With best wishes,



Prof. (Dr.) Susanta Kumar Biswal

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Evolving Frontiers in Medicinal Plant Research: Tradition to Translation

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Introduction

Medicinal plant research is experiencing a decisive transformation. Traditionally centred on taxonomy, morphology, and ethnobotanical documentation, the discipline has evolved into a technology-enabled, data-driven and translational science. This shift is particularly significant for India, where traditional medical systems such as Ayurveda, Siddha, Unani, and diverse folk practices are deeply embedded in botanical knowledge.

A defining and distinctive feature of Indian traditional medicine is the integration of plants as both medicine and food (Ahara). Unlike modern biomedical systems that sharply separate nutrition and pharmacology, Ayurveda views diet as a primary regulator of health and disease prevention. In the present context of rising chronic diseases, antimicrobial resistance, and lifestyle disorders, this integrated approach offers a scientifically relevant and sustainable framework.

The theme *Advances in Medicinal Plant Research and Innovations* is therefore timely, especially for teachers and students of botany who are expected to shape the next generation of evidence-based traditional medicine, functional food research, and plant-based healthcare innovation.

Medicinal Plants, Ayurveda and Ahara: A Scientific Continuum

Ayurveda and other Indian traditional medicine (TM) systems are fundamentally plant-centric and food-oriented. Classical Ayurvedic texts document nearly 1,200 medicinal plant species, many of which serve dual roles as therapeutic agents (*aushadha*) and dietary components (*ahara*). This food–medicine continuum is a key scientific distinction of Indian systems.

Core features of this framework include:

- Use of multi-component formulations rather than single molecules
- Emphasis on synergistic action
- Long-term safety ensured through habitual dietary use
- Focus on disease prevention and health promotion

From a botanical perspective, Ayurveda represents a historically validated bioprospecting and ethnonutritional database. Plants such as *Curcuma longa* (turmeric), *Zingiber officinale* (ginger), *Phyllanthus emblica* (amla), *Tinospora cordifolia*, and *Moringa oleifera* exemplify how dietetic botanicals regulate metabolism, immunity, and inflammation.

Modern research increasingly confirms that dietary botanicals modulate molecular pathways, oxidative stress, immune responses, and gut microbiota, providing scientific validation to classical dietary recommendations.

Botanicals as a Proven Source of Drugs and Functional Foods

Notable examples from Indian botanical resources include:

- *Rauwolfia serpentina* → reserpine (antihypertensive, neuropharmacology)
- *Catharanthus roseus* → vincristine and vinblastine (anticancer drugs)
- *Artemisia annua* → artemisinin (antimalarial therapy with global impact)

In parallel, the global expansion of nutraceuticals and functional foods has brought dietary botanicals to the forefront. Curcuminoids, gingerols, polyphenols, alkaloids, and dietary fibers now form the scientific basis of preventive and adjunct healthcare strategies.

These examples establish a clear conclusion: botanical research, when rigorously executed, yields globally relevant therapeutics and health-promoting interventions.

Major Advances in Medicinal Plant and Dietary Botanical Research

From Classical Taxonomy to Molecular Authentication

While taxonomy remains foundational, modern medicinal plant research demands molecular authentication.

This transition represents a shift from descriptive identification to quality-assured, regulatory-grade botany.

From Phytochemistry to Metabolomics and Nutrigenomics

Traditional phytochemistry focused on isolating one or two marker compounds. Contemporary research uses metabolomics (LC–MS, GC–MS, NMR) to generate holistic chemical and nutritional fingerprints.

Benefits include:

- Improved standardization of herbal drugs and dietary botanicals
- Identification of chemotypes linked to efficacy and safety
- Correlation of cultivation practices with bioactive profiles

This approach aligns conceptually with Ayurvedic principles of *rasa*, *guna*, *virya*, and *vipaka*, which recognize functional variability in plant materials.

Bioassay-Guided and Systems-Level Approaches

Modern medicinal plant research integrates:

- Cell-based and enzyme assays
- Network pharmacology
- Multi-target screening strategies

Rather than forcing botanicals into a single-target drug model, systems-level approaches recognize their strength in managing complex, multifactorial diseases such as diabetes, inflammation, and neurodegeneration. Dietary botanicals are increasingly studied for their long-term regulatory effects rather than acute pharmacological action alone.

Genomics, Biotechnology and Sustainable Innovation

Decoding biosynthetic pathways of medicinal and edible plants has opened new avenues for:

- Sustainable production of high-value phytochemicals
- Conservation of threatened species
- Development of standardized plant-based ingredients

This has created interdisciplinary career pathways linking botany, genomics, biotechnology, and food science.

Medicinal Plant and Ahara Research Ecosystem in India

Current research frameworks in India integrate:

- Field botany and ethnobotanical–ethnodietetic surveys
- Herbarium-based taxonomy and documentation
- Molecular biology and analytical chemistry
- Preclinical pharmacology, nutritional evaluation, and safety studies
- Clinical validation under national regulatory mechanisms

The inclusion of dietary botanicals within this framework has shifted medicinal plant research from informal practice to evidence-based, preventive and promotive healthcare science.

Innovation-Driven Research Areas Aligned with Healthcare Needs

Priority research domains include:

- Metabolic and lifestyle disorders: dietary botanicals offer safe, long-term management strategies.
- Neurocognitive health: adaptogenic and neuroprotective plants address stress-related disorders.
- Gut health and inflammation: botanicals modulate the gut–immune–brain axis.
- Functional foods and nutraceuticals: provide rapid translational pathways with high societal impact.

Role of Teachers and Students of Botany

For the development of any science, mentoring is the foundation. Thus, capacity building aligned with emerging interdisciplinary research areas will be more fruitful for teachers and students.

- Medicinal plant research now includes nutritional and dietary dimensions.
- Competence in molecular tools, metabolomics, and data analysis is essential.
- Interdisciplinary collaboration with pharmacology, nutrition science, and traditional medicine institutions is strategic.

Students trained at this interface are well-positioned for careers in research, industry, regulatory science, and public health.

Conclusion

Advances in medicinal plant research reflect a convergence of traditional knowledge, botanical science, nutrition, and modern technology. Ayurveda and Indian TM systems provide conceptual direction through the Ahara–Aushadha continuum; botany supplies the scientific foundation; contemporary tools deliver validation, scalability, and innovation.

For Odisha, endowed with rich floristic diversity and academic strength, this theme is not merely academic—it is strategic. The future of medicinal plant research lies in innovation without losing roots, and botanists will remain central to this transformation.

Institutional Herbal Gardens as Centers for Learning, Research, Conservation, Healthcare and Entrepreneurship

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An herbal garden refers to the systematic cultivation and maintenance of medicinal and aromatic plants (MAPs) possessing preventive and curative properties against various diseases and ailments. Herbal gardens are increasingly being established across diverse settings, particularly in educational and research institutions, where they serve as living repositories of important medicinal plant germplasm. These gardens support conservation efforts while also providing valuable resources for teaching, learning, and scientific research, in addition to promoting healthcare awareness and medical tourism. The establishment of herbal gardens plays a significant role in creating awareness about locally available medicinal plants used for common health conditions. Such initiatives also encourage small and marginal farmers to cultivate medicinal plants, thereby enhancing livelihood opportunities and income generation. Systematic cultivation and propagation further contribute to the conservation of valuable and threatened medicinal plant species that are increasingly vulnerable in their natural habitats.

An institutional herbal garden is a purposeful and curated collection of medicinal plants maintained within college and university campuses. It functions as a multidisciplinary platform that supports education, research, biodiversity conservation, healthcare awareness, and sustainable development, thereby strengthening the integration of traditional knowledge with modern scientific approaches.

Experiential Learning and Skill Development

Herbal gardens offer students practical, hands-on learning experiences beyond the conventional classrooms. Students from disciplines such as botany, pharmacy, agriculture, biotechnology, and environmental science can learn how to identify medicinal plants, understand their cultivation methods, and study their medicinal uses. This direct exposure helps students develop practical skills, improve observation, and strengthen scientific thinking.

Academic Research and Scientific Exploration

At the college and university level, herbal gardens act as living laboratories for academic projects, dissertations, and field studies. They support research in areas such as ethnobotany, phytochemistry, pharmacology, and medicinal plant biotechnology. The garden also promotes interdisciplinary research by linking traditional medicinal knowledge systems with modern scientific approaches.

Conservation of Medicinal Plant Resources

Rapid environmental degradation and overexploitation have placed many medicinal plants at risk. Institutional herbal gardens contribute to ex-situ conservation by preserving rare, endangered, and indigenous species. Through participation in conservation activities, students develop environmental awareness and a sense of responsibility toward sustainable resource management.

Healthcare Awareness and Traditional Knowledge

Herbal gardens help students understand plant-based healthcare systems, including Ayurveda, Siddha, Unani, and folk medicine. They educate students on the therapeutic uses of medicinal plants for common ailments, emphasizing safe, informed, and ethical use of herbal remedies.

Entrepreneurship Opportunities and Sustainable Livelihoods

Herbal gardens also create opportunities for entrepreneurship. Students learn about nursery management, herbal product preparation, value addition, and small-scale business models. This exposure encourages innovation, self-employment, and the development of eco-friendly enterprises based on sustainable principles.

Overall Significance of Institutional Herbal Gardens

An institutional herbal garden is both an academic and social asset. By linking education, research, conservation, healthcare awareness, and entrepreneurship, it helps students to become skilled

professionals, environmentally responsible citizens, and innovators committed to sustainability and human well-being.

The following medicinal plants (Table 1), comprising 25 herbs, 11 climbers, 6 shrubs, and 17 trees, have been carefully selected for introduction into institutional herbal gardens based on their ease of cultivation and processing, as well as their proven effectiveness in managing common ailments, thereby supporting primary healthcare needs.

Table 1: List of Important Medicinal Plant Species Selected for Institutional Herbal Gardens

Sl. No.	Botanical name & Family	Vernacular name(s)	Use(s)	Threat status
HERBS				
1.	Acorus calamus L. [ARACEAE]	ବଡ଼ (O), Sweet-flag (E)	Pharyngitis, bronchitis	---
2.	Aloe vera (L.) Burm.f. [LILIACEAE]	ଘି କୁଆଁରୀ (O), Indian aloe (E)	Wound healing, skin care	---
3.	Alpinia galanga (L.) Willd. [ZINGIBERACEAE]	କୁଳିଙ୍ଗନ (O), The greater galangal (E)	Indigestion, bronchitis, stomach pain	---
4.	Andrographis paniculata (Burm.f.) Wall. ex Nees [ACANTHACEAE]	ଭୂଇଁ-ନିମ୍ବ (O), Creat (E)	Liver disorders, immunity booster	---
5.	Bacopa monnieri (L.) Pennell [SCROPHULARIACEAE]	ବ୍ରାହ୍ମୀ (O), Thyme leaved gratiola (E)	Improves memory, cognitive health	---
6.	Catharanthus roseus (L.) G. Don. [APOCYNACEAE]	ସଦାବିହାରୀ (O), Madagascar Rosy flower (E)	Diabetes, Hypertension, leukemia	---
7.	Centella asiatica (L.) Urb. [APIACEAE]	ଥାଲକୁଡ଼ି / ହାତୀଖୋଜିଆ (O), Indian penny wort (E)	Memory enhancer, wound healing	---
8.	Coleus ambonicus Lour. [LAMIACEAE]	ରୁକୁଣୀ-ହାତପୋଛା / କୁଆଣୀ-ପତ୍ର (O), Pashanabhedi (San)	Fever, cold, indigestion	---
9.	Costus speciosus (Koenig) Sm. [ZINGIBERACEAE]	ଗାଲଗୋବର/ଗାଲଗୋଜିଆ/କଉକଉକା (O), Elegant costus (E)	Fever, rheumatism, lumbago and neuralgia	---

10.	Crinum asialism L. [AMARYLLIDACEAE]	ଅର୍ଶ/ ଅରିଶ (O), Nagadamani, Vishamandala (San)	Inflammation, skin diseases	---
11.	Curculigo orchoides Gaertn. [HYPOXIDACEAE]	ଚାଳମୁଳି/ ମାଣିଆ କନ୍ଦ (O), Talamulika, Musali (San)	Bronchitis, jaundice, piles	---
12.	Curcuma longa L. [ZINGIBERACEAE]	ହଳଦୀ (O), Common turmeric (E)	Skin disease, jaundice, rheumatism	---
13.	Cymbopogon citratus (DC.) Stapf. [POACEAE]	ଧନ୍ଦୁତରୀ (O), Lemongrass (E)	Rheumatic pain, indigestion	---
14.	Hedychium coronarium J.Koenig [ZINGIBERACEAE]	ଅବା ପୁଲ / ରାମ କେଦାର (O), Ginger lily (E)	Bronchitis, cough, tonsillitis	Vulnerable
15.	Kaempferia rotunda L. [ZINGIBERACEAE]	ଗଦ (O), Bhumichampaka (San)	Anorexia, mumps, stomach disorders	---
16.	Kalanchoe pinnata (Lam.) Pers. [CRASSULACEAE]	ଅମରପୋଇ / ହେମ କେଦାର (O), Mexican love plant (E)	Diarrhoea, wound healing properties	---
17.	Mentha arvensis L. [LAMIACEAE]	ପୋଦିନା (O), Common Mint (E)	Indigestion, cooling agent	---
18.	Ocimum basilicum L. [LAMIACEAE]	ତୁଳସୀ/କପରକାଢି/ ବ୍ରାହ୍ମଣୀ ଜଟା (O), Sweet basil (E)	Chronic diarrhoea, dysentery, bowel complaints of children	---
19.	Ocimum gratissimum L. [LAMIACEAE]	ରାମତୁଳସୀ (O), Lemon basil, Shrubby basil (E)	Headache, influenza, rheumatism	---
20.	Psoralea corylifolia L. [FABACEAE]	ବାକୁଟୀ (O, San), Malay tea scur pea, Bouchée seed plant (E)	Leukoderma, leprosy, psoriasis	Rare
21.	Rauvolfia serpentina (L.) Benth. ex Kurz [APOCYNACEAE]	ପାତାଳ ଗରୁଡ଼ (O), Serpentine root (E)	Hypertension, mild anxiety, expulsion of intestinal worms	Endangered
22.	Tribulus terrestris L.	ଗୋଖରା (O), Puncture-vine	Infertility in	---

	[ZYGOPHYLLACEAE]	(E).	both sexes, kidney problems, tonic	
23.	Uraria picta (Jack.) Desv. ex DC. [FABACEAE]	ଇଶ୍ବରଜଙ୍ଗା / ଶଙ୍କରଜଙ୍ଗା (O), Chitraparni (San)	Oral ulcer, Inflammation, Immunity	Endangered
24.	Withania somnifera (L.) Dunal [SOLANACEAE]	ଅଶ୍ବଗନ୍ଧା (O), Ashvakandika (San)	Stress relief, debility from old age	---
25.	Zingiber zerumbet (L.) Sm. [ZINGIBERACEAE]	ପରଶୁ କେଦାର/ ଗଦ (O), Wild ginger (E)	Dyspepsia, cough, diabetes, peptic ulcers	---
CLIMBERS				
1.	Argyreia nervosa (Burm.f.) Boj. [CONVOLVULACEAE]	ବଚରାଜ/ ମଖମଲ ଲତା/ ମୁଣ୍ଡା-ଲତା (O), Elephant creeper (E)	Rheumatism, nervine tonic, general tonic.	---
2.	Asparagus racemosus Willd. [LILIACEAE]	ସତାବରୀ (O), Wild asparagus (E)	Reproductive health, rheumatism, tonic	---
3.	Cissus quadrangularis L. [VITACEAE]	ହାଡ଼ଭଜା (O), Edible-stemed vine (E)	Asthma, scurvy, bone fracture	---
4.	Gloriosa superba L. [LILIACEAE]	ପାଞ୍ଚଆଙ୍ଗୁଳିଆ / ଦଶହରା ଫୁଲ (O), Malabar glory lily (E)	Skin disease, bleeding piles, Rhematism	Endangered
5.	Gymnema sylvestre (Retz.) R.Br. ex Schult. [ASCLEPIADACEAE]	ଗୁଡ଼ମାରି (O), Periploca of the woods (E)	Diabetes, cardiac stimulant, diuretic.	---
6.	Paederia foetida L. [RUBIACEAE]	ପଦାରୁଣୀ (O), Chinese moon- creeper (E)	Gastric problem, Rheumatism	Vulnerable
7.	Piper longum L. [PIPERACEAE]	ପିପ୍ପଳି (O), Indian Long pepper (E)	Respiratory disorders, indigestion	Endangered
8.	Pueraria tuberosa (Willd.) DC. [FABACEAE]	ଭୂଇଁ କଖାରୁ (O), Indian Kudzu (E).	Dysuria, rheumatism, as lactagogue	Vulnerable

9.	Scindapsus officinalis (Roxb.) Schott & Endl. [ARACEAE]	ଗଜପିସ୍ତଳି (O)	Respiratory disease, rheumatic pain	Vulnerable
10.	Tinospora cordifolia (Willd.) Hook.f. & Thoms. [MENISPERMACEAE]	ଗୁଡୁଡି / ଗୁଲୁଡି (O), Tinospora (E)	Chronic fever, general debility	---
11.	Tylophora indica (Burm.f.) Merr. [ASCLEPIADACEAE]	ଅଜମୂଳ (O), Emetic swallow-wort (E)	Asthma, bronchitis, whooping cough	---
SHRUBS				
1.	Calotropis procera (Ait.) R.Br.[ASCLEPIADACEAE]	ଶ୍ୟାମ ଅରଖ (O), Madar milk-weed (E)	Asthma, catarrh, anorexia, tumours	Rare
2.	Clerodendrum chinense (Osbeck) Mabb. [LAMIACEAE]	ବ୍ରଜମଲ୍ଲି (O), Peanur butterplant (E)	Diabetes, inflammation, rheumatism	---
3.	Embelia ribes Burm.f. [MYRSINACEAE]	Embelia (E).	Coughs, diarrhoea, tape worm infestation	Vulnerable
4.	Justicia adhatoda L. [ACANTHACEAE]	ବାସକ / ବାସ / ବାସକ (O), Vasaka (E)	Asthma, cough, bronchitis	---
5.	Lawsonia inermis L. [LYTHRACEAE]	ମଞ୍ଜୁଆତି (O), Henna, Egyptiana priven (E)	Skin care, Jaundice	---
6.	Vitex negundo L. [VERBENACEAE]	ବେଗୁନିଆ (O), Five-leaved chaste tree (E)	Rheumatic pain, Anti-inflammatory, piles	---
TREES				
1.	Aegle marmelos (L.) Corr. [RUTACEAE]	ବେଲ (O), Wood apple, Bael tree (E)	Constipation, dyspepsia, dysentery, diarrhoea	---

2.	Alstonia scholaris (L.) R.Br. [APOCYNACEAE]	ଛତିଆନା/ ସପ୍ତପର୍ଣ୍ଣୀ (O), Devil's tree (E)	Malaria, rheumatic swellings. beriberi	---
3.	Azadirachta indica A. Juss. [MELIACEAE]	ନିମ (O), Neem tree, Margosa (E)	Skin diseases, pyorrhea	---
4.	Bixa orellana L. [BIXACEAE]	କୁକୁମ/ ଗୁଲବାସ (O), Chinese dry tree, Annatto (E)	intermittent fevers, gonorrhoea, dysentery	---
5.	Cassia fistula L. [FABACEAE]	ସୁନାରୀ (O), Golden shower tree (E)	Skin diseases, constipation, diabetes	---
6.	Cinnamomum verum Presl. [LAURACEAE]	ଡାଲଚିନି (O), Ceylon cinnamon (E)	Nausea, vomiting, pimples, black heads	---
7.	Cycas circinalis L. [CYCADACEAE]	ଅରଗୁନା (O), Fern palm (E)	Hypertension, hair growth, diabetes	Vulnerable
8.	Mesua ferrea L. [CLUSIACEAE]	ନାଗେଶ୍ୱର / ନାଗକେସର (O), Mesua tree, Iron-wood tree (E)	Rheumatism, cardiotonic	Vulnerable
9.	Murraya koenigii (L.) Spreng. [RUTACEAE]	ଭେରସୁଜା (O), Curry leaf tree (E)	Diabetes, indigestion, stomachaches	---
10.	Nyctanthes arbor-tristis L. [OLEACEAE]	ଗଜସିରିନି (O), Night jasmine, Coral jasmine (E)	Fever, arthritis, Intestinal worms	---
11.	Oroxylum indicum (L.) Vent. [BIGNONIACEAE]	ପଣପଣା (O), Midnight horror, Indian trumpet tree (E)	Acute rheumatism, otorrhoea. stomach-ache	Endangered
12.	Phyllanthus emblica L. [EUPHORBIACEAE]	ଧାତ୍ରୀ-ଆଁଳା (O), Indian gooseberry (E)	Polyuria, constipation, cough, anaemia	---
13.	Pterocarpus marsupium Roxb. [FABACEAE]	ପିଆଶାଳ (O), Indian Kino tree (E)	Diabetes, Urinary tract infection, leukoderma	Endangered
14.	Pterocarpus santalinus	ରକ୍ତ-ଚନ୍ଦନ (O, Sans, Beng),	Skin diseases,	Vulnerable

	L.f. [FABACEAE]	Red sandal wood (E)	leprosy, inflammations	
15.	Saraca asoca (Roxb.) de Wilde [CAESALPINIACEAE]	ଅଶୋକ (O), Ashoka (E)	Gynecological disorders, diabetes	Critically Endangered
16.	Stereospermum chelonoides (L.f.) DC. [BIGNONIACEAE]	ପାଟଳ / ଘୁଣ୍ଟା (O), Trumpet-flower (E)	Analgesic, liver stimulant, tonic	Endangered
17.	Symplocos racemosa Roxb. [SYMPLOCACEAE]	ଲୋଧ (O), Lodh tree (E)	Menstrual disorders, bleeding gums	Critically Endangered

[Abbreviations: Odia (O), English (E), Sanskrit (Sans)]

In conclusion, the integration of herbal gardens within educational institutions represents a holistic and sustainable approach to education and development. Strengthening and expanding such initiatives can significantly contribute to biodiversity conservation, capacity building, healthcare awareness, and socio-economic development, thereby reinforcing the role of institutions as active contributors to sustainable and inclusive growth.

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Scope of Ethnobotany

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Since long ethno-botany has had a narrow use and was confined only to economic botany and medicinal botany. Of Late scholars have recognised the broad scope and dimension of ethno-botany. Etymologically, the term 'ethno-botany' has its origin from two Greek words, *ethnos* and *botany*. In basic it connotes the botanical knowledge of the ethnic people (Encyclopedia of Social Science 1985). It broadly connotes the knowledge, use, exploitation and conservation of plant resources by ethnic groups, particularly by tribal communities. Considering the multifarious uses of plant resources by different communities, both primitive and modern, Harsberger has rightly coined the term 'ethno-botany' in 1895. However, Introduction to Ethno-botany by P.J. Faulks, which was published in 1958, was the first book specifically on this subject. Faulks mostly dealt with plants of economic importance. Since then, many scholars have tried to define ethno-botany in a scientific way.

According to R.E.Schultes ethno-botany is the study of the relationship that exists between the people of primitive societies and their plant environment. S.K.Jain has also opined that ethnobotany deals with the direct relationship of plants with man. Further, King (1974) has stated that the science of ethno-botany is concerned with the relationship between man and vegetation, as well as his influence on it. R. Ford has described ethno-botany as the study of foods, fibers, dyes, tans and other useful and harmful plants, taboos, avoidance and even magico-religious beliefs about plants. According to Rao (1981), ethno-botany has been defined as a multidisciplinary study involving the relationship between plant and the aboriginal people along with some anthropological knowledge of the region.

S.K. Jain (1981) further described that the importance of ethno-botany has been realized mainly in respect of the various economic uses of the plant by the primitive societies. Rao and Hajra (1987) have rightly stated that ethnobotany is the science which deals with the study of tribal rural people, with a view to unearth their deep and unique knowledge about the properties and uses of plants. It is an interdisciplinary science which involves the study of botany, anthropology, pharmacology, sociology, medico botany, ecology and palaeobotany. Therefore, any general study in ethnobotany should give emphasis on such relevant aspects.

The growth of interest in ethno-botany has considerably expanded during past three decades, both concept and scope. Beginning with the study of plants used by tribals for food, medicine and shelter, it now encompasses studies like conservational practices of the tribals, ethno-pharmacology, ethno-pharmacognosis, ethno-gynaecology, and ethno-musicology.

In this connection the various dimensions of ethnobotany, given by J.K.Maheswari are worth mentioning. Archeo-ethno-botany deals with the identification of plant materials from and contents. Ethno-mycology studies the origin and antiquity of the human use of fungi for food, medicine and for the preservation of such materials. Ethno-narcotics is the study of the use of narcotics, snuffs, hallucinogens, etc. Ethno-pharmacology deals with the identification description, observation and experimental investigations of the ingredients used in various recipes prepared by aboriginal and tribal people and their effects on indigenous drugs. Ethno-taxonomy deals with the naming and classification of plants by primitive societies in their languages. Ethno-toxicology studies the uses of various toxic plants that are used as fish poisons, arrow poisons, weedicides, pesticides etc. in tribal societies. Palaeo-ethno-botany deals with the identification of fossilised plant materials and remains for studying on ancient plant economy, history of old crops, and changing pattern of use of plants by ancient cultures.

These various information collected for ethno-botanical studies are of immense interest to mainly two categories of scholars viz. the social scientists and the biologists including the phytochemists. The social scientists are more interested in the association of plants with material cultures, folklore, socio-religious and other sacred purposes. Plants for food and medicinal importance are of less interest to the social scientists. On the other hand, the biologists are more keen to study the selective use of plants for food and nutrition, medicinal plants and the chemical analysis of plants. Thus, ethno-botany has very recently become a multidisciplinary subject of interest. Scholars from various disciplines like anthropology, botany, ecology, ethnology, pharmacology and agricultural economy have shown their interests on different aspects of ethno-botany. Their interests and researches can be classified into four broad areas

- (a) ethno-botany of individual or a group of plants
- (b) ethno-botany of selected tribal communities
- (c) ethno-botany of specific areas and
- (d) ethno-botany of certain utility groups such as food, fodder. economy. medicine. sacred purposes.

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ETHNOBOTANICAL INSIGHTS

Current status of ferns and fern allies of Bhubaneswar, Odisha, India

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Abstract

Ferns and their allies (pteridophytes) are one of the ecologically important plant groups vital for providing various ecosystem services to mankind starting from economic, medicinal, environmental to ornamental values. About 1267 species of pteridophytes are found in India till date out of 13,109 species reported to occur worldwide. So far 160 species pteridophytes have been recorded from Odisha. A study was conducted for the period from January 2023 to April 2023 to assess the current status and distribution of ferns and fern allies of Bhubaneswar Municipal Corporation (BMC) covering selected sites like Sikharchandi, Dhauligiri, Khandagiri, Udayagiri and the State Botanical Garden. In total 22 species of ferns and fern allies belonging to 13 genera and 8 families were documented during the study period. The occurrence and distribution of these species varied across different sites, reflecting habitat diversity and microclimatic conditions. The findings provide baseline information on the diversity and current status of pteridophytic flora in Bhubaneswar and highlight the importance of conserving suitable habitats to maintain fern diversity in urban and semi-natural landscapes.

Keywords: Ferns, Pteridophytes, BMC, Microclimatic, Diversity, Landscapes

Ethnobotanical Documentation of Wild Medicinal Plants Used by Economically Backward Tribal Communities of Kandhamal District, Odisha

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Abstract

Traditional knowledge of medicinal plants has evolved over centuries through indigenous health care systems such as Ayurveda, Unani, and Siddha, and continues to play a vital role in the primary health care of rural and tribal populations. The present study documents the ethnobotanical practices and traditional medicinal knowledge of economically backward tribal communities inhabiting the forested and foothill regions of Kandhamal district, Odisha, India. The tribal communities of this region, including Kutia Kandha, Kandha, Santal, and other indigenous groups, largely depend on plant-based remedies for the treatment of various ailments due to limited access to modern health care facilities and prevailing socio-economic constraints. Extensive field surveys were conducted during different seasons to record ethnomedicinal information through direct interaction with traditional healers, elderly community members, and local inhabitants. Data were collected on local plant names, parts used, methods of preparation, dosage, and therapeutic applications. Notable medicinal plants documented include *Phyllanthus fraternus* and *Phyllanthus amarus* for dysentery and jaundice, *Justicia adhatoda* for bronchitis, *Spilanthes paniculata* for dental and oral infections, *Scoparia dulcis* for conjunctivitis, *Rumex dentatus* and *Calotropis procera* species for skin ailments, *Seseli diffusum* and *Eryngium foetidum* for

gastrointestinal disorders, *Saraca asoca* bark for gynecological conditions, *Gloriosa superba* for joint pain, and *Michelia champaca* root juice for post-natal care. The findings indicate that ethnomedicinal practices in Kandhamal district are deeply influenced by socio-cultural beliefs, traditional wisdom, and ecological availability of plant resources. The present documentation provides a valuable baseline for future research and emphasizes the need for detailed phytochemical, pharmacological, and biochemical investigations to scientifically validate the therapeutic efficacy, identify active principles, and standardize dosages of the recorded medicinal plants. Such studies may contribute to the sustainable utilization of medicinal plant resources and potential development of novel plant-based drugs.

Keywords: Ethnobotany, Ethnomedicinal plants diversity, Tribal communities, Common ailments, Sustainable

Ecological niche modelling of a critically endangered species, *Saraca asoca* (Roxb.) W.J.de using bioclimatic and non-bioclimatic factors in the state of Odisha

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Abstract

Saraca asoca (Roxb.) W.J.de Wilde is a critically endangered medicinal tree species of high conservation and cultural importance in India, threatened by habitat loss, fragmentation and overexploitation for pharmaceutical use. The present study employs ecological niche modelling to predict the potential habitat suitability of *S. asoca* in the state of Odisha, India, using a combination of bioclimatic and non-bioclimatic environmental variables. Species occurrence data were compiled from field surveys, herbarium records and published literature, while environmental predictors included bioclimatic variables, topographic factors, land-cover patterns and soil characteristics. The MaxEnt modelling approach was applied to assess habitat suitability and identify key environmental drivers influencing species distribution. Model performance was evaluated using standard validation metrics, and habitat suitability maps were generated to classify areas into high, moderate and low suitability zones. The results indicate that precipitation, temperature seasonality, elevation, forest cover and soil parameters play a significant role in determining the potential distribution of *S. asoca* in Odisha. Several forested regions of Mayurbhanj, Anugul and parts of central and southern Odisha were identified as highly suitable habitats, including areas beyond the species' currently known distribution range and outside protected areas. The study highlights priority areas for in-situ conservation, habitat restoration and assisted regeneration of *S. asoca*. The findings provide valuable baseline information for conservation planning, sustainable management and policy-level decision-making, and demonstrate the effectiveness of ecological niche modelling as a tool for conserving critically endangered medicinal plant species in Odisha.

Keywords: Critically endangered, Ecological niche modelling, MaxEnt, Habitat suitability, Medicinal plants

Antibacterial and antioxidant potential of *Melia azedarach* L. and *Sterculia foetida* L. bark: An *in vitro* study

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Abstract

The objective of the present investigation was to evaluate the antibacterial and antioxidant potential of *n*-hexane and methanolic bark extracts of *Melia azedarach* L. and *Sterculia foetida* L. The antibacterial activity of the extracts was assessed against human pathogens responsible for diarrhoea and dysentery, namely *Shigella flexneri* (MTCC-9543), *Salmonella enterica* ser. *typhi* (MTCC-733), *Bacillus subtilis* (MTCC-1305), *Streptococcus mitis* (MTCC-2897), *Klebsiella pneumoniae* (MTCC-109), and *Staphylococcus aureus* (MTCC-1430), using the agar well diffusion method. The results revealed that the *n*-hexane extract of *Melia azedarach* bark was highly effective against *Shigella flexneri*, while *Streptococcus mitis*, *Staphylococcus aureus*, and *Bacillus subtilis* showed no response; the remaining test pathogens exhibited moderate sensitivity. The methanolic extract of *Melia azedarach* showed strong inhibitory activity against *Salmonella enterica* ser. *typhi* and *Streptococcus mitis*, with moderate effects against the other bacteria. Similarly, the *n*-hexane extract of *Sterculia foetida* bark was highly effective against *Shigella flexneri*, whereas *Klebsiella pneumoniae* showed no response and the other tested pathogens exhibited moderate susceptibility. The methanolic extract of *Sterculia foetida* showed strong inhibition against *Salmonella enterica* ser. *typhi*, no activity against *Shigella flexneri*, and moderate effects against the remaining bacteria. Antioxidant activity assessed by the DPPH radical scavenging assay revealed significant antioxidant potential of both *n*-hexane and methanolic extracts, with IC₅₀ values of 84.37 and 66.79 µg/mL, respectively, for *Melia azedarach*, and 51.26 and 66.84 µg/mL, respectively, for *Sterculia foetida*. Ciprofloxacin was used as the reference antibiotic.

Key Words: Agar well diffusion, Antibacterial activity, Antioxidant activity, Diarrhoea, Susceptibility

Ethnobotany and traditional health care practices by tribals in Rayagada district

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Abstract

India, being one of the world's oldest civilizations have a long tradition of using native and exotic flora in the preparation of medicine by its indigenous population. Odisha is one of the states within India having the highest number of scheduled tribes, renowned for its unique medicinal practices. Ethnobotanical studies and Traditional medicine play an important role in advancements in scientific research. Traditional healing practices have relied on plants and herbs as the primary source of bioactive compounds while also serving as a base for modern herbal medicine. The present study was based on the ethnobotanical studies of the Rayagada district (Gunupur) and the traditional health care methods of the

tribals to use nature for cure. 47 plants having ethnomedicinal values for the treatment of different diseases and disorders were studied under 28 families. Out of these 42 species (89%) belong to dicotyledons and 5 species (11%) belong to monocotyledons. Parts such as leaves (45%), whole plant (22%), seeds (11%), root (12%), stem (4%), fruit (4%) and bulb (2%) are used by the tribals for medicine. Comparison of the plant parts used as a medicinal source indicates that the leaf predominates, followed by the whole plant, root, seed, stem and fruit, then bulb. Out of these, juice of 28% plants are used for medicine preparation, paste of 26% plants are made, decoction of 15% plants are made, powder of 12% are made, latex of 7% were extracted, 6% was dried plant parts which are taken directly, and tea is prepared from 4%. The indigenous tribes handed down this knowledge in the form of folk traditions, but it is slowly dissipating due to the emergence of modern medicine, forest degradation and lack of employment for the younger generation. Although the locals have a tremendous repository of knowledge within themselves, by sheer experience. Much of the ethnobotanical knowledge remains in the dark and is slowly going extinct day by day. These major issues are in the way of traditional folk medicine from realizing its true potential. Another important view is that the rapid degradation of the forest has impacted the lives of these tribal people by stripping them of their homeland. Due to this situation, it has become very difficult for them to lead their traditional way of life. It has been forcing them, particularly the younger generation, to discard their traditional practices and adopt the more modern practices. To solve this problem, a number of herbal medicine marketplaces have been established with public-private partnerships. They should also create awareness about online marketplaces/e-commerce ecosystem, which will give traditional medicine worldwide customers and will create jobs for the younger generation.

Keywords: Ethnobotany, Traditional medicine, Tribals, Predominates, e-commerce

Ethnomedicinal plants used by different ethnic groups in forest fringe areas of Similipal Biosphere Reserve, Mayurbhanj, Odisha

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Abstract

Ethno medicine refers to use of different herbs, plant parts like root, bark, stem, leaf, tuber, seed, flower and fruit which usually grow in a natural habitat and is used by the ethnic groups habiting the natural landscape. Recently WHO has introduced Global traditional medicine strategy 2025-2034 where WHO has described about codified and non-codified traditional medicine and integrative medicine. WHO also describes about indigenous people's right on their traditional knowledge on use of plants as medicine for curing various common diseases. In this current study, the traditional knowledge of local people on ethnomedicinal plants has been documented and interpreted. Mayurbhanj is a biodiversity rich district of Odisha whose forest cover is about 40% of the total area of the district. It is also home to about more than 40 ethnic groups which contribute over 55% of total population of the district (Census 2011). Areas surrounding Similipal biosphere reserve is both rich in ethnomedicinal plants and their users. In this study, four forest fringe areas of Similipal Biosphere Reserve i.e., Lulung, Bangriposhi, Devkund, Thakuramunda and some villages of Moroda block has been visited. A total of 20 informants has been

interviewed through semi structured questionnaire. In this research about 50 plants and their ethnomedicinal plants have been noted. The study aims to preserve the traditional knowledge of indigenous people belongs to different ethnic group, mentioned by them. The scientific studies like quantitative analysis of the gathered data using various matrices like Informant Consensus Factor, Use Value, Fidelity level, Relative Frequency Citation would help in identifying common use of a plant in specific disease. However, the pharmacognosy validation of the documented plants can be achieved by testing the mentioned plants in the document. Further laboratory study of the plants for the specific plant metabolites can also lead to new drug formulation which can be served as an alternative medicine to the conventional medicine.

Key Words: WHO, Biosphere Reserve, Ethnomedicinal plants, Ethnic groups, Relative Frequency

Gupteswar biodiversity heritage site: a treasure for ethnomedicinal practices among local communities

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Abstract

Gupteswar Biodiversity Heritage Site (BHS), declared on 9 February 2024 under Section 37 of the Biological Diversity Act, 2002, represents a unique ecological and cultural landscape in the Koraput District of Odisha. The BHS is characterised by dense tropical moist deciduous forests dominated by **Shorea robusta**, perennial hill streams, rich medicinal plant diversity, and a strong ethnocultural identity centred around the sacred Lord Gupteswar Shiva Temple. Indigenous communities inhabiting the surrounding villages maintain a close relationship with forest ecosystems and possess rich traditional knowledge of plant-based healthcare systems that continue to support primary health needs. The present study aims to systematically document and analyse ethnomedicinal knowledge associated with Gupteswar BHS, focusing on species diversity, local uses, preparation methods, and their role in community health and conservation. Field-based participatory approaches were adopted, including repeated village visits, semi-structured interviews, focus group discussions, and guided forest walks with elderly knowledge holders, traditional healers (Vaidyas), and women herbal practitioners. Plant specimens were collected with prior consent, scientifically authenticated using standard floras and herbarium references, and cross-validated through multiple informants and literature. The verified data were incorporated into the People's Biodiversity Register (PBR) of Gupteswar BHS to ensure community ownership and long-term documentation. A total of 22 ethnomedicinal plant species belonging to herbs, shrubs, climbers, and trees were recorded. Leaves and roots were the most frequently used plant parts. These plants are employed to treat common ailments such as cuts, cough, dysentery, diarrhoea, and joint pain, as well as chronic conditions including epilepsy, diabetes, hypertension, jaundice, and anxiety. Species such as *Scindapsus officinalis*, *Asparagus racemosus*, *Euphorbia nivulia*, and *Rauvolfia serpentina* reflect the depth of indigenous knowledge. Systematic documentation through PBRs strengthens biodiversity conservation, promotes sustainable use, supports intergenerational knowledge transfer, and highlights the need for community herbal gardens and community-led conservation initiatives for long-term sustainability.

Keywords: Biodiversity, Ethnomedicine, Traditional Knowledge, PBR, Sustainable

Escaped Ornamental Flora and Their Ecological Implications in Koraput District, Odisha, India

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Ornamental plants that escape from cultivation and successfully establish self-sustaining populations in natural or semi-natural habitats constitute a significant component of feral flora and are increasingly recognized for their ecological implications. The present study aims to document escaped ornamental plant species and evaluate their potential ecological impacts on local vegetation in Koraput district of Odisha, India, a region well known for its rich floristic diversity and varied agro-climatic conditions. Extensive field-based surveys were carried out between 2018 and 2024 across different habitats in the district, including roadsides, abandoned gardens, agricultural margins, forest edges, and semi-natural landscapes. Plant species were identified using standard taxonomic keys and regional floras, while their invasion and naturalization status was assessed through a comprehensive review of relevant scientific literature. The study recorded a total of 30 escaped ornamental plant species belonging to 22 different families. Among these, Acanthaceae emerged as the most dominant family, represented by six species, highlighting its popularity in ornamental horticulture and its strong ecological adaptability. Amaryllidaceae, Convolvulaceae, and Verbenaceae were moderately represented with two species each, whereas the remaining 18 families were represented by a single species. Analysis of growth forms revealed that shrubs constituted the largest group with 12 species, followed by herbs (8 species), climbers (7 species), and trees (3 species). Most of these species were originally introduced for their attractive appearance, rapid growth, prolific reproduction, and ease of propagation—traits that also enhance their ability to escape cultivation and become naturalized. While several escaped ornamental plants were found to integrate into local ecosystems and contribute to habitat heterogeneity and aesthetic value, certain species demonstrated invasive tendencies. Notably, *Lantana camara* and *Ipomoea cairica* showed aggressive growth and competitive behavior, posing potential threats to native plant diversity and ecosystem functioning. The study underscores the dual role of escaped ornamental plants as both valuable biological resources and potential ecological threats. It emphasizes the need for increased awareness, regular monitoring, and informed management strategies to balance ornamental plant use with biodiversity conservation in Koraput district.

Keywords: Ornamental plants, Escaped cultivation, Feral flora, Biodiversity, Koraput district, Odisha.

Role of People's Biodiversity Registers in protection and conservation of medicinal and aromatic plants in Odisha

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Abstract

As per section 41 of the Biological Diversity Act, 2002, every local body in India shall constitute a Biodiversity Management Committee (BMC) within its jurisdiction. The main function of these BMCs is to prepare People's Biodiversity Registers (PBRs) in consultation with local people. PBRs are legal

documents of BMCs which contains comprehensive information on locally available biological resources and the indigenous traditional knowledge (ITK) associated with them. Medicinal and aromatic plants are the most important biological resources in each PBR which are accessed by all stakeholders for both livelihood and commercial purpose. These registers are considered as baseline database on biological diversity of the respective local bodies which will be useful in conserving, managing and utilizing the local bioresources in a sustainable manner. The PBRs will also be instrumental in protecting the intellectual property rights (IPRs) of local communities. Till date 7256 BMCs have been constituted in Odisha covering all the Gram Panchayats, Blocks and Urban Local Bodies (ULBs) and equal number of dynamic PBRs have been prepared in the state using both primary and secondary research methods. Firsthand information on ethnobotanical application of various medicinal plants have been provided in these PBRs which will pave pathways for institutionalizing the Intellectual Property Rights (IPRs), Patents and other ethnobotanical claims. Based on the detailed information published in 4 PBRs related to biodiversity and socio-economic significance, 4 biodiversity rich sites in Odisha such as Mandasaru in Kandhamal, Mahendragiri in Gajapati, Gandhamardan in Balangir and Bargarh and Gupteswar in Koraput have been declared as Biodiversity Heritage Sites (BHSs) by the state government. In total 400 medicinal plants including the ITK associated with them have been documented in these PBRs. This comprises several threatened and endemic plants. Since BMCs have the power to develop strategies and action plan for protection of biodiversity in their respective jurisdictions, PBRs will play most significant role in enforcing their rights and responsibilities towards the conservation of medicinal plants in Odisha.

Keywords: Biological Diversity Act, People's Biodiversity Register (PBR), Indigenous traditional Knowledge, Medicinal Plants, Biodiversity Heritage Sites.

Role of the Peoples' Biodiversity Register in Conserving Medicinal Plants of Bhitarkanika Ramsar Site, Kendrapara, Odisha

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Abstract

As mandated under Section 41(1) of the Biological Diversity Act, 2002 and its 2023 amendment, along with Rule 22 of the Biological Diversity Rules, 2004 and Rule 21 of the Odisha Biological Diversity Rules, 2012, every local body is required to constitute a Biodiversity Management Committee (BMC) to promote conservation, sustainable use, and documentation of biological diversity. One of the core responsibilities of BMCs is the preparation of People's Biodiversity Registers (PBRs) in collaboration with local communities. PBRs serve as comprehensive records of biological resources within a BMC jurisdiction, documenting species diversity along with associated medicinal, traditional, and utilitarian knowledge. The National Biodiversity Authority (NBA) has prescribed 31 formats for PBR documentation, encompassing agricultural, domesticated, wild, and urban biodiversity, with Formats 12 and 22 specifically dedicated to medicinal plants. In alignment with the Government of India's conservation strategy, the Amrit Dharohar initiative emphasizes the protection of ecologically significant

Ramsar sites. Odisha hosts the biodiversity-rich Bhitarkanika Ramsar Site in Kendrapara district, renowned for its mangrove ecosystem that supports over 73 species of mangroves and associated flora. These mangroves play a crucial role in coastal protection by mitigating cyclone impacts and preventing soil erosion, while also supporting local livelihoods. This study documents the traditional use of mangrove species by local communities for handicrafts, food, medicines, timber, and fuelwood. Species such as *Avicennia alba*, *Avicennia officinalis*, *Rhizophora mucronata*, *Excoecaria agallocha*, *Acanthus ilicifolius*, and *Heritiera fomes* are widely used in traditional healthcare. Knowledge recorded from local healers through participatory rural appraisal, interviews, and surveys enhances community awareness and conservation ethics. PBRs further provide a foundation for conservation planning, establishment of medicinal plant nurseries, and implementation of Access and Benefit Sharing mechanisms for sustainable resource management.

Keywords: Biological Diversity, BMC, Jurisdiction, Conservation, Handicrafts

Ethnobotanical documentation and analysis of medicinal plant knowledge in Bilaspur district, Chhattisgarh, India

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Abstract

The present study documents and analyzes traditional knowledge related to the use of medicinal plants in Bilaspur district, Chhattisgarh, India. Ethnobotanical field surveys were conducted in selected rural and forest-fringe villages using semi-structured interviews and informal discussions with local healers and knowledgeable villagers. A total of 30 medicinal plant species, belonging to different families, were recorded as being used in the treatment of various human ailments. The documented plants were commonly used to manage diseases such as gastrointestinal disorders, skin infections, respiratory problems, fever, wounds, joint pain, and diabetes. Leaves were the most frequently used plant part, followed by roots, bark, seeds, and whole plants. Most remedies were prepared as decoctions, pastes, or powders and administered orally or topically. The study highlights the rich ethnomedicinal knowledge preserved by local communities and underscores the importance of conserving both medicinal plant resources and associated traditional knowledge. The documented information may serve as a baseline for future pharmacological and phytochemical investigations.

Keywords: Ethnobotany, Forest-fringe, Indigenous knowledge, Medicinal plants, Traditional medicine.

In vitro Assessment of Antifungal Potential of *Melia azedarach* L. Bark against Pathogens responsible for Skin Diseases

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Skin diseases comprise a wide spectrum of disorders that affect the skin and are among the most common health problems worldwide, affecting individuals of all age groups. Many skin diseases are commonly caused by fungal infections, particularly under climatic conditions characterized by high temperature and humidity. The present investigation was undertaken to evaluate the antifungal potential of successively extracted *n*-hexane and methanolic bark extracts of *Melia azedarach* L. against selected skin disease-causing fungi. The fungitoxic efficacy of the extracts was assessed against yeast-like fungi, namely *Candida albicans* (MTCC-3017), *Candida krusei*, *Candida tropicalis*, and *Cryptococcus marinus* (MTCC-1029), using the agar well diffusion method, and against mycelial fungi such as *Aspergillus niger* (MTCC-9933) and *Rhizopus oryzae* using the poisoned food technique. The results revealed that the *n*-hexane extract exhibited strong inhibitory activity against *Candida krusei*, while *Candida albicans* and *Candida tropicalis* showed no response and *Cryptococcus marinus* exhibited moderate sensitivity. Similarly, the methanolic extract showed high inhibition against *Candida krusei*, no activity against *Candida albicans* and *Candida tropicalis*, and moderate activity against *Cryptococcus marinus*. Both *n*-hexane and methanolic extracts showed greater zones of inhibition against *Rhizopus oryzae* compared to *Aspergillus niger*. Fluconazole and clotrimazole were used as reference antifungal drugs. The results clearly indicate that the bark of *Melia azedarach* L. contains bioactive phytochemicals responsible for the inhibition and suppression of fungal growth.

Keywords: Agar well diffusion, Poison food method, Antifungal activity, *Melia azedarach* L.

The Role of Wild Edible Plants in Providing Nutrition: A Case Study in Barunei Hill

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Abstract

As the world increasingly relies on a handful of cultivated crops, the remarkable nutritional wealth of wild edible plants remains largely untapped. For generations, rural and indigenous communities have depended not only on farmed produce but also on a rich variety of wild plants growing in forests, hills, and uncultivated lands. These wild species are natural storehouses of essential vitamins, minerals, proteins, and health-promoting compounds, often containing higher nutritional value than common vegetables. In areas experiencing seasonal food shortages and economic hardships, wild edible plants serve as a vital green safety net, ensuring food and nutritional security for vulnerable populations. This study examines the nutritional significance of wild edible plants through field research conducted at Barunei Hill in Khordha District, Odisha. A diverse range of wild species were identified and

documented, including leafy greens, fruits, tubers, seeds, and flowers, many of which local communities consume seasonally. These wild resources become especially important during periods when agricultural production is limited. However, excessive collection, loss of natural habitats, and disappearing traditional knowledge pose serious threats to the continued availability of these plants. This research highlights the critical need for conservation efforts, responsible harvesting practices, and community awareness programs to protect and preserve these invaluable nutritional resources for current and future generations. Keywords: Wild edible plants, Nutritional security, Barunei Hill, Indigenous knowledge, Sustainable use, Food shortage periods

PLANT DIVERSITY EXPLORATION AND PHYTOGEOGRAPHICAL STUDY ON BARUNEI HILL OF KHURDA DISTRICT, ODISHA

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Abstract

Khurda is a region steeped in rich historical significance, prominently featuring the impressive Barunei and Khurda Forts. The present study on Barunei Hill documented 149 plant species, over 135 genera and 54 Families. Among the 149 recorded species, trees represent 32.89% followed by 31.54% herbs, 24.16% for shrubs, and 11.41% LTCs (lianas, twidders, and climbers). The top ten dominant families (with species) are Fabaceae (15), Acanthaceae (11), Malvaceae (11), Euphorbiaceae (9), Rubiaceae (8), Apocynaceae (6), Rutaceae (6), Poaceae (5), Lamiaceae (4), and Moraceae (4). According to the International Union for Conservation of Nature and Natural Resources (IUCN) status, two species, *Psydrax dicoccos* Gaertn. (Tree) and *Lepidagathis hamiltoniana* Wall. (Herb) are found vulnerable, and *Eriocaulon sharmae* R. Ansari & NP Balakr (Herb) is critically endangered. The recorded 149 plant species are assessed with the phytogeographical affinity to five states and six nearby countries and continents. The study found that Barunei Hill shares the strongest affinity with Bangladesh (87.24%), Sri Lanka (80.53%), Myanmar (73.15%), Nepal (62.41%), Africa (46.30%), and Australia (38.92%). Barunei Hill has affinity with Tamil Nadu (47.65%), Andhra Pradesh/Telangana (46.30%), Jharkhand/Bihar (22.14%), West Bengal (20.80%), and Madhya Pradesh/Chhattisgarh (16.77%). A total of 24.83% of the recorded plant species of Barunei hill are present across countries and continents, and 4.02% are absent in those landmasses. Research findings show that Barunei Hill remains largely unexplored in terms of plant diversity. This study highlights the hill's taxonomic diversity and the IUCN status of its species, emphasizing the need for such studies to aid conservation and understand species distribution and relationships.

Keywords: Barunei Hill, Taxonomic diversity, IUCN status, Phytogeography affinity, Conservation

Ethnobotanical and Medicinal Significance of Plants Used in Temple Rituals of Jajpur District, Odisha

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Abstract

Plants have played a fundamental role in human survival, culture, and intellectual development since the dawn of civilization. In many ancient cultures, plants were not merely viewed as physical resources but were also revered as sacred elements symbolizing life, purity, healing, and spiritual power. India, with its immense cultural, religious, and ecological diversity, exhibits a particularly strong relationship between human society and plant life. The present study focuses on documenting the use of plants and their various parts in the daily temple rituals of the Jajpur district in Odisha. In addition to their religious significance, special attention has been given to understanding the therapeutic and medicinal value of these plants. A systematic and comprehensive survey was conducted to identify the plant species commonly used throughout the year in temple practices. Information was collected through direct interactions and interviews with temple priests, knowledgeable local residents, and traditional healers who possess extensive indigenous knowledge passed down through generations. The findings of the study reveal the use of as many as 228 different plant species in religious rituals. These plants are employed in diverse forms, including leaves, flowers, fruits, seeds, bark, roots, and whole plants. A significant number of these species are known for their medicinal properties, while several others are edible and contribute to nutritional well-being. This highlights the dual role of ritual plants as both spiritual and health-supporting resources. However, the increasing demand for these plants raises concerns about their over-exploitation and possible depletion. To ensure their long-term availability, effective conservation strategies must be adopted. Domestication through propagation, cultivation, and regular maintenance of these species should be encouraged not only within temple premises but also in surrounding private households, village schools, and youth organizations. Such community-based conservation initiatives are essential for preserving these valuable plants as sustainable and renewable resources for future generations.

Keywords: Ethnobotany, Medicinal plants, Temple rituals, Traditional knowledge, Biodiversity conservation

Augmenting the potentiality of de-oiled seed cake of *Madhuca longifolia* (J. Koenig ex L.) J.F.

Macbr. for sustainable utilization in Sundargarh district, Odisha

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Abstract

Madhuca longifolia (J. Koenig ex L.) J.F. Macbr. is widely found in Kandhamal, Koraput, Nabarangapur, Malkangiri and Sundargarh districts of Odisha. 'Kusna daaru' is one of the country liquors prepared by

the “Oraon” tribe from the flowers of *M. longifolia*, mostly consumed by rural tribal people of the Sundargarh districts of Odisha. Leftover de-oiled seed cake is a burden to the soil because of containing the toxic materials saponins. Mahua seed contains 35-50% oil and is used for making soaps and candles. Due to its saponin content, the de-oiled seed cakes show pesticide and fungicide properties. A study revealed that detoxified seed cakes can also be used as fertilizers due to their high nitrogen content, low cost, and high nutritional value as cattle feed for increasing milk production, as well as antimicrobial agents against human pathogens, in addition to their pesticidal and insecticidal activity. The seed cakes are also used as a base material for mushroom production due to their high protein and nitrogen content. Seed cake is used as the raw material for converting into vermicompost to maintain the soil health and sustainable soil ecosystem. To mitigate its impact on soil, this study was carried out exploring the potential use of de-oiled seed cake into valuable products for society with environmentally friendly technologies to make the best out of waste.

Keywords: De-oiled seed cake, fertilizers, saponin, Potential, Valuable products

ETHNIC METHODS OF DETOXIFYING TOXIC MEDICINAL PLANTS: AN ETHNOBOTANICAL SURVEY IN BARGARH DISTRICT, ODISHA

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Abstract

Long-term curative efficacy, low cost, easy availability, and no side effects rather some side benefits are the peculiar features of the traditional herbal system of treatment which is the best gift of nature to the living society to live a healthy life. The cleverest animal Human has been using these plants since the ancient era and doing experiments on various toxic plants and their usage, detoxification process, and accurate dose for treating ailments. This knowledge of folklore medicines is restricted and limited to their own family only. The current paper is an attempt to bring this knowledge of toxic plants, detoxification process, toxicity, ethnic use, and dose to the limelight. Bargarh is loaded with various forest patches and tribal inhabitants having plenty of ethnic knowledge of folklore medicines. During the study 19 mostly used toxic plants belonging to 14 families are identified. Out of 19 plant species 5 are herbs, 6 are shrubs, 3 are trees and 5 are climbers. Regarding the toxicity and phytochemicals of toxic plants, and the importance of detoxifying media various books, journals, and databases have been used. It is found from the study that toxic plants are more effective as compared to non-toxic plants due to their unique property of spreading all over the body quickly if they could be detoxified before use and taken in appropriate doses. Cow milk, cow urine, and cow ghee along with the juice of some plant parts are found to be used in almost all processes of detoxification. However more research and pharmacological as well as clinical trial is required regarding the importance and usage of detoxified toxic plants as medicines that could be the gateway for the discovery of new drugs.

Keywords: Ailments, Ethnomedicines, Detoxification, Folklore, Phytochemicals

An inventory of ethnobotanicals used as medicines: A case study of the Paudi Bhuyan tribe in Angul district of Odisha, India

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Abstract

Indigenous and tribal communities across the world possess distinct customs, traditions, religious beliefs, rituals, taboos, legends, and traditional healthcare systems. These communities have extensive knowledge of wild plants used to meet basic needs such as food, shelter, and medicine, developed through long-term interaction with forest resources. However, traditional knowledge related to plant-based healing practices is rapidly declining due to the expansion of modern healthcare systems. An ethnobotanical survey conducted in tribal-dominated areas of Angul district, Odisha, revealed rich traditional knowledge related to medicinal plants among the Paudi Bhuyan tribe. Information on indigenous medicinal practices and plant usage was collected through semi-structured questionnaires and personal interviews with local traditional healers. The study documented the use of 92 plant species belonging to 77 genera and 57 families for the treatment of various ailments. Fresh plant materials were predominantly preferred for medicinal preparations. Several medicinal plant species were found growing naturally in forest habitats, while others were domesticated by the local inhabitants. These plants are usually collected from nearby forest areas and medicines are prepared under the guidance of experienced traditional healers. The present study focuses on the exploration, identification, and documentation of medicinal plants used by the Paudi Bhuyan tribe of Angul district, Odisha. The findings are expected to be valuable for pharmaceutical research, particularly for the isolation of bioactive compounds and the development of new drugs.

Keywords: Ethnobotany, Medicinal plants, Paudi Bhuyan tribe, Traditional healthcare, Tribal

Integrative Assessment of Ethnobotanical Knowledge, Phytochemical Composition, Nutritional Value and Bioactivities of *Bambusa arundinacea* and *Bambusa balcooa*

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Abstract

Bamboo species have gained increasing scientific attention due to their combined importance as traditional medicinal resources and nutrient-rich plant materials. Among them, *Bambusa arundinacea* (Retz.) Willd. and *Bambusa balcooa* Roxb. are widely distributed across India and are deeply embedded in indigenous knowledge systems. Ethnobotanical investigations revealed extensive traditional use of various plant parts, including young shoots, leaves, culms, and roots, in the treatment of a range of

ailments. Indigenous communities commonly utilize these species for managing gastrointestinal disorders, inflammatory conditions, fever, wounds, skin infections, and metabolic problems. Qualitative phytochemical analysis of different plant parts of both species demonstrated the presence of a broad spectrum of bioactive secondary metabolites. These included phenolic compounds, flavonoids, tannins, alkaloids, saponins, terpenoids, and glycosides, all of which are known to contribute to antioxidant, antimicrobial, and anti-inflammatory activities. The diversity and abundance of these compounds indicate that both *B. arundinacea* and *B. balcooa* possess significant phytochemical richness, supporting their traditional medicinal applications. Bioactivity assessments further confirmed the medicinal potential of these species. Strong antioxidant activity was observed, largely attributed to the high phenolic and flavonoid content, which play a crucial role in scavenging free radicals. In addition, extracts exhibited notable antibacterial activity against selected pathogenic bacteria, indicating their possible use in controlling microbial infections. Toxicity evaluation using the brine shrimp lethality assay showed low to moderate toxicity, suggesting a favorable safety margin at doses consistent with traditional usage. Comparative analysis revealed species-specific strengths: *B. arundinacea* generally exhibited higher phenolic content and stronger antioxidant activity, while *B. balcooa* showed superior mineral composition and enhanced antibacterial efficacy. Overall, the findings substantiate the ethnomedicinal importance of these bamboo species and highlight their promise as sources of nutraceuticals and plant-based therapeutic agents.

Keywords: Gastrointestinal, Qualitative, Phytochemical, Scavenging, Microbial

Conservation of medicinal plants by traditional methods.

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Abstract

Medicinal plants form the backbone of traditional healthcare systems and play a vital role in primary healthcare, especially in rural and indigenous communities. However, increasing anthropogenic pressures such as habitat fragmentation, deforestation, overexploitation, climate change, and large-scale commercialization have resulted in the depletion of many medicinal plant taxa. In this scenario, traditional conservation methods rooted in indigenous knowledge and cultural practices play a crucial role in ensuring the sustainable use and long-term survival of medicinal plant resources. India possesses a rich and diverse ethnobotanical knowledge system that has evolved through centuries of close interaction between indigenous communities and their natural environment. This traditional knowledge includes a wide range of conservation practices such as in situ conservation through sacred groves, regulated harvesting based on phenological stages, domestication of medicinal plants within agroforestry systems, indigenous seed preservation techniques, and the enforcement of cultural taboos and customary laws. Sacred groves like the Kavu forests of Kerala serve as important in situ conservation sites, protecting medicinal plants such as *Rauvolfia serpentina*, *Aegle marmelos*, and *Saraca asoca* due to strong religious and cultural beliefs. Selective harvesting practices followed by tribal communities, such as collecting leaves of *Azadirachta indica* (Neem) instead of uprooting the entire plant, allow for natural regeneration

and sustainable use. Similarly, the cultivation of medicinal plants like *Ocimum sanctum* (Tulsi), *Aloe vera*, and *Curcuma longa* (Turmeric) in household gardens reduces pressure on wild populations while ensuring accessibility for daily medicinal needs. Cultural beliefs also contribute significantly to conservation; for example, cutting *Ficus religiosa* (Peepal) is traditionally prohibited due to its sacred status. The integration of medicinal plants like *Embllica officinalis* (Amla) into traditional agroforestry systems further promotes biodiversity and farm sustainability. Integrating these traditional frameworks with modern scientific approaches can enhance effective and sustainable medicinal plant conservation for future generations.

Keywords: Medicinal plants, Traditional knowledge, Indigenous knowledge, Sacred groves, Ethnobotany

Integration of ethnobotany and traditional knowledge systems into modern healthcare

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ABSTRACT

Ethnobotany is the study of medicinal plants & their cultural significance plays a vital role in conserving traditional knowledge and promoting sustainable use of medicinal plants. This field encompasses various applications, including conservation of biodiversity, development of new medicines, sustainable livelihoods, food security, cultural preservation ecotourism and pharmaceutical applications. Medicinal plants have been an integral part of human healthcare for centuries, offering a rich source of bioactive compounds with therapeutic properties. In traditional medicinal, plants like turmeric (*Curcuma longa*), Ginger (*Zingiber officinale*), and Tulsi (*Ocimum sanctum*) have been revered for their medicinal properties, often being used in traditional rituals and ceremonies to promote good health and wellbeing. Research highlights potential of ethnobotany to address various issues related to health problems, now which is a emerging problem of human beings' daily life existence. In many traditional societies, medicinal plants are believed to possess spiritual properties, and their use is often guided by cultural and religious beliefs. By integrating traditional knowledge with various modern scientific techniques (1:-Data collection – Ethnobotanical survey , Ethical framework , Systematic documentation , 2 :-Chemical analysis, 3:- Biological validation & mechanism, 4:- Computational approaches, 5:- Drug development & standardization) we can unlock the full potential of several kinds of medicinal plants and promote the development of new , healthy , advance kind of medicine , drug , & therapies in future . The Rig Veda and Charak Sanhita are ancient Indian text books that represents the early pharmacological & medicinal knowledge of our ancestors. The Rig Veda describes 67 medicinal plants & their uses for digestive, respiratory, and skin issues. The Charak Sanhita describes about 350 medicinal plants and categorized the treatments into 8 specific categories for holistic healthcare. There are some ancient techniques which can enhance modern healthcare. These includes Ayurvedic Herbalism, Acupuncture, Yoga, Shamanic Healing, Armotherapy, Massage, Cupping therapy, & pulse Diagnosis. Worldwide Countries like India, China, Japan, Sri Lanka, UAE, Korea, Brazil & Tibet are recognizing the value of traditional knowledge and integrating them into modern health care for maintaining smooth & healthy life style.

Keywords: Ethnobotany, Biological validation, Ayurvedic, Knowledge, Healthcare

Declining Medicinal Plant Resources in Sukinda valley of Jajpur District of Odisha: Utilization & Conservation

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Abstract

The present paper is based on extensive field investigations conducted by the authors in Jajpur district of Odisha over a period of twenty years, from 1990 to 2010. These long-term surveys were undertaken to document the diversity, distribution, and utilization of medicinal plants occurring in the region, with particular emphasis on species used in traditional healthcare systems. During the course of the study, more than 1,000 species of flowering plants and ferns were recorded from the district. Among these, approximately 530 species were identified as having medicinal value and are used either in classical Ayurvedic formulations or in local folk medicine practices. The paper presents a detailed account of forty medicinal plant species that are fast declining in the study area and therefore require immediate attention for conservation and protection. This documentation aims to strengthen the linkage between traditional knowledge systems and scientific conservation efforts. A number of important medicinal plants identified as threatened include *Asparagus racemosus*, *Bacopa monnieri*, *Centella asiatica*, *Cissampelos pareira*, *Drosera burmanii*, *Dendrophthoe falcata*, *Desmodium gangeticum*, *Eclipta prostrata*, *Hemidesmus indicus*, *Gloriosa superba*, *Sphaeranthus indicus*, *Pterocarpus marsupium*, *Saraca asoca*, *Pueraria tuberosa*, *Plumbago indica*, *Rauwolfia serpentina*, *Vanda tessellata*, *Woodfordia fruticosa*, and *Urginea indica*. These species are widely used in Ayurvedic medicine as well as in indigenous healthcare practices and folklore traditions. The paper further analyzes the major factors responsible for the decline of these medicinal plants and proposes strategies for their sustainable utilization, cultivation, and *in situ* and *ex situ* conservation. Emphasis is placed on awareness generation, community participation, and the integration of traditional knowledge with modern conservation approaches to ensure long-term preservation of medicinal plant resources in Jajpur district.

Keywords: Medicinal plants, Ethnobotany, Ayurvedic medicine, Threatened plant species, Conservation

Conservation and Sustainability of Medicinal Plants

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ABSTRACT

Medicinal plants are integral to India's biodiversity and traditional healthcare systems, including Ayurveda, Unani, Siddha, and indigenous tribal medicine. India, being one of the world's mega-biodiverse countries, harbours thousands of species used for therapeutic purposes. However, unchecked harvesting, habitat destruction, population pressure, and climate change have increasingly threatened many medicinal plant populations. Conservation and sustainable utilization of these resources are

therefore essential to protect biodiversity and support long-term medicinal plant availability for both ecological and socio-economic purposes. Medicinal plant conservation strategies are broadly classified into in situ and ex situ approaches. In situ conservation involves protecting species within their natural ecosystems, allowing them to undergo natural ecological processes. Protected areas such as biosphere reserves, wildlife sanctuaries, and sacred groves serve this purpose. For example, regions like the Eastern Ghats and forests of Odisha support valuable medicinal species such as *Rauvolfia serpentina* (Sarpagandha), *Withania somnifera* (Ashwagandha), *Terminalia arjuna* (Arjuna), and *Tinospora cordifolia* (Guduchi). These areas help maintain genetic diversity, ecological interactions, and natural regeneration of plant populations. Ex situ conservation complements in situ methods by preserving species outside their native habitats. This includes botanical gardens, herbal gardens, seed banks, cryopreservation, and plant tissue culture techniques like micropropagation. Such methods allow rapid multiplication and safeguarding of rare, endemic, or endangered medicinal plants. In Odisha, medicinal plant gardens and nurseries contribute to conserving and multiplying species such as *Asparagus racemosus* (Shatavari) and *Curcuma longa* (Turmeric), enhancing both conservation and research opportunities. Sustainability emphasizes responsible use that meets present needs without compromising future availability. Unsustainable harvesting, especially of roots and whole plants, has led to population declines for many species. Sustainable practices, such as regulated harvesting seasons, selective harvesting, and cultivation, help maintain natural populations. Cultivation reduces dependence on wild stocks, supports rural livelihoods, and ensures quality raw material supply for industry. Several government schemes promote conservation and sustainable use of medicinal plants. At the national level, the Central Sector Scheme on Conservation, Development and Sustainable Management of Medicinal Plants, implemented by the National Medicinal Plants Board (NMPB) under the Ministry of AYUSH, provides project-based support for in situ and ex situ conservation, establishment of herbal gardens, support to local committees for value-addition activities, and awareness programs. Under this scheme, thousands of hectares have been brought under conservation and resource augmentation, and numerous herbal gardens and nurseries have been established across India. ♦ The national and state schemes in India, complemented by local scientific and traditional knowledge, play a pivotal role in sustaining medicinal plant biodiversity for future.

Keywords: Mega-biodiverse, Medicinal plant, conservation strategies, Sustainable Management,

Ethnomedicinal Importance of wild leafy vegetables practiced by tribal communities of Koraput, Odisha

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Since ancient times, wild plants have been playing a very relevant role in human life. A number of wild plants used by rural and tribal people make important contributions to food basket ensuring food security along with livelihood for major communities around the world. The dependence on these wild plants has gradually declined with cultivation of high yielding varieties and introduction of more exotic plant species. However, many people in tribal pockets still use those species as a supplement to their basic food needs. The present ethno-botanical study based on extensive botanical survey and interviews from selected tribal villages of Koraput reflects on the use of potential wild leafy vegetable plants and their

ethnomedicinal uses. The study documented 83 wild leafy vegetable plant species distributed in 69 genera spread over 41 families. The plant species recorded include 21 trees, 03 shrubs, 48 herbs and 15 climbers/creepers. The largest number of plant species are distributed under family Amaranthaceae, followed by Brassicaceae and Cucurbitaceae. The plants used either as raw or cooked form by the local tribal communities. Some important plants widely used as leafy vegetables include *Achyranthes aspera*, *Alternanthera sessilis*, *Centella asiatica*, *Bauhinia purpurea*, *Emilia sonchifolia*, *Hibiscus sabdariffa*, etc. In addition to their dietary uses, these wild plants are also exploited for their medicinal properties. Most of these species are utilised against various diseases by the local communities through their indigenous knowledge. For example, leaf of the plant *Achyranthes aspera* used to control vomiting and dysentery. *Aerva lanata* used against swelling and eye diseases. The plant *Glinus oppositifolius* is used as medicine for itchs and other skin diseases. Similarly, several plants were used to treat many diseases like fever, dysentery, joint pain, asthma, stomach disorder, skin disease, mouth disorder, indigestion, vomiting, cold and cough. The herbal medicines are taken orally along with different additives such warm water, common salt and milk. The study tries to provide baseline data which could be useful for prioritization of conservation, besides sustainable use and management of the resources keeping the regional food security and health care in view.

Keywords: Ethnomedicine, Wild food plants, Tribal communities, Conservation

Ethnobotanical and Pharmacological Evaluation of Medicinal Plants Used in the Treatment of Urinary Tract Infections in Dhenkanal District, Odisha

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Abstract

India possesses a rich heritage of traditional knowledge on plant-based medicines used in preventive and curative healthcare systems. Owing to its vast biodiversity and long-standing indigenous practices, the country holds immense potential for the development of herbal drugs. Odisha, the third-largest tribal-populated state in India, is endowed with remarkable medicinal plant diversity. Dhenkanal district, characterized by hilly forested tracts in the north and fertile plains in the south, is predominantly inhabited by tribal communities who depend largely on traditional herbal remedies due to limited access to modern healthcare facilities. The present investigation focuses on ethnobotanical studies related to the treatment of urinary tract infections (UTIs), one of the most common bacterial and fungal infections affecting individuals across all age groups. Extensive field surveys conducted among 25 tribal communities of Dhenkanal district resulted in the documentation of 320 plant species belonging to 295 genera. Although 85 ethnomedicinal claims were initially documented, only 63 were validated through cross-verification, while the remaining were excluded due to misidentification or lack of confirmation. Six medicinal plants-*Abutilon indicum*, *Aerva lanata*, *Mangifera indica*, *Phyllanthus fraternus*, *Tinospora cordifolia* and *Vetiveria zizanioides* were selected for detailed phytochemical, antimicrobial, antioxidant and trace elemental analyses. Plant materials were extracted using petroleum ether, methanol and ethanol solvents. Phytochemical screening revealed the presence of diverse secondary metabolites, with methanolic and

ethanolic extracts proving most effective. Antimicrobial assays demonstrated significant antibacterial and antifungal activity against major UTI-causing pathogens, including *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Candida species*. Notably, *Phyllanthus fraternus* and *Mangifera indica* exhibited high antioxidant activity. Trace elemental analysis using PIXE revealed essential elements such as Fe, Zn, Cu, Mn and Se, contributing to therapeutic efficacy. Overall, the study scientifically validates traditional medicinal practices and highlights the potential of these plants for future drug development.

Keywords: Ethnobotany, Medicinal plants, Urinary tract infection (UTI, Tribal knowledge, Phytochemical analysis, Antimicrobial activity

Phenological studies of genus *Amorphophallus* Blume ex Decne. (Araceae) from Mayurbhanj District of Odisha

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Abstract

Family Araceae also known as Arum family is well known for its food, ornamental, ritual and ethical properties. The genus *Amorphophallus* Blume ex Decne. represented by more than 20 species in India and 3 species in Odisha. Among these 3 species, *Amorphophallus paeoniifolius* (Dennst.) Nicolson and *Amorphophallus bulbifer* (Schott) Blume available in Mayurbhanj district of Odisha. Frequent field visit was conducted to different regions of Mayurbhanj district to observe the phenological trends of the genus. Some information regarding *A. paeoniifolius* was collected from local people as it is cultivated in different regions. In this investigation different characteristics like variations in the life cycle, sprouting of corm to its maturity, opening of flower bud to anthesis of flower, formation of fruits and its development were studied. Flowering period of the genus is April to June. The flowering of the both species occurs before the formation of leaves. The life cycle of both the species ends in generally December to January indicated by drying of vegetative parts. The flower of *A. paeoniifolius* is foul odour with high longevity. The *A. paeoniifolius* is cultivated in the different regions for its edible corm. The corm is used as propagules for the cultivation of the plant. It undergoes a dormancy period of 40 to 60 days. The sprouting of both the species occurs during pre-monsoon showers. The obtained information plays a crucial role for the conservation of the germplasm and sustainable usage of the genus *Amorphophallus* in Odisha.

Keywords: *Amorphophallus*, Araceae, Life cycle, Phenology, Germplasm

Women, Weaver Ants and Well-being: Traditional Healthcare, Food Systems and Livelihoods among Tribal Communities in Odisha, India

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Abstract

The Red Weaver Ant (*Oecophylla smaragdina*) is an ecologically significant eusocial insect known for constructing leaf nests using larval silk. They serve as an important prey species for the Indian pangolin (*Manis crassicaudata*), a nocturnal insectivore dependent on ants and termites. This study synthesizes the specific roles and contributions of women within the study of Red Weaver Ant (*Oecophylla smaragdina*) use by tribal communities in Mayurbhanj, Sundargarh and Keonjhar districts of Odisha. The field works were carried out during 2022-2025. Results revealed that women constituted 69.23 % of the 65 informants (≈45 individuals), and their participation was pivotal for documenting ethno-medicinal recipes, household uses and preparation modes. Female informants provided first-hand knowledge on harvesting seasons, the preparation of relishes, pickles and multi-ingredient medicinal formulations and domestic administration practices for ailments such as coughs, fevers, eye problems and heat-stress. Women's contributions were also evident in maintaining household nutraceutical practices and in intergenerational transmission of entomophagy-based ethnomedicine. Despite clear expertise, the study showed that women are underrepresented in market-level interactions described in the survey; commercialization and collection activities were largely reported at market levels without gender-disaggregated economic data. Present study recommends targeted ethnopharmacological validation, gender-sensitive value-addition training and inclusive livelihood programs so that women's knowledge and agency in sustainable RWA utilization are recognized, conserved and equitably rewarded.

Keywords: Ecological significance, Ethno-entomology, sustainability, Traditional knowledge, Women empowerment

Diversity and Distribution of the Medicinal members of Gentianaceae in the Indian Himalayan Region

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Abstract

The Indian Himalayan Region (IHR) serves as a critical reservoir for medicinal plant diversity, harboring approximately 5,197 species. Globally, the family comprises 103 genera and nearly 1,800 species; in India, it is represented by 21 genera and approximately 196 species. The study aims to explore the distribution, traditional medicinal applications, phytochemical significance, and conservation status of medicinally important Gentianaceae taxa within the IHR. Data were synthesized through extensive field surveys, a critical review of scientific literature from global electronic databases, and the examination of herbarium specimens housed at major repositories, including CAL, ASSAM, ARUN, BSHC, and BSD.

The investigation documented 60 medicinally important species across 16 genera. *Gentiana* and *Swertia* emerged as the most dominant genera, contributing 24 and 18 species, respectively. Other represented genera include *Gentianella*, *Gentianopsis*, *Lomatogonium*, *Hoppea*, *Canscora*, *Centaurium*, *Jaeschkea*, *Tripterospermum*, *Exacum*, *Crawfurdia*, *Veratrilla*, *Halenia*, *Megacodon*, and *Comastoma*. Ethnomedicinal analysis reveals that leaves and roots are the most frequently utilized parts, possessing significant pharmacological properties. Key species such as *Gentiana leucomelaena* Maxim. ex Kusn, *Gentianella moorcroftiana* (Wall. ex G.Don) Airy Shaw, *Veratrilla baillonii* Franch, *Swertia chirayita* (Roxb.) H.Karst, and *Jaeschkea oligosperma* Knobl are widely employed in traditional medicine to treat hepatic disorders, gastrointestinal ailments, and fevers. Furthermore, the study identifies critical bioactive compounds reported across the family that underpin these therapeutic uses. Despite their value, these species face severe threats from increasing anthropogenic pressure and unsustainable harvesting. Notably, *Swertia chirayita* is currently categorized as Critically Endangered (CR) by the IUCN and has been identified as a high-priority species for conservation by the Indian National Medicinal Plants Board (2016). The findings underscore an urgent need for the conservation and sustainable management of medicinal Gentianaceae in the IHR. This study provides a comprehensive scientific baseline to inform future conservation strategies, sustainable utilization frameworks, and pharmacological research aimed at preserving this vital botanical heritage.

Keywords: Gentianaceae, Indian Himalayan Region, Medicinal plant diversity, Ethnobotany, Phytochemistry, Bioactive compounds.

Medicinal Plants Used to Enhance Lactation Among Tribal Women of Keonjhar District, Odisha

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Abstract

Odisha ranks fifth among the states of India in terms of tribal population, with nearly seven million tribal people belonging to 62 notified communities. The tribal population constitutes approximately 24% of the total population of the state and is predominantly concentrated in rural areas. In Keonjhar district of Odisha, tribal communities account for 43.88% of the total district population (Census 2001), of which about 86.36% reside in rural regions. Major tribes inhabiting the district include Bhathudi, Bhuyan, Gond, Ho, Juang, Khaswar, Kisan, Kolha, Kora, Munda, Oran, Santal, Saora, Sabari, and Saunti. Adequate breastfeeding provides essential nutrients, immunity, and overall well-being to newborns. In rural and tribal areas, the use of herbs and herbal-based foods is a traditional practice to improve lactation. Nursing mothers commonly consume specific plant-based foods, fruits, and herbal preparations believed to enhance milk production. Several plants are traditionally recognized for their galactagogue properties and are widely used by tribal communities to induce and sustain lactation. The present study aims to document and investigate plant species used as galactagogues by the tribal communities of Keonjhar district, Odisha. An ethnobotanical survey was conducted to collect information on medicinal plants used to promote lactation among nursing mothers. Indigenous knowledge was gathered through structured questionnaires and personal interviews with local inhabitants and traditional healers. A total of twenty informants aged between 50 and 68 years were interviewed, including five experienced tribal practitioners. The study revealed that traditional healers and local inhabitants use 29 plant species belonging to 28 genera and 22 families as lactation inducers. Fresh plant materials were predominantly

preferred for preparing remedies. The findings highlight that breastfeeding plays a crucial role in infant nutrition among tribal communities, and lactation-enhancing remedies are commonly used to meet the nutritional needs of infants. Some galactagogue plant species are naturally available in the surrounding forests, while others are cultivated or domesticated near habitations. The documented galactagogue plants, along with their parts used, provide valuable insight into traditional healthcare practices related to maternal and child health among the tribes of Keonjhar district.

Keywords: Breastfeeding, Galactagogue plants, Lactation enhancement, Nursing mother, Tribal Traditional medicine

Ethnopharmacological Relevance of *Cissampelos pareira* L. Root in the Management of Skin Disorders

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Abstract

Cissampelos pareira L. (Menispermaceae), also known as Patha, which is perennial climbing herb widely employed in traditional medical systems such as Ayurveda, Siddha, Unani, and varied ethnomedicinal practices in India, Africa, and Southeast Asia. Among its different plant parts, the root possesses important ethnopharmacological value in the management of skin problems. Traditional healers have long employed root decoctions, pastes, and powders of *C. pareira* to treat a wide range of dermatological disorders including eczema, dermatitis, psoriasis, scabies, leprosy, skin ulcers, boils, wounds, and inflammatory skin infections. This abstract demonstrates the ethnobotanical relevance, traditional knowledge foundation, and pharmacological reasoning supporting the use of *C. pareira* root in skin health care. Phytochemical examinations have revealed the existence of bioactive substances such as alkaloids, flavonoids, tannins, Saponins, phenolics, steroids, and terpenoids compounds, which contribute to its medicinal efficacy. These compounds are known for their anti-inflammatory, antioxidant, antibacterial, and wound-healing effects. Modern pharmacological investigations increasingly validate traditional claims by establishing the root's inhibitory actions against pathogenic bacteria linked with skin infections, along with its capacity to lower oxidative stress and inflammation-key contributors in chronic skin illnesses. The integration of ethnopharmacological knowledge with experimental study highlights the promise of *C. pareira* root as a natural source for generating safe, inexpensive, and effective dermatological formulations. Moreover, its traditional use underlines the necessity of protecting indigenous knowledge systems and medicinal plant variety. *C. pareira* root is a useful ethnomedicinal resource for skin problem care. A systematic combination of traditional wisdom with contemporary scientific validation may assist the creation of novel Phyto-therapeutic compounds and encourage evidence-based application of this plant in modern dermatology.

Keywords: Ethnopharmacology, Skin disease, Phytochemicals, Dermatology, Traditional

Objective assessment of the natural relationship of some medicinally important members of the family Cyperaceae

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Abstract

The family Cyperaceae, commonly known as the “Sedge” family, consists of a diverse group of plants found in various habitats, particularly in wetlands and grasslands. The family is represented by 90 genera and approximately 5,500 species. In India, there are 32 genera, 553 species and 33 varieties. Morpho-anatomical and chemotaxonomic studies of Cyperaceae members from the Eastern Ghats of India provide valuable insights into their structural (morphological and anatomical) traits, such as plant height, stem type, leaf dimensions, inflorescence and achene features, vascular bundle organization, epidermal layers, and cell arrangement, and chemical profiles, including secondary metabolites (alkaloids, flavonoids, saponins, tannins) and pigment composition (chlorophylls and carotenoids), thereby aiding accurate species identification, classification, differentiation, and understanding of ecological adaptations in this region. Chemical markers play an important role in distinguishing between closely related species within Cyperaceae, and the study of these compounds also provides insight into their therapeutic potential (medicinal properties) and ecological interactions. In the enumeration, for each species, the correct name has been cited followed by synonym(s) and basonym (if applicable), local name, locality of collection, ecological and nomenclatural notes, etc. Artificial dichotomous keys to genera within the family and species within a genus have been provided for easy identification. Phenetics, which concern with the objective interpretation of form- relationship in taxa, was applied on nine genera belonging to family Cyperaceae. The Operational Taxonomic Units (OTUs) selected were: *Cyperus compressus*, *Cyperus tenuispica*, *Pycneis flavidus*, *Fimbristylis dichotoma*, *Fimbristylis quinquangularis*, *Fimbristylis miliacea*, *Fuirena ciliaris*, *Kyllinga brevifolia*, *Eleocharis geniculata*, *Courtoisina cyperoides*, *Schoenoplectus juncooides* and *Schoenoplectiella articulata*. All these specimens were collected from different parts of Balangir district. As many as 45-unit characters, covering morphology, anatomy and phytochemistry were used for cluster analysis of the twelve selected operational taxonomic units (OTUs). A phenogram was prepared in with reference to complete linkage- Euclidean distance using the computer software PAST. The phenogram thus prepared exhibits a form- relationship of the selected OTUs and hands over a natural system of classification that strongly correlates with Bentham and Hookers’ system of classification.

Keywords: Cyperaceae, Morpho-anatomical, Chemotaxonomy, Phenetics, Eastern Ghats

Carbon sequestration of some selected medicinally important plant species in Chhota Harishankar forest, Odisha

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Abstract

The variety and variability of plant species within a given area is essential for preserving ecological stability and controlling global carbon cycles. By collecting atmospheric carbon dioxide through photosynthesis and storing it in biomass and soil, plants function as both primary producers and

significant carbon sinks. In order to comprehend their role in mitigating climate change and promoting ecological sustainability, the current study focuses on the Phyto diversity and carbon sequestration capacity of particular plant species. Trees, shrubs, and herbaceous species that are frequently found in the research area and represent a variety of taxonomic groups and growth styles are among the 15 medicinally important plant species. Standard floristic survey techniques were used to assess Phyto diversity, recording species richness, abundance, and distribution. In addition to above-ground and below-ground biomass calculations, biomass metrics such tree diameter at breast height (DBH), height, and wood density were measured to determine the potential for carbon sequestration. The findings show that species with denser wood structures, longer lifespans, and higher biomass accumulation have higher capacities for storing carbon. While ground vegetation is crucial for soil carbon enrichment, trees make a larger contribution to carbon sequestration than shrubs and herbs. The study shows that carbon sequestration effectiveness is positively correlated, with diverse plant communities boosting ecosystem resilience and productivity. Increased species diversity improves soil organic carbon concentration, lowers carbon loss, and maximizes resource usage. Medicinally important 15 plants were selected for carbon sequestration. The carbon sequestration potential of 15 individual trees belonging to each of 15 different genera was determined of which has registered the highest in teak (*Tectona grandis* L.f.: Verbenaceae) and the lowest in Dhataki (*Woodfordia fruticosa* Kurz: Lythraceae). In conclusion, one important factor influencing terrestrial ecosystems' capacity to sequester carbon is Phyto diversity. Sustainable ecosystem management and climate change mitigation can be successfully achieved by preserving a variety of plant communities and incorporating Phyto diversity-based tactics into land-use planning and afforestation.

Keywords: Carbon storage, Biomass, *Tectona grandis* L.f., *Woodfordia fruticosa*, Phyto diversity.

Air pollution tolerance index of some selected medicinally important plant species of Rajendra University campus, Balangir, Odisha

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This paper investigates the air pollution tolerance index of medicinally important tree members within the campus of Rajendra University in Balangir, Odisha. A thorough campus flora survey would help in the quantification of carbon storage and assessment of the biodiversity available. Carbon sequestration potential of a plant, one of the parameters essential for its selection in green belt development, is defined as absorption of carbon dioxide by the plants from the surrounding atmosphere and its storage in the form of biomass in the tree trunks, branches, foliages and roots that can be re-emitted in the form of gaseous carbon dioxide if the biomass is incinerated. Our results present the vital contribution of campus vegetation to climate change mitigation and indicate the importance of preserving and improving green areas within educational institutions. In the inventory of tree species in the University campus includes as many as 32 species belonging to 31 genera of 16 families could be included. Many of these species are medicinally important, attractive and potentially sources of various phytoresources and aesthetic pleasure. The carbon sequestration potential of 15 individual trees belonging to each of 14 different genera was determined of which has registered the highest (4.09 gm) and the lowest values (0.02 gm) 15 dicot species were selected for determining their Air Pollution Tolerance Index (APTI). While determining the APTI values, chlorophyll content was found to range from 0.004677315 mg/g (*Tamarindus indica* L.) to 0.0225590833 mg/g (*Aegle marmelos* (L.) Corrêa), relative water content

from 7.98652632 (*Santalum album* L.) to 214.563951 (*Syzygium cumini* (L.) Skeels); ascorbic acid from 1.17 ± 0.03 mg/g (*Tectona grandis* L.f.) to 10.5 ± 0.12 mg/g (*Casuarina equisetifolia* L.) and leaf pH from 3.53 (*Tamarindus indica* L.) to 8.5 (*Azadirachta indica* A. Juss.). APTI values ranged from 1.525 (*Tamarindus indica* L.) to 22.916 (*Ficus benghalensis* L.) thus indicating all selected species to be highly tolerant to air pollution, hence suitable for greening parks and gardens in polluted areas.

Keywords: Air Pollution Tolerance Index, Ascorbic acid, Biomonitoring, Relative water content.

In Vitro Antibacterial Activity of Some Selected Epiphytic Foliose and Fruticose Lichens of Odisha: Validating Traditional Uses

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Abstract

To validate folklore claims regarding the ethno-medicinal use of certain lichens, an experimental study was conducted to assess the antibacterial activity of three selected lichen species: *Heterodermia diademata*, *Parmotrema reticulatum*, and *Roccella montagnei*. Fifteen human pathogenic bacteria were tested, including seven Gram-negative (*Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Salmonella enterica* Ser. Typhi, *Salmonella paratyphi*, *Shigella flexneri*, *Vibrio cholerae*), six Gram-positive (*Bacillus circulans*, *Bacillus subtilis*, *Micrococcus luteus*, *Staphylococcus aureus*, *Streptococcus mitis*, *Streptococcus salivarius*), and two resistant strains (*Escherichia coli* Res and *Staphylococcus aureus* Res). Among the tested lichens, *Parmotrema reticulatum* exhibited the highest antibacterial activity against all 13 susceptible species, with *Streptococcus salivarius* being the most sensitive (ZoI $\approx$ 19 mm). It was also highly effective against *Vibrio cholerae*, *Salmonella enterica* Ser. Typhi, *Streptococcus mitis*, and *Salmonella paratyphi* in decreasing order of sensitivity. The fruticose lichen *Roccella montagnei* showed notable activity against *Vibrio cholerae*, *Salmonella paratyphi*, *Salmonella enterica* Ser. Typhi, and *Pseudomonas aeruginosa*, but was less effective (ZoI <10 mm) against several Gram-positive species. The foliose lichen *Heterodermia diademata* exhibited clear antibacterial effects against *Micrococcus luteus*, *Staphylococcus aureus*, *Salmonella paratyphi*, *Salmonella enterica* Ser. Typhi, and *Vibrio cholerae* (ZoI 11–13 mm), with moderate or limited activity against other tested pathogens. MIC and MBC values of the n-hexane extract of *P. reticulatum* demonstrated strong inhibition and bactericidal effects against *Streptococcus salivarius* and *Vibrio cholerae* (15.62/31.25 μ g/ml, respectively). Intermediate activity was observed against *Bacillus circulans*, *Micrococcus luteus*, *Staphylococcus aureus*, *Streptococcus mitis*, *Salmonella enterica* Ser. Typhi, and *Shigella flexneri* (MIC/MBC 31.25/62.5 μ g/ml), while *E. coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, and *Salmonella paratyphi* were comparatively less sensitive (MIC/MBC 62.5/125 μ g/ml).

Keywords: Epiphytic lichens, Antibacterial activity, Ethnomedicinal validation, Agar well diffusion, Human pathogenic bacteria

Survey and ethnobotany of Murophytes in Balangir, Odisha

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Abstract

Murophytes, commonly referred to as mural flora, are specialized plants that colonize walls, fences, and other man-made structures by utilizing limited water and nutrient resources. These artificial habitats closely resemble rocky substrates and provide unique ecological niches for diverse plant species. The present study aims to document and analyze the diversity of murophytes growing on walls and crevices of historical and ancient buildings in Balangir District, Odisha along with the documentation of their ethnobotanical importance. Deposition of dust, organic matter, atmospheric moisture, and suspended particles on wall surfaces leads to the formation of a thin soil layer, which supports the establishment of mural vegetation. Systematic field surveys were conducted at selected sites within the study area to record plant species growing on walls and structural crevices. Both cryptogamic and phanerogamic plants were documented. Based on their ecological characteristics, mural flora were broadly categorized into ediphytes, which grow in moist wall cracks, and chasmophytes, which inhabit dry crevices and damaged foundations. These plants exhibit several adaptive features such as strong root systems, drought tolerance, and the ability to survive under extreme environmental conditions including high temperature, wind exposure, and limited nutrient availability. The results indicate that Murophytes can thrive under both mesic and xeric conditions and contribute significantly to local biodiversity. However, their colonization on historical buildings poses serious conservation challenges, as root penetration and seed trapping can weaken structures and accelerate deterioration. This study emphasizes the ecological significance of mural flora while highlighting the need for effective conservation and management strategies to protect historical monuments. The documentation of murophytes from Balangir District provides valuable baseline data for future ecological and conservation studies related to wall-dwelling plant communities.

Keywords: Murophytes, Mural flora, Wall vegetation, Chasmophytes, Cryptogamic

Ethnobotanical Wealth and Ethnopharmacological Potential of Wetland Plants of Loktak Lake, Manipur, India: Implications for Nutraceuticals, Drug Discovery, and Conservation

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ABSTRACT

Loktak Lake, a Ramsar-designated freshwater wetland in Manipur, Northeast India, supports high plant biodiversity that underpins the livelihood, food security, and traditional healthcare practices of indigenous communities. Comprehensive field surveys conducted between 2020 and 2026 documented 161 wetland plant species, many of which possess food, medicinal, and therapeutic value. Ethnobotanical investigations revealed the regular dietary use of 28 plant species and medicinal applications of 31 species across diverse genera and families, several of which function as nutraceuticals. Detailed ethnopharmacological evaluation of selected species (*Ludwigia adscendens*, *Oenanthe javanica*, *Blumea*

flava, *Phragmites karka*, and *Polygonum barbatum*), with particular emphasis on *L. adscendens* (Onagraceae), validated tribal claims through phytochemical screening and antimicrobial assays. Extracts from these plants showed appreciable levels of phenolics, flavonoids, and tannins, along with significant inhibitory activity against pathogenic microorganisms, thereby supporting their traditional medicinal application. The findings highlight Loktak Lake as an important reservoir of bioactive plant resources with considerable potential for future drug development, particularly in the context of antimicrobial resistance. However, escalating anthropogenic pressures, habitat degradation, and unsustainable harvesting practices pose serious threats to this fragile wetland ecosystem. Overall, the study underscores the urgent need for systematic documentation, value addition, and conservation-oriented management of wetland bioresources to promote sustainable utilization while preserving indigenous knowledge systems and ecological integrity.

Keywords: Antimicrobial resistance, Indigenous, Nutraceutical plants, Phytochemical screening, Wetland ecosystems

ETHNOBOTANY FOR CONVENIENT AND AFFORDABLE HEALTHCARE

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Abstract

Ethnobotany plays an important role in addressing the worldwide necessity for convenient and affordable healthcare solutions, specifically in resource-constrained and rural areas. Traditional knowledge systems, developed through centuries-old connectivity between indigenous people and their ecological context, provide premium insights into the medicinal use of plants for the prohibition and treatment of several illnesses. This knowledge constitutes the bedrock of many ancient healing systems (e.g. Ayurveda) that are cost-effective, socially acceptable and locally accessible. Incorporating ethnobotanical knowledge into modern healthcare can intensify primary healthcare delivery, encourage self-reliance, and decrease dependency on costly synthetic drugs. Besides, scientific authentication of ethnomedicinal plants has resulted in the discovery of bioactive compounds with alternative potential, contributing to drug development and innovation. Ethnobotany also supports regenerative healthcare by promoting the conservation of medicinal plant biodiversity and the preservation of indigenous knowledge. Nevertheless, challenges like a lack of documentation, overutilization of plant resources, and moral conflicts related to intellectual property rights must be addressed. Overall, ethnobotany provides a hopeful direction toward inclusive, accessible and sustainable healthcare for diverse populations.

Keywords: Resource-constrained, Indigenous, Ecological context, Intellectual, Ethnobotany

From Traditional Knowledge to Therapeutic Agents: An Ethnopharmacological and Phytochemical Approach

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Abstract

Traditional knowledge systems serve as a foundational resource for discovering novel therapeutic agents with significant medicinal potential. This study investigates the systematic transformation of ancient medicinal practices into scientifically validated remedies through an integrated ethnopharmacological and phytochemical methodology. Ethnopharmacological research enables comprehensive documentation and rigorous evaluation of traditional plant-based medicines by examining their historical applications, cultural significance, and perceived therapeutic efficacy within indigenous communities. Building upon this foundation, phytochemical investigations employ advanced analytical techniques to isolate, characterize, and identify bioactive secondary metabolites responsible for observed pharmacological activities. The integration of traditional wisdom with contemporary biochemical, pharmacological, and molecular biology approaches enhances the efficiency of lead compound discovery and provides scientific validation for traditionally used medicinal plants. This synergistic framework bridges the gap between conventional healing systems and evidence-based modern medicine, facilitating the development of safe and effective therapeutic interventions. Additionally, this approach addresses critical ethical considerations including the protection of intellectual property rights, equitable benefit-sharing mechanisms with indigenous communities, and the conservation of medicinal plant biodiversity for future generations. The research underscores the importance of multidisciplinary collaboration in harmonizing traditional therapeutic knowledge with modern pharmaceutical science, ultimately contributing to sustainable, culturally respectful, and scientifically rigorous drug discovery processes that honor both ancestral wisdom and contemporary medical standards.

Keywords: Ethnopharmacology, Phytochemistry, Traditional Medicine, Bioactive Metabolites, Drug Discovery

Ethnomycological Study of Wild Edible and Medicinal Mushrooms of Koraput District, Odisha, India

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Abstract

Wild edible mushrooms (WEM) are naturally occurring, non-cultivated fungi that are low in fat, calories, and cholesterol, and are rich sources of protein, fiber, minerals, and trace elements. In addition to their nutritional value, WEM contain bioactive compounds that contribute to medicinal properties, making them important in combating malnutrition in many Asian and African regions. This study aimed to

identify the most commonly used WEM, record local knowledge, and assess their cultural and medicinal significance in Koraput. A total of 150 informants aged 25-80 years were interviewed, and the information collected was analyzed using use reports, the Cultural Importance Index (CI), and Factor Informant Consensus (Fic) to evaluate cultural relevance and knowledge consistency. Differences in WEM use among informant groups were analyzed using ANOVA. The study recorded thirteen species of WEM commonly used by locals, including *Agaricus californicus*, *Auricularia auricula-judae*, *Calvatia bovista*, *Coprinellus micaceus*, *Geastrum saccatum*, *Lepiota procera*, *Leucoagaricus rhodocephalus*, *Morchella esculenta*, *Podaxis pistillaris*, and five species of *Termitomyces* (*T. clypeatus*, *T. eurhizus*, *T. heimii*, *T. striatus* var. *annulatus*). The most represented families were Agaricaceae and Lyophyllaceae, with *Termitomyces* as the dominant genus. Among the recorded mushrooms, *Termitomyces eurhizus* had the highest CI value (0.59), followed by *T. heimii*, *T. clypeatus*, and *T. striatus* var. *annulatus*. Over 75% of the documented WEM represent new culinary and medicinal records for Odisha. Fic values ranged from 0.78 (skin disorders) to 0.95 (culinary uses). Knowledge of WEM was significantly higher ($P < 0.05$) among women, older individuals, and those without formal education. Although residents of Koraput possess rich traditional knowledge of WEM, threats such as lack of documentation, reliance on elderly informants, and environmental degradation pose serious risks to this heritage. Raising awareness, promoting education, and conducting further research on cultivation and sustainable use of WEM could help conserve biodiversity while providing livelihood opportunities for local communities.

Keywords: Cultural importance, Ethnomycology, Koraput district, Traditional knowledge, Wild edible mushrooms

Ethnobotanical Approaches to Chickenpox: A Study of Medicinal Plant Usage in Boudh District Odisha

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Abstract

Present study represents the ethnobotanical survey in Harbhanga block of Boudh district to highlight the traditional knowledge of medicinal plants being used by the ethnic community of the district for the treatment of chickenpox. Chickenpox is a viral infectious disease that is caused by a virus called *varicella-zoster* virus. This virus spreads through air or by direct contact with the infected persons. Now a days there are so much availability of pharmaceutical medicine for the treatment of chickenpox like zovirex and antihistamine. Still people faces some problems. Long term use of these drugs often leads to various side effect and limited accessibility in rural area. Traditionally ethnomedicinal plants used widely, provide an alternative therapeutic strategy due to their availability, affordability and bioactive compound and immunomodulatory properties. There are so many medicinal plants are used against skin diseases like psoriasis, acne, eczema, cellulites, scabies and chickenpox. Use of herbal medication is a very old method and it is spread in different reason of the world. Mainly plant based medicines are utilized by the villagers

and forest dwellers. Medicinal plants are an important source of active ingredients in herbal medicine and offer a safer, more cost-effective approach to disease treatment. This ethnomedicinal knowledge passed down through generation to generation highlights a diverse ordering of plants with anti-oxidant, anti-inflammatory and anti-microbial properties. Information present here was gathered on the basis of personal interviews with ethnic community of Harbhanga, Boudh. In this study a total of 13 species belonging to 8 families have been documented. Among them 7 species are widely used to treat chickenpox.

Key words: Ethnomedicinal plants, chickenpox, ethnic community, Harbhanga, Boudh

Ethnobotanical Insights into Herbal Hair-care and Scalp Remedies among Rural Communities of Balasore District, Odisha

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Abstract

Since time immemorial, herbal healing practices have formed an integral component of primary healthcare systems among indigenous and rural communities in India. These traditional systems, deeply rooted in cultural beliefs and experiential knowledge, have been especially important in addressing common health problems using locally available plant resources. However, in recent decades, this rich ethnomedicinal heritage has been gradually declining, particularly among younger generations. The present communication documents and analyzes the traditional knowledge related to scalp infections and hair-care practices among tribal and rural communities inhabiting tribal-rich villages of the Balasore district in Odisha, India. The study records a total of 42 wild plant species belonging to 31 different families that are traditionally used for treating various scalp-related ailments, promoting hair growth, preventing hair fall, controlling dandruff, and maintaining overall hair health. Data collection involved the use of semi-structured questionnaires, personal interviews, and informal discussions with knowledgeable elders, traditional healers, and local practitioners. The respondents provided detailed information regarding the local names of plants, parts used, methods of preparation, modes of administration, and dosage. Several of the documented practices, such as the use of specific plant parts or products as hair washes, natural dyes, hair oils, and scalp-care agents, are already known and practiced in modern society. These lesser-known practices possess significant potential for future research and may contribute to the development of new herbal-based medicated cosmetics, dermatological formulations, and beautician preparations. All plant specimens with ethnomedicinal claims were carefully collected from their natural habitats, processed using standard herbarium techniques, critically examined, identified with the help of relevant floras, and preserved for future reference. The documented plant species are arranged alphabetically by their botanical names, followed by details of family, accession number, local name, mode of administration, and dosage. This study not only helps preserve valuable traditional knowledge but also emphasizes the need for its conservation and sustainable utilization before it is lost permanently.

Key words: Ethnobotany, Phytomedicine, Hair-care, Scalp infections, Traditional

Diversity and Distribution of Invasive Alien Plants in Angul District, Odisha

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Abstract

Angul district, located in the central part of Odisha, India, possesses diverse ecological features supported by the presence of two major rivers, the Mahanadi and the Brahmani, which enhance soil fertility and sustain varied vegetation types. Although industrial development has contributed significantly to the regional economy, extensive and unregulated industrialization has resulted in severe environmental degradation, placing Angul among the most polluted districts of India. In this context, an exhaustive floristic survey was conducted during 2013–2015 to assess the diversity, nativity, and utilization of invasive alien plant species (IAPS) in the district. The study aimed to document the extent of plant invasions and to understand their ecological implications in an industrially stressed environment. The floristic exploration revealed a total of 136 invasive alien plant species belonging to 101 genera under 41 families. Habit-wise analysis showed a clear predominance of herbaceous species, accounting for 117 species (86.02%), followed by shrubs (14 species), climbers (3 species), and trees (2 species). Among the plant families, Asteraceae emerged as the most dominant with 25 species (18.18%), followed by Amaranthaceae and Euphorbiaceae with 8 species each, Caesalpiniaceae and Convolvulaceae with 7 species each, Fabaceae and Solanaceae with 6 species each, and Mimosaceae and Poaceae with 5 species each. Other families such as Asclepiadaceae, Cleomaceae, and Tiliaceae were represented by four species, while Cyperaceae and Lamiaceae contributed three species each. The most aggressive and widespread invasive species recorded included *Chromolaena odorata*, *Alternanthera philoxeroides*, *Eichhornia crassipes*, *Lantana camara*, *Parthenium hysterophorus*, *Mikania micrantha* and *Hyptis suaveolens*. The dominance of Asteraceae indicates its strong adaptive potential and significant ecological impact in the region. Information on the utilization of invasive alien plant species showed that several are used locally for medicinal purposes, while others serve as fuel, ornamentals, leafy vegetables, or raw materials for rope making. The study highlights the growing influence of invasive alien plants on local floristic composition and emphasizes the need for effective management strategies to mitigate their impact on native biodiversity in Angul district.

Keywords: Nativity, Invasive alien plant species, Ethnobotany, Ornamentals, Mitigate

Exploring the edible nutraceutical plant resources in Mayurbhanj district, Odisha, India.

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Abstract

The present study documented and analyzed the diversity, distribution, and traditional uses of plant-based nutraceuticals across the 26 administrative blocks of Mayurbhanj district in Odisha, India. Field surveys conducted from 2023 to 2024 identified a total of 84 edible nutraceuticals belonging to 42 families. Notably, the Fabaceae, Anacardiaceae, Phyllanthaceae, and Moraceae families emerged as dominant contributors to the local nutraceutical flora. Among the various plant parts utilized, fruits (approximately 45%) and leaves (approximately 33%) represented the primary edible components, followed by roots and tubers (approximately 12%), flowers (approximately 6%), and seeds or grains (approximately 4%). This distribution underscores a balanced use of both vegetative and reproductive parts. Block-wise analysis revealed that Rairangpur, Kaptipada, Thakurmunda, and Baripada are biodiversity hotspots, showcasing the highest species richness, influenced by both ecological and cultural factors. The findings highlight the significant role of traditional knowledge in supporting local food security, healthcare, and biodiversity conservation. To promote nutritional resilience and eco-cultural sustainability in the tribal and rural communities of Mayurbhanj district, it is vital to encourage sustainable harvesting practices and community-based conservation of these plant-based nutraceutical resources. Active participation from local communities in conservation efforts is essential, as their traditional knowledge and practices are invaluable for preserving these resources. Implementing educational programs and workshops can raise awareness regarding sustainable harvesting methods and the nutritional benefits of these plants. Additionally, collaboration with local authorities and environmental organizations can facilitate the establishment of guidelines and policies for effective protection and management of these natural resources. Integrating these nutraceuticals into broader healthcare and nutritional programs could further enhance public health outcomes. By fostering a profound respect for the ecological and cultural heritage of Mayurbhanj, these initiatives can lay the groundwork for a more sustainable and health-conscious future. Moreover, documenting and disseminating this knowledge can inspire other regions to adopt similar strategies, thereby contributing to global efforts in biodiversity conservation and sustainable development.

Keywords: Edible plants, ethnobotany, Mayurbhanj, nutraceutical diversity, Odisha, plant parts, species richness, traditional knowledge

Traditional Knowledge and Its Role in Medicinal Plant Conservation

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Abstract

Traditional knowledge has played a vital role in the conservation and sustainable use of medicinal plants for centuries. Indigenous and local communities possess rich ethnobotanical knowledge regarding the identification, cultivation, harvesting, and therapeutic use of medicinal plants, which has been passed down through generations. This traditional knowledge contributes significantly to the conservation of medicinal plant diversity by promoting sustainable harvesting practices, seasonal collection methods, and habitat protection. The present paper examines the role of traditional knowledge systems in medicinal plant conservation and highlights their importance in maintaining ecological balance and supporting primary healthcare. It also discusses the threats faced by traditional knowledge, including modernization, loss of cultural practices, and overexploitation of plant resources. By integrating traditional knowledge with modern scientific approaches, sustainable cultivation and effective conservation strategies can be developed. The study emphasizes the need to document, preserve, and legally protect traditional knowledge to prevent its erosion and misuse. Recognizing and involving local communities in conservation programs can enhance biodiversity conservation and ensure the sustainable availability of medicinal plants for future generations. Thus, traditional knowledge remains a crucial component in achieving sustainable medicinal plant conservation and promoting environmental sustainability.

Keywords: Traditional Knowledge, Medicinal Plant, Biodiversity Conservation, Sustainable Utilization.

Medicinal Efficacy of Plants in the Treatment of Diabetes

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Abstract

Medicinal plants and their active principles are used not only in native phytotherapy, but also find remarkable application to modern drug development programme. Many phytochemical constituents of native Indian plants have become chief ingredients of a number of pharmaceutical preparations used against variety of diseases. Folklore claims of tribes or ethnomedicine is a part of ethnobotany which deals with the study of medicinal use of flora present within the surrounding environment of man. The WHO has laid down the list of nearly 25,000 plant taxa possessing noted medicinal uses. Diabetes has been known to mankind for 3500 years when Egyptians first described the clinical features similar to the disease. Diabetes (Madhumeha) was known to Indian 'Ayurveda' since about 3000 years affecting the populace of both developed and developing countries since time immemorial. It was "Sushruta", the great Indian physician who diagnosed diabetes during 1000 B.C. Based on different medicinal systems such as 'Ayurveda', 'Unani' and 'Siddha' the knowledge of medicinal plants has been accumulated since many centuries. Many folklores indigenous Indian medicinal plants have been found to be effective in management of diabetes. It is advantageous to use herbal drugs as they are easily available and have very

low side effects. The ethno-botanical survey reports about 800 plants that possess anti-diabetic potential. Plants have been an exemplary source of many currently available herbal drugs whose adequate herbal formulations form the modern-day cure for *Diabetes mellitus*. The antidiabetic or anti hyperglycaemic effects of these plants is dedicated to the ability of these plants to facilitate the metabolites in insulin dependent processes or to restore the function of the pancreatic tissue by increasing the insulin output. Hence, the treatment of *Diabetes mellitus* with herbal formulations/drugs aims on protecting β -cells and maintaining the glucose levels. Plants contain many secondary metabolites like glycosides, alkaloids, terpenoids, flavonoids, carotenoids etc. that frequently implies having anti-diabetic effect. *Aegle marmelos*, *Allium cepa*, *Asparagus racemosus*, *Boerhaavia diffusa*, *Catharanthus roseus*, *Clerodendrum philippinum*, *Cocculus hirsutus*, *Gymnema sylvestre*, *Hybanthus enneaspermus*, *Murraya koenigii*, *Naringi crenulata*, *Portulaca pilosa*, *Terminalia chebula*, *Toddalia asiatica*, *Vetiveria zizanioides* are some antidiabetic plants which have been proved effective in minimising sugar levels recorded by folklore claims.

Keywords: Ethnomedicine, *Diabetes mellitus*, Herbal formulations, Alkaloids, Ayurveda

Ethnobotanical Survey of Medicinal Plants in Mahendragiri Hills in Gajapati District, Odisha

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Abstract

The Mahendragiri Hill Complex, located in the Eastern Ghats of Odisha, is a significant hill range and a rich repository of medicinal plants. An ethnofloristic survey documented 157 ethnomedicinal plant species from 145 genera and 69 families, used to treat over 30 human diseases and 18 animal ailments. Human ailments addressed include boils, bronchitis, cold and cough, colic, conjunctivitis, cracked nipples, diabetes, diarrhoea, dysentery, ear infections, fever, gastric problems, hemicrania, jaundice, joint pain, migraine, miscarriage, mumps, night blindness, obesity, peptic ulcer, piles, scabies, sinusitis, sterility in women, sunstroke, swelling, sprain, and others. Animal ailments include blood dysentery, urinary disorders, respiratory troubles, constipation, dyspepsia, ectoparasites, throat gland enlargement, filariasis, fire injuries, flatulence, foot-and-mouth disease, galactorrhoea, indigestion, mastitis, post-delivery uterine care, throat infections, wounds, swellings, and more. Several plants were also noted for enhancing milk production and improving strength and vitality in livestock. The most common human and animal diseases in the area were bronchitis, constipation, conjunctivitis, diarrhoea, dysentery, foot-and-mouth disease, mumps, and respiratory disorders. Folklore herbal medicine offers immense potential for drug discovery and nutraceutical development, making it crucial to document traditional knowledge. Species such as *Celastrus paniculata*, *Crateva magna*, *Gloriosa superba*, *Oroxylum indicum*, *Paederia foetida*, *Piper longum*, and *Pueraria tuberosa*, once abundant, are now near extinction due to habitat degradation. Conservation of the Mahendragiri Hill Complex is therefore vital for preserving indigenous knowledge, local livelihoods, and ecological balance.

Keywords: Ethnofloristic inventory, Medicinal plant diversity, Mahendragiri Hill Complex, Common ailments

Lichen: A Natural Celebrity for Dye and Ecological Resilience

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Abstract

Natural Symbiotic association of a mycobiont and photobionts are well known as lichen which are cosmopolitan in distribution and grow on a wide range of substrates from moist rock to tree trunks. A major characteristic of lichens is their relatively slow growth and long-life span compared to other living organisms, and their ability to produce large amounts and diverse groups of secondary metabolites that provide significant functional roles for the lichen itself, as well as for other organisms. Some of these secondary metabolites include various natural pigments, which have been traditionally used as dyes in the textile industry for thousands of years. Odisha is rich in lichen diversity. Numerous lichen species have been documented as sources of natural dyes. Specifically, there are a number of genera that are sources of natural dyes, including *Rocella*, *Ochrolechia*, *Lasallia*, and *Xanthoria*. These lichen genera produce phenolic and anthraquinone pigments that produce purple, red, yellow, and orange colors, respectively. Historically, there were many uses for lichen-derived dyes in traditional European dyeing practices. Recent studies have confirmed that lichen pigments can be effectively extracted using hot water and mild alkaline extraction processes. Experimental research has shown that lichen dyes can also be applied to natural fiber products made from wool and silk with good fiber affinity and acceptable color fastness. Thus, lichen dyes are an important part of any small scale, environmentally conscious textile manufacturing practices. Lichens are often used for dye production as dye sources but are also known for their ecological resiliency. Lichens have the capability of being poikilohydric and can continue to dry and rehydrate itself repeatedly without causing harm or damage of any kind to them. The Potential of lichens to survive under adverse conditions such as; extreme temperatures, exposure to extreme solar radiation nutrient deprivation, allows lichens the ability to colonize areas that would seem impossible for other types of plants or organisms. Lichens can be classified as pioneer organisms, and therefore play a major role in soil formation via physical weathering and chemical weathering of the underlying substrate. Lichens also provide a habitat for nutrient cycling, such as nitrogen fixation via cyanobacterium that inhabit specific lichens. Furthermore, lichens are extremely sensitive to environmental factors such as atmospheric composition. Because of this sensitivity, lichens have become the primary tool used to estimate air quality and the health of the environment. Many environmental monitoring programs utilize the diversity, abundance and physiological parameters of various Lichens to ascertain levels of air pollution and ecosystem health. Their reaction to environmental stress has been well documented in ecological and environmental studies. However, despite these benefits, the large-scale utilization of lichens as dyes is hampered by their slow rate of growth and susceptibility to over-exploitation. Conservation research highlights the importance of sustainable harvesting and habitat protection. In conclusion, lichens are a special biological resource that integrates cultural significance, chemical diversity, and ecological importance. The established uses of lichens in natural dye preparation and environmental monitoring illustrate their importance as hardy organisms in both natural and modified environments.

Keywords: Lichens; natural dyes; secondary metabolites; ecological resilience; bioindicators; symbiosis; environmental monitoring; sustainable resources

Pteridophytic Diversity and New Species Records from Angul District, Odisha

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Abstract

The present study revealed that Angul district harbours a remarkable diversity of pteridophytes, largely due to its varied geography, climate, and vegetation types. Comprehensive field surveys conducted across different habitats in the district resulted in the collection and identification of 90 species, comprising 8 Lycophytes and 82 ferns. These species are distributed across 50 genera and 16 families, reflecting the rich taxonomic diversity of pteridophytes in the region. For systematic classification, the Pteridophyte Phylogeny Group (PPG I, 2016) system was followed, with minor modifications to accommodate the local flora. Notably, the collection included one subspecies, *Asplenium yoshinagae* Makino subsp. indicum (Sledge) Fraser-Jenk, marking an addition to the known flora of Odisha. The Lycophytes recorded in the study belong to three families: Lycopodiaceae, Selaginellaceae, and Isoetaceae. Among them, Selaginellaceae is represented by a single genus with five distinct species, whereas Lycopodiaceae comprises two genera and two species. Isoetaceae is represented by only one genus and a single species. During the field survey, it was observed that several species of pteridophytes occurred rarely in the district, highlighting the importance of detailed floristic studies for conservation and documentation. Within the fern families, Gleicheniaceae, Equisetaceae, Dennstaedtiaceae, Isoetaceae, Lindsaeaceae, and Psilotaceae were each represented by one genus and one species. In contrast, Schizaeaceae, Marsileaceae, and Selaginellaceae were represented by a single genus each but included multiple species. Families such as Pteridaceae, Cyatheaceae, Salviniaceae, Aspleniaceae, Polypodiaceae, Ophioglossaceae, and Lycopodiaceae exhibited both multiple genera and multiple species, reflecting the high diversity and complex structure of the district's pteridophytic flora. Significantly, seven species were documented as new records for Odisha, namely *Asplenium yoshinagae*, *Azolla filiculoides* Lam., *Dryopteris carthusiana*, *Lygodium palmatum*, *Pityrogramma calomelanos* (L.) Link, and *Thelypteris kunthii* (Desv.) C.V. Morton. These findings not only expand the known floristic inventory of the region but also emphasize the ecological significance and conservation value of pteridophytes in Angul district. The study provides an essential baseline for future taxonomic, ecological, and conservation-oriented research on pteridophytes in Odisha, highlighting the need for continued exploration and documentation of this ancient and ecologically important group of plants.

Keywords: Pteridophytes, Fern diversity, Lycophytes, Flora of Odisha, New species records

Ethnomedicinal Significance of Leafy Vegetables for Gastrointestinal Disorders in Balasore district of Odisha, India

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Abstract

With the rapid growth of the global population and the consequent rise in food demand, ensuring nutritional security has become a major challenge, particularly in developing regions. Leafy vegetables constitute an essential component of the human diet, as they are rich sources of vitamins, minerals, dietary fiber, and bioactive compounds, and they play a crucial role in combating malnutrition and food scarcity. The present study was undertaken to assess the diversity of leafy vegetables consumed by local

inhabitants and to document their traditional use in the management of gastric disorders in the Balasore district of Odisha, India. Ethnobotanical surveys were conducted through field visits, interviews, and interactions with local communities, traditional healers, and elderly informants. The study documented a total of 126 leafy vegetable species belonging to 93 genera and 43 plant families. Among the documented species, 25 leafy vegetables were reported to possess ethnomedicinal properties specifically used to treat gastrointestinal ailments such as diarrhoea, dysentery, stomach pain, indigestion, and peptic ulcers. This indicates their significant role in maintaining gut health and overall well-being of the local population. *Oxalis corniculata* L. emerged as the most frequently cited ethnomedicinal leafy vegetable for the treatment of gastrointestinal disorders and diarrhoea, exhibiting a high-fidelity level of 93.83%, which reflects strong agreement among informants regarding its therapeutic efficacy. Furthermore, the Factor of Informant Consensus (Fic) value was found to be highest (Fic = 1) for the disease category of peptic ulcer, suggesting a high degree of uniformity in the selection of plant species used for this ailment. Overall, the findings of the present study demonstrate that leafy vegetables serve a dual purpose by fulfilling both nutritional and medicinal needs of local communities. The documented ethnomedicinal knowledge underscores the potential of these leafy vegetables as valuable nutraceutical resources. Further phytochemical, pharmacological, and clinical investigations are recommended to validate their therapeutic efficacy and promote their sustainable utilization in modern healthcare and nutrition systems.

Keywords: Leafy vegetables, Ethnobotany, Gastrointestinal disorders, Nutraceutical potential, Therapeutic

Ethnoveterinary Plants Used for Gastrointestinal Disorders in Livestock from Dhenkanal District, Odisha: Phytochemical and Antibacterial Insights

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Abstract

The medicinal value of plants used in ethnomedicine and ethnoveterinary practices is primarily attributed to the presence of secondary metabolites or phytochemicals. In the Dhenkanal district, Odisha, traditional ethnoveterinary practitioners utilize about 278 medicinal plant species to manage various animal ailments. Among these, *Blumea lacera* (Burm.f.) DC. and *Phyllanthus reticulatus* Poir. are extensively used for the treatment of gastrointestinal disorders in livestock. The antibacterial activity of different solvent extracts of the selected plants was assessed against four potentially pathogenic bacterial strains, namely *Clostridium perfringens* (MTCC-1349), *Escherichia coli* (MTCC-119), *Shigella flexneri* (MTCC-1457), and *Salmonella typhimurium* (MTCC-3231). All bacterial strains were procured from the Microbial Type Culture Collection (MTCC) and Gene Bank, Chandigarh, India. Ciprofloxacin (HiMedia Laboratories, India) was used as a positive control, while Dimethyl Sulfoxide (DMSO) served as the negative control. Antibacterial susceptibility was evaluated using the agar well diffusion method on nutrient agar media. Preliminary phytochemical analysis revealed the presence of various bioactive compounds in different solvent extracts. In *Blumea lacera* (whole plant), the petroleum ether extract showed the presence of flavonoids and steroids; the methanolic extract contained alkaloids, tannins, saponins, steroids, and phenols; while the aqueous extract revealed alkaloids, flavonoids, tannins, glycosides, and phenols.

Comparative analysis revealed that *Phyllanthus reticulatus* exhibited stronger antibacterial activity than *Blumea lacera*. Minimum inhibitory concentration (MIC) studies showed the lowest MIC value (25 mg/ml) for the aqueous extract of *P. reticulatus* against *Salmonella typhimurium*, whereas the aqueous extract of *B. lacera* showed an MIC of 50 mg/ml against *Shigella flexneri*. The results of phytochemical screening and antimicrobial evaluation confirm the presence of diverse bioactive constituents in *Blumea lacera* and *Phyllanthus reticulatus*, which likely contribute to their antibacterial efficacy. These findings scientifically validate their traditional use in ethnoveterinary medicine for managing gastrointestinal disorders.

Keywords: Ethnoveterinary medicine, *Blumea lacera*, *Phyllanthus reticulatus*, Phytochemicals, Antibacterial activity

Floristic Diversity and Conservation Significance of Sacred Groves in Sitabinji, Keonjhar District, Odisha, India

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Abstract

Sacred groves are traditionally protected forest patches that function as important natural repositories for the conservation of wild plant species and play a crucial role in maintaining genetic resources and ecosystem diversity. Keonjhar district, located in the state of Odisha, is widely recognized as a tribal-dominated region where indigenous communities have maintained a close relationship with nature. The traditional customs, taboos, and belief systems practiced by these tribal populations have significantly contributed to the protection and sustainable management of biodiversity within sacred groves across the district. The present study was undertaken to document the floristic composition and assess the current status of plant species occurring in the sacred groves of Sitabinji, situated in the Ghatgaon area of Keonjhar district. The investigation revealed the presence of a total of 112 plant species belonging to 67 genera and 45 families, highlighting the rich floristic diversity of the area. Among the various growth forms recorded, trees constituted the dominant category, followed by climbers, herbs, shrubs, and creepers, indicating a structurally complex and well-established vegetation pattern. Analysis of family-wise dominance showed that Fabaceae emerged as the most prominent family in terms of species representation, followed by Combretaceae and several other ecologically significant families. The presence of diverse life forms and taxonomic groups reflects the ecological stability and conservation value of the sacred grove. Importantly, the study also recorded several plant species of medicinal, ecological, and cultural significance, including a few that are considered rare or threatened in the region. The findings of this study emphasize the urgent need for proper documentation, monitoring, and conservation of plant species found within the sacred groves of Keonjhar. These groves not only serve as vital reservoirs of genetic diversity but also act as living repositories of traditional ecological knowledge. The study is expected to enhance awareness among the present and future tribal generations about the ecological importance of sacred groves and encourage continued community participation in their conservation and sustainable management.

Keywords: Sacred groves, Tribal communities, Biodiversity conservation, Floristic composition, Conservation.

Ethnoveterinary Practices and Medicinal Plant Use in Dhenkanal District, Odisha

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Abstract

The use of plants as medicinal resources predates recorded human history, with even animals exhibiting instinctive consumption of specific plants when diseased. Through centuries of empirical observation and experimentation, humans have developed structured herbal medical systems for both human and animal healthcare. In India, documented evidence of medicinal plant uses dates back to the Vedic period, underscoring the country's long-standing ethnomedical heritage. The present study aimed to systematically record and analyze plant species used by local communities for the treatment of animal diseases. Ethnoveterinary data were collected through repeated field surveys conducted across different seasons between 2016 and 2019 in selected rural and tribal-dominated villages of Dhenkanal district. Information was obtained through structured and semi-structured interviews with traditional ethnoveterinary practitioners and knowledgeable informants. A total of 278 plant species belonging to 234 genera and 79 families were documented based on 958 interviews. Herbs constituted the dominant life form (103 species), followed by trees (94), shrubs (44), and climbers/twiners (37). Fabaceae emerged as the most represented family (46 species), followed by Poaceae (19), Euphorbiaceae (14), Malvaceae (12), and Lamiaceae (11). Dicotyledonous species were used more frequently than monocotyledonous species. Ethnoveterinary formulations predominantly involved single plant species or specific plant parts rather than polyherbal combinations. Leaves were the most frequently used plant part (138 prescriptions), followed by roots (79), seeds (67), and bark (48). Fresh plant materials were preferred over dried forms. The principal modes of preparation included paste, decoction, powder, juice, and infusion, with paste being the most common. Additionally, plant-derived products such as latex, sap, and oils were occasionally employed. The therapeutic efficacy of these plants is attributed to the presence of bioactive secondary metabolites or phytochemicals. Among the recorded species, *Blumea lacera* (Burm.f.) DC. and *Phyllanthus reticulatus* Poir. were particularly prominent due to their frequent traditional use.

Keywords: Dhenkanal, Medicinal plants, Odisha, Traditional knowledge, Veterinary practices.

An ethnobotanical assessment of medicinal plant knowledge in Kharsia Block, Raigarh District, Chhattisgarh, India

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Abstract

This study records and examines traditional knowledge associated with the use of medicinal plants in Kharsia Block of Raigarh District, Chhattisgarh, India. Ethnobotanical surveys were carried out in selected rural and forest-adjacent villages through semi-structured interviews and informal interactions with local healers and experienced community members. A total of 35 medicinal plant species from

diverse families were documented for the treatment of various human ailments, including gastrointestinal disorders, skin diseases, respiratory problems, fever, wounds, joint pain, and diabetes. Leaves were the most commonly utilized plant part, followed by roots, bark, seeds, and whole plants. Remedies were primarily prepared as decoctions, pastes, or powders and administered either orally or topically. The findings highlight the extensive ethnomedicinal knowledge maintained by local communities and emphasize the need to conserve both medicinal plant resources and the associated traditional knowledge. The documented data provide a foundation for future pharmacological and phytochemical studies.

Keywords: Raigarh, Ethnobotany, Medicinal plants, Traditional knowledge, Indigenous healthcare, Chhattisgarh

Ethnobotanical assessment of traditional medicinal plant knowledge in Bilaspur District, Chhattisgarh, India

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Abstract

This study documents and evaluates traditional knowledge associated with the use of medicinal plants in Bilaspur district, Chhattisgarh, India. Ethnobotanical surveys were carried out in selected rural and forest-fringe villages through semi-structured interviews and informal discussions with local healers and knowledgeable community members. A total of 32 medicinal plant species belonging to various families were recorded for the treatment of diverse human ailments, including gastrointestinal disorders, skin diseases, respiratory problems, fever, wounds, joint pain, and diabetes. Leaves were the most commonly utilized plant part, followed by roots, bark, seeds, and whole plants. Remedies were primarily prepared as decoctions, pastes, or powders and administered either orally or topically. The findings highlight the extensive ethnomedicinal knowledge preserved by local communities and emphasize the need for conservation of medicinal plant resources and associated traditional knowledge. The documented data may serve as a baseline for future pharmacological and phytochemical studies.

Keywords: Bilaspur district; Ethnobotany; Indigenous knowledge; Medicinal plants; Traditional medicine.

SACRED SCENTS AND HEALING ROOTS: Evaluation of ethnomedicinal properties and antioxidant activities of sacred grasses used in Jagannath tradition.

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Abstract

Benachera (*Chrysopogon zizanioides* (L.) Roberty syn. *Vetiveria zizanioides* L.), is a sacred perennial aromatic grass deeply embedded in ethnomedicinal traditions of Odisha, particularly within the Jagannath cult of Puri. It plays a significant role in daily temple rituals, major festivals such as Snana Yatra, Anasara, and Nabakalebara, as well as in funerary and transitional rites of temple servitors. A key ritual application of Bena chera is in the preparation of Phuluri Tela, a medicated oil produced ritual purification, and blending of vetiver roots with sesame oil, fragrant flowers, and medicinal herbs. During the Anasara

period, when the deities are believed to suffer from fever following the ceremonial bath, this oil is applied to the wooden bodies (Daru Brahma) of Lord Jagannath, Balabhadra, and Subhadra, symbolizing healing, protection, and regeneration while also acting as a cooling, antiseptic, and preservative agent.

Among tribal communities of Mayurbhanj, Koraput, and Kandhamal, including the Santhal and Kondh, vetiver is used in healing rituals, ancestor worship, and seasonal festivals such as Raja Parba to purify sacred spaces and ward off negative energies. Ethnomedicinal practices involve herbal baths, topical applications for wounds and skin infections, and inhalation therapy for mental relaxation and insomnia. Phytochemical studies indicate the presence of bioactive sesquiterpenoids such as khusimol, vetiverol, and β -vetivone, contributing to antimicrobial, antioxidant, anti-inflammatory, and neuroprotective properties. Plants with comparable phytochemical relevance, notably Kusha grass (*Desmostachya bipinnata*) and Darbha grass (*Imperata cylindrica*), are also incorporated in ritual purification and cooling processes.

The present study evaluates comparative antioxidant activity of extract of grasses. Root extract of all three grasses exhibited remarkable antioxidant activity and reducing power, specifically root extract of Khus khus, showing 75.3% peroxidation of linoleic acid. They scavenged 100% hydroxyl radical at a dosage of 5 mg. The root extracts also showed 55 - 70% and leaf extract showed 45-60% scavenging effect on alpha, alaphadiphenyl-beta-picrylhydrazyl radical. The extracts exhibited a 60-70% scavenging effect on superoxide at a dose of 1 mg and 30 - 60% scavenging effect on hydrogen peroxide at a dose of 500 microgram.

These practices demonstrate an advanced ethnobotanical understanding integrating spiritual belief with therapeutic function, highlighting the potential for sustainable utilization and future integration into modern herbal medicine.

Keywords: Antioxidant activity, Benachera, Drabhagrass, Kusha grass, Phuluri Tela, Jagannath cult

Nature-Derived Therapeutics for Women's Health: An Ethnobotanical Review of Traditional Knowledge and Pharmacological Evidence

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Abstract

Medicinal plants have been extensively utilized worldwide for the prevention and management of gynaecological and reproductive disorders, ranging from menstrual abnormalities to infertility and menopausal complications. Approximately 80% of the global population continues to depend on plant-based medicines for primary healthcare, particularly in developing regions where access to allopathic medicine is limited or culturally less accepted. In recent years, there has been a growing global resurgence of interest in herbal therapeutics, often described as a "return to nature," driven by the demand for holistic, cost-effective, and chemical-free alternatives to synthetic drugs. Women's health is uniquely sensitive to hormonal, physiological, and environmental factors, making women particularly susceptible to a wide range of disorders, including urinary tract infections, menstrual irregularities, polycystic ovary syndrome (PCOS), bacterial vaginosis, infertility, sexually transmitted infections, and hormone-related cancers. Additionally, women are increasingly affected by non-communicable diseases such as cardiovascular disorders, diabetes, respiratory ailments, and cancer. Contemporary research increasingly emphasizes the integration of traditional ethnomedicinal knowledge with modern pharmacological

validation to substantiate their therapeutic efficacy. Several plants are repeatedly documented for specific gynecological applications. *Saraca asoca* (Asoka) is recognized as a potent uterine tonic, traditionally used to regulate menstrual cycles and manage menorrhagia, dysmenorrhea, and amenorrhea due to its rich content of tannins, ketosterols, and flavonoids. *Zingiber officinale* (ginger), containing bioactive gingerols, functions as a warming emmenagogue and has been scientifically shown to alleviate menstrual pain and inflammation. *Asparagus racemosus* (Shatavari), a well-known female rejuvenative herb, contains phytoestrogens that support follicular development, enhance reproductive health, and mitigate hyperinsulinemia associated with PCOS. *Withania somnifera* (Ashwagandha), an adaptogenic herb rich in withanolides and saponins, is used to restore hormonal balance, reduce stress-related infertility, and improve libido. Curcumin, the principal bioactive compound of *Curcuma longa* (turmeric), exhibits potent anti-inflammatory properties by inhibiting COX-2 enzymes, thereby reducing dysmenorrhea and premenstrual symptoms. *Hibiscus rosa-sinensis* (China rose) is traditionally employed to manage excessive menstrual bleeding and relieve uterine cramps due to its astringent and antispasmodic properties, while *Mimosa pudica* is valued for its hemostatic effects that aid in controlling abnormal uterine bleeding. This review highlights the ethnobotanical significance of medicinal plants in women's healthcare and underscores the need for further scientific validation to support their integration into modern therapeutic strategies.

Keywords: Ethnomedicine, Gynaecological and reproductive disorders, Women's health

From Ashwagandha to Nightshades: Comparative Anticancer Potential of Steroidal Lactones in Medicinal Plants: A review

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Abstract

Steroidal lactones represent a structurally diverse class of phytochemicals with growing relevance in natural product-based anticancer research. Among them, the withanolides of *Withania somnifera* (Ashwagandha) have received considerable attention for their potent cytotoxic, immunomodulatory, and stress-adaptive properties. Withaferin A, the flagship molecule of this group, is known to disrupt mitotic spindle assembly, impair cell-cycle checkpoints, and trigger mitotic catastrophe—ultimately driving malignant cells toward apoptosis or permanent growth arrest. Beyond *W. somnifera*, several members of the broader nightshade family (Solanaceae), including *Physalis*, *Datura*, and *Solanum* species, also synthesize structurally related steroidal lactones such as physalins, daturalactones, and solanocapsine derivatives. Comparative phytochemical analyses reveal that while these plants share a common biosynthetic framework, their lactone profiles differ in ring modifications, oxidation patterns, and side-chain substitutions, resulting in distinct biological activities. Present study explores emerging evidence suggesting anti-cancer potential of steroidal lactones in *Physalis* species with physalins exhibiting strong pro-apoptotic and anti-metastatic effects, whereas certain *Solanum* lactones demonstrate selective cytotoxicity against drug-resistant cancer phenotypes. *Datura* species, though less explored, contain unique lactone scaffolds with promising antiproliferative potential.

Keywords: Anticancer activity, mitotic catastrophe, steroidal lactones

Diversity, Ethnobotanical Usage, and Livelihood Implications of Wild Edible Plants (WEPs) in Jajpur District, Odisha, India

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Abstract

Wild edible plants (WEPs) serve as a vital nutritional reservoir and a cornerstone of food security for the tribal and rural communities of Jajpur district, Odisha. Documenting these genetic resources is essential for enhancing local socio-economic conditions and advancing the sustainable development of bioprospecting. This study aimed to evaluate the diversity, utilization patterns, and livelihood linkages of WEPs through extensive field surveys, botanical collections, and participatory interviews with local knowledge holders. The findings reveal a rich diversity of 98 wild species across 64 genera and 41 families, with trees being the most prevalent life form. Families such as Poaceae, Asteraceae, Moraceae, Fabaceae, and Amaranthaceae dominate the landscape, with fruits and leaves being the primary parts harvested for consumption. Species such as *Acacia auriculiformis*, *Cyperus rotundus*, *Dioscorea pentaphylla*, *Cycas circinalis* and *Glinus oppositifolius* were identified as highly significant to local diets. Summer provides an abundance of wild fruits; communities rely on the preservation of tubers and pickled fruits to ensure sustenance during periods of food scarcity. Beyond immediate consumption, these wild resources contribute significantly to the livelihoods of the district's rural and tribal inhabitants. This study provides a foundational baseline for the prioritization and conservation of wild food resources. Furthermore, it advocates for the nutritional analysis, domestication, and cultivation of these species to bolster long-term food and nutritional security in the region.

Keywords: Diversity, Wild edible, Sustainable use, Conservation, Jajpur

Conservation of medicinal plants and associated traditional knowledge in Ramsar sites of Odisha through people's biodiversity register (PBR)

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Abstract

India's 94 Ramsar Sites, including six in Odisha, are critical ecosystems supporting biodiversity and livelihoods. The Amrit Dharohar Scheme, 2023 promotes their sustainable management through biodiversity enhancement and eco-tourism. Central to this framework is the People's Biodiversity Register (PBR), a participatory tool mandated under the Biological Diversity Act, 2002 (Amendment 2023), implemented by Biodiversity Management Committees (BMCs) at grassroots level. PBRs document biological resources, traditional knowledge, and conservation practices of local communities. Aquatic medicinal plants like *Bacopa monnieri*, *Centella asiatica*, *Eclipta prostrata*, *Enhydra fluctuans*, *Marsilea minuta*, and *Nymphaea* species are vital for primary healthcare, treating fever, wounds, skin infections, and gastrointestinal ailments. These species also support wetland fauna as food sources and habitats,

maintaining ecological balance. Documentation through PBRs validates traditional ecological knowledge and enables actionable conservation. Threatened aquatic medicinal plants can be protected through in-situ and ex-situ conservation measures managed sustainably by BMCs. This knowledge foundation supports community-based enterprises producing herbal powders, oils, and teas, creating green livelihoods and economic incentives for conservation. Access and Benefit Sharing (ABS) mechanisms ensure equitable distribution of benefits from commercial utilization of wetland resources to local communities. PBRs bridge policy with practice, empowering communities as custodians of their Ramsar Sites while preserving natural and cultural heritage. This participatory approach integrates traditional wisdom with modern conservation science, making PBRs essential for sustainable wetland management and future drug discovery through identification of bioactive compounds from documented medicinal flora.

Keywords: Ramsar Sites, People's Biodiversity Register, medicinal plants, threatened species, Biodiversity



CONSERVATION AND SUSTAINABLE USE OF PLANTS

A Comparative Study on the Influence of Banana Peel Extract Biofertilization on Germination and Early Growth in Cucumber (*Cucumis sativus*) and Tomato (*Solanum lycopersicum*)

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ABSTRACT

Banana peel is an unexplored agricultural by-product rich in nutrients and secondary metabolites that may serve as a natural plant growth promoter. This study evaluated the influence of banana peel extract on the germination and early vegetative growth of cucumber (*Cucumis sativus*) and tomato (*Solanum lycopersicum*) seedlings. Seeds were treated with varying concentrations of banana peel extract (1%, 3%, and 5%) and compared with a tap-water control. Growth experiments were conducted using 20 mL, 40 mL, and 60 mL extract volumes applied to seedlings for 30 days. Phytochemical screening of aqueous and ethanolic extracts was performed to identify major metabolites. Results showed that cucumber seeds treated with 3% and 5% extract exhibited 100% germination, compared with 40% in the control. Tomato seeds displayed maximum germination (100%) at 3% extract. Cucumber seedlings receiving 60 mL extract demonstrated the greatest shoot length (14.9 cm) and biomass (1.5458 g), whereas tomato seedlings responded most positively to moderate extract volumes (20–40 mL). Phytochemical analysis revealed the presence of tannins, flavonoids, alkaloids, saponins, and triterpenoids. The findings indicate that banana peel extract enhances seed germination and early seedling development, highlighting its potential use as a sustainable biofertilizer.

Keywords: *Cucumis sativus*, *Solanum lycopersicum*, Banana peel, Biofertilizer

Bio-stimulation of Nutritional Efficacy in Beet greens through MLE Foliar Application

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ABSTRACT

Beet greens (Beetroot leaves) are nutritional powerhouses, rich in K, Fe, Ca, Mg, P like minerals, vitamins and antioxidants (betalains) that boost immunity, maintain bone and eye health, improve blood circulation via nitrates, rich with fiber, possess potential anti-cancer properties, and preventing anemia. Moringa leaves contain antioxidants, amino acids, vitamins, hormones, macronutrients, and micronutrients. The main purpose of this study is to determine the optimal concentration of *Moringa oleifera* L. leaf extract (MLE) as an effective biostimulant to improve nutritional quality in Beet root (*Beta vulgaris* L.). Three concentrations of MLE (3, 6, and 12%) were foliar sprayed to the plant leaves at a rate of 50 mL plant⁻¹ for once in a week from 30DAS till 5 sprays before final observation, while control plants were sprayed with distilled water only. Results showed that MLE greatly increased Beet root leaf nutrient content, mineral content and pigment content, while a high concentration of 12% MLE could also

significantly reduce nitrate content in Beet leaves. In comparison to the control plants, sprays of 3%, 6%, and 12% MLE reduced nitrate content by 12%, 19%, and 11%, respectively against control. Total soluble sugar (TSC), minerals (K, Mg and Ca) and pigment content were significantly higher after spraying with 12% MLE, while enhanced in Ascorbic acid (AsA) accumulation and lower nitrate were found in the plants treated with 6% MLE. A positive correlation was observed in chlorophyll a and chlorophyll b with AsA (vitamin C) at *p* levels of 0.05 where resulted a negative connection with nitrate content. Plants treated with MLE could significantly improve the concentration of ascorbic acid. Findings of this study showed the positive role of MLE in improving chlorophyll a, chlorophyll b and carotenoids content in leaves than control plants under summer condition. Though the higher TSC value was observed in 12% MLE but more percentage of increment visible in 6% of moringa leaf extract (12.84 mg.g⁻¹) over control. Analysis showed a significant increase in Beet leaves treated with 6, 8, and 10% MLE and resulted in enhanced nutritional content such as Ca, K and Mg. Hence 6% of MLE found more effective in comparison with concentration and quality improvement. It may be concluded that Beet greens are high in nutritional value which is possible to stimulate by MLE foliar application, gained many amazing benefits of eating more beet greens for a healthy life.

Key words: Beet greens, MLE, Nitrate, TSC, Ascorbic acid, Bio-stimulant

Biotechnological application to *Semecarpus anacardium* L. a medicinally important tree Species

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ABSTRACT

Semecarpus anacardium commonly known as marking nut or bhilawa, is a tree deciduous forest tree native to India. The fruit nut of *Semecarpus* contains number of alkaloids, flavonoids, biflavonoids, and other compounds. For genetic improvement of this species there is a need for suitable in vitro regeneration system and molecular level studies for *in vitro* regeneration, diversity analysis and to understand the metabolic pathways for secondary metabolite production in this plant. We report here some biotechnological application to the species. *In vitro* seed germination was achieved at the rate of 64%. Proliferation of shoots from axillary meristems of seedling derived nodal explants was achieved in woody plant medium (WPM) medium supplemented with BAP and Kinetin. *In vitro* shoots rooted (100%) in half strength liquid medium with 2.46µM of IBA (indole Butyric acid). Development of shoots from this mass on withdrawal of TDZ indicated inhibitory effect of TDZ on shoot differentiation. Additional shoots developed on repeated transfers to GR free medium. Pre culturing in TDZ 2.27µM, and there after repeated transfer to GR free medium produced optimum number of shoots. Mature tree derived nodal buds were collected during the month of April, May and June. Explants pre-cultured in TDZ, sprouted producing multiples buds which differentiated and elongated in growth regulator free WPM medium containing antibiotics for 4 passages of 4 weeks each. Rooting was 100% in medium with 7.38 µM IBA. Rooted shoots survived in sand: soil mixture and the hardened plants were transferred to green house. In further research cotyledonary explants of semimature seeds were cultured in WPM medium with varying concentrations of growth regulators. Caulogenic buds and embryogenic mass like structures appeared on the surface of the explants in TDZ containing medium. The caulogenic buds differentiated to form shoot primordia and shoot in GR free WPM with charcoal (0.2%). The shoots rooted in half strength liquid WPM with IBA. Maximum rhizogenesis was observed in explants co-cultured with strain ATCC 15834. Integration of rol genes (A, B and C) was confirmed by PCR. Amentoflavone, a biflavonoids

having potential anticancerous, neuroprotective, antiviral and anti-inflammatory activity, was detected in the leaves of the in vitro grown plants. Cotyledon-derived callus tissue also produces Amentoflavone.

Keywords: *Semecarpus anacardium*, seed germination, TDZ, WPM medium, caulogenic buds

Organic Farming: A New Approach towards Sustainability of Plant Biodiversity and Restoration of Soil Microbial Flora-A Case Study

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Abstract

Organic farming (OF) is a farming system that uses eco-friendly methods of weed, pest and disease control and management. OF offers an alternative to more widespread, high input farming practices that use synthetic fertilizers, fungicides and pesticides. It is based on the idea that the soil is a living system so these synthetic products are largely excluded from organic farms. Organic agriculture relies on crop rotation, animal manures, crop residues, green manures and the biological control of pests and diseases to maintain soil health and productivity. Organic crops are often of higher value than conventional ones and the volume of organic crops show a continually increasing production trend. The sale of crops labeled as organic or biological is highly regulated in most advanced markets. The environmental impact of organic farming is low and can be seen as a way of cleaning up and improving degraded agricultural land. To increase the profitability of marginal farmers, possibility of growing horticultural and agricultural crops are being evaluated at Kadambasole village of block Betnoti, Mayurbhanj, Odisha. The horticultural crops like sweet corn, watermelon, Zucchini (summer squash), pumpkin, and brinjal were cultivated with and without addition of organic manures like FYM, neem cake, mahua cake, azolla etc. Biopesticides, neem-based pesticides, yellow card and pheromone traps were implemented to control the pests and diseases. The different biochemical and agronomic parameters were studied to check the productivity and quality of yield. The result indicated that organic products were less perishable with long duration of field residence period as compared to inorganic products. Moreover, initial evidence indicates that organic agricultural systems deliver greater ecosystem services and social benefits. The microbial population as well as earthworm populations were significantly increased. Although organic agriculture has an untapped role to play when it comes to the establishment of sustainable farming systems, no single approach will safely feed the planet. Rather, a blend of organic and other innovative farming systems is needed. Significant barriers exist to adopting these systems, however, and a diversity of policy instruments will be required to facilitate their development and implementation.

Keywords: Organic farming, sustainability, Plant biodiversity, Microbial flora

Azolla-Based Agro-Technology for Sustainable Rice Production and Environmental Protection

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ABSTRACT

Rapid depletion of soil fertility and the escalating cost of chemical fertilizers have intensified the need for eco-friendly and low-cost alternatives in agricultural production. Biofertilizers have therefore emerged as sustainable inputs for maintaining soil health and crop productivity. At the same time, medium- and low-lying rice fields located near urban and industrial zones are increasingly threatened by pollution arising from domestic sewage and industrial effluents. This article highlights the dual role of the aquatic fern *Azolla* in promoting sustainable rice cultivation while simultaneously contributing to environmental remediation. Tropical rice ecosystems provide an ideal habitat for the prolific growth of free-living cyanobacteria and the *Azolla*–*Anabaena* symbiotic association. In recent years, *Azolla* has attracted considerable attention for its agricultural applications, particularly in paddy fields. *Azolla* is a small, aquatic leptosporangiate pteridophyte that harbors a heterocystous nitrogen-fixing cyanobacterium, *Anabaena azollae*, within specialized cavities in the dorsal lobe of its fronds. The *Azolla*–*Anabaena* complex is capable of fixing atmospheric nitrogen at rates of approximately 40–60 kg N ha⁻¹ per crop and 300–900 kg N ha⁻¹ yr⁻¹ under natural conditions. Owing to its association with the highly efficient nitrogen-fixing endosymbiont *A. azollae*, *Azolla* serves as an effective biofertilizer for waterlogged rice fields. In addition, it functions as a biological agent for environmental decontamination due to its capacity to hyperaccumulate heavy metals such as Pb, Fe, Cd, Cr, and Ni from aquatic systems. The primary objective of this article is to encourage marginal rice farmers in developing countries, including India, to adopt *Azolla*-based agro-technology for sustainable agriculture, while also proposing a practical strategy for protecting agricultural fields from domestic and industrial pollution.

Keywords: Azolla, biofertilizer, sustainable agriculture, rice cultivation, nitrogen fixation, phytoremediation

Allelopathic Effects of *Alternanthera sessilis* on Seed Germination and Growth of *Vigna radiata* L.

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ABSTRACT

Allelopathy offers a sustainable approach to weed management through biochemical interactions mediated by secondary metabolites. This study investigated the allelopathic potential of *Alternanthera sessilis*, a notorious perennial weed, on seed germination and seedling growth of *Vigna radiata* (mung bean). Aqueous leaf extracts were prepared at four concentrations (25, 50, 75, and 100 mg/ml) to evaluate effects on germination, growth parameters, biomass, photosynthetic pigments, and protein content under

controlled laboratory conditions. Results demonstrated concentration-dependent allelopathic inhibition across all parameters. Seed germination declined from 87.56% in controls to 32.46% at 100 mg/ml, representing 62.9% reduction. Growth analysis revealed differential organ sensitivity, with root length showing exceptional vulnerability (71.9% reduction at 75 mg/ml) compared to shoot length (21.5% reduction). Biomass parameters exhibited dramatic alterations, with fresh weight declining by 51.5%, dry weight by 84.6%, and water content by 43.6% at sublethal concentrations. Photosynthetic pigment analysis revealed severe degradation: chlorophyll *a* decreased by 60.3%, chlorophyll *b* by 49.2%, and total chlorophyll by 72.7% at maximum concentration. Phytochemical screening identified diverse secondary metabolites including alkaloids, tannins, flavonoids, terpenoids, glycosides, and saponins. Phenolic compounds inhibit enzymatic activities, alkaloids disrupt membrane integrity, terpenoids generate oxidative stress, and saponins enhance membrane permeability. Allelopathy likely contributes to *A. sessilis*' invasiveness and documented capacity to cause 19-60% yield reductions in field crops. For *V. radiata* cultivation, management strategies must address both resource competition and allelopathic suppression. This research provides baseline data for developing integrated weed management approaches, screening crop varieties for allelopathic tolerance, and potentially isolating allelochemicals for bioherbicide development as environmentally sustainable alternatives to synthetic herbicides.

Keywords: Allelopathy, allelochemicals, germination inhibition, secondary metabolites, sustainable weed management

Chromium-Induced Physiological Stress in Crop Plants: A Comparative Study of *Macrotyloma uniflorum* (Lam.) Verdc. and *Cucumis sativus* L.

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ABSTRACT

The present study aimed to examine the toxic effects of hexavalent chromium (Cr^{6+}) on seed germination, seedling growth, and essential biochemical parameters in two plant species, *Macrotyloma uniflorum* (Lam.) Verdc. and *Cucumis sativus* L. Chromium, particularly in its hexavalent form, is a highly toxic heavy metal known to interfere with plant metabolism and development. To assess its impact, seeds of both species were germinated and grown in a controlled liquid culture system supplemented with different concentrations of Cr^{6+} . The study focused on evaluating physiological responses, including germination percentage, root and shoot length, as well as biochemical markers such as total chlorophyll content, soluble protein content, and proline accumulation. Results showed a clear dose-dependent inhibitory effect of Cr^{6+} on both species. As chromium concentrations increased, seed germination rates declined significantly, indicating that Cr^{6+} interferes with the early stages of plant development. Root and shoot growth were also markedly suppressed, reflecting the metal's toxic impact on cellular division and elongation processes. Biochemical analysis revealed a substantial decrease in total chlorophyll content, suggesting impaired photosynthetic capacity, and a reduction in soluble protein content, highlighting disruption of normal metabolic activities. In contrast, proline levels increased in seedlings exposed to higher Cr^{6+} concentrations, which is a well-known adaptive response to oxidative and osmotic stress in plants. At the highest concentration tested, 100 ppm Cr^{6+} , seed germination in *Macrotyloma uniflorum*

declined to 68%, while in *Cucumis sativus* it was almost completely inhibited, dropping to only 1%. This pronounced difference indicates species-specific variation in chromium tolerance, with *Macrotyloma uniflorum* displaying a greater capacity to withstand heavy metal stress compared to *Cucumis sativus*. Such tolerance may be linked to its ability to maintain relatively higher metabolic activity and accumulate protective compounds like proline under stress conditions. Overall, the findings demonstrate that hexavalent chromium exerts severe inhibitory effects on plant growth and metabolism, disrupting both physiological and biochemical processes. The observed species-specific responses emphasize the importance of selecting tolerant plant species for environmental studies related to heavy metal stress. Notably, the relatively high tolerance of *Macrotyloma uniflorum* suggests its potential utility in phytoremediation strategies aimed at mitigating chromium contamination in soils, making it a promising candidate for further research into heavy metal stress management in plants.

Keywords: Hexavalent Chromium, Toxicity, *Macrotyloma uniflorum*, *Cucumis sativus*, Seed germination.

Mancozeb Application Alters Photosynthetic Performance and Chlorophyll *a* Fluorescence in Green Gram: Implications for Nutritional Quality

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Abstract

Mung beans are a low-calorie, extremely nutritious legume that is rich in protein, fiber, antioxidants, and essential minerals like potassium and magnesium. Because they enhance digestion, aid in weight management, reduce "bad" LDL cholesterol, and help regulate blood sugar, they are ideal for managing diabetes. As the usage of the broad-spectrum fungicide Mancozeb for crop management increases, worries concerning agricultural production and the nutritional content of these legume grains are growing. The nutritional value of this food grain for eating is greatly influenced by its protein content, polyphenol, phytic acid, and residual Mg of fungicide Mancozeb. In the current study, a brief 7-day exposure to mancozeb (zinc ethylene bis-dithiocarbamate combined with manganese) at different concentrations (control, 500, 1000, and 3000 ppm) significantly affected growth parameters such as root shoot ratio, polyphenol, proline, carbohydrate, protein, and photosynthetic activity at photosystem-II. At 3000 ppm, there was a significant decrease in germination rate and a dose-dependent decrease in root growth compared to the control. As the amount of mancozeb dose increased, the polyphenol content gradually increased along with the carbohydrate content. The amount of chlorophyll progressively increased with increasing concentration but root length significantly decreased. At 500 ppm concentration, improved growth, chlorophyll content, and chlorophyll *a* fluorescence activity at 'J', 'I', and 'P' transient points having lower values compared to control treatment. The ΔV_t curve showed a considerably greater chlorophyll transient value 'J' transient point than the control, which gradually dropped at higher concentrations, the most decreased in 3000ppm. ABS/RC, Df/RC, trapping with increased electron transport from PSII to PSI, and photosynthetic activity (PIabs) reduced by roughly 2.2 to 3.5 fold over control from 500 ppm to 3000 ppm, respectively as demonstrated by a radar plot. As one of the nutrient-rich foods for humans, the higher exposure of Mancozeb in sprouting mung bean with high protein, carbohydrate, and phenol content as well as higher chlorophyll content and photosynthetic activity with

high Mg may have significant health benefits. The significant root reduction in higher concentration of Mancozeb treatment have implication on a residual pesticide effect on health hazard.

Keywords: Chlorophyll, Fungicide, health benefit, Photosyntheti

Inhibitory effects of Polar compounds present in *Boerhaavia diffusa* L. on secretory proteins of *Escherichia coli*

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ABSTRACT

Naturally available compounds show more bioactivities, avoiding side effects. A typical quinolizidine group of alkaloids is present in the *Boerhaavia diffusa* root, which enhances its medicinal properties. Structural validation and resemblance of these alkaloids can be used as a composition of drug quality enhancement effect to improve ailing patients' healing potential. Sophisticated instruments like Ultra performance liquid chromatography (UPLC) in ESI-MS and FTIR methods of analysis of compounds present in purified alkaloids was found to be R_f 4.17, 7.42, and 11.08 for the compounds i.e. C₂₄H₂₆N₂O₁₃, C₂₄H₂₆N₂O₁₃, C₁₈H₁₅NO₄, respectively, which match with the thin layer chromatography (TLC). Phytocompounds were separated through column chromatography, and quantification tests were conducted later. From FTIR, functional groups are identified at 2942, 2563, 2314, and 1250 wavenumbers (cm⁻¹). Two compounds of alkaloids have significant cumulative these alkaloids have high bactericidal activities by inhibiting bacterial metabolism. BDA17 has been purified among these compounds to verify the similarity effects. Its rapid effects on the bacteria are identified by testing the antimicrobial activities (~78.12%) concerning antibiotic control. Later, it was confirmed by UV-visible spectrophotometer spectral representation. The ligands present in the compound are mainly responsible for damaging the bacterial outer membrane. So, it can be useful for preparing the safest drug as compared to synthetic drugs. Secondary metabolites like these alkaloids may be future supplementing compounds for the modification of present medications for a specific disease.

Keywords: Bioactivities, Quinolizidine alkaloids, *Boerhaavia diffusa* root, UPLC, FTIR, BDA17, antimicrobial activities.

An analysis of the challenges and potential solutions for microbially facilitated waste-to-chemical metabolism

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ABSTRACT

Waste, including environmental contamination, is growing alarmingly due to the expanding population. The current state of recycling technology is fraught with problems, such as high energy consumption, low product utilization rate, etc. Incineration and conventional mechanical recycling have inherent limitations,

leading to a decline in quality and an inability to recover value. Consequently, new treatments like waste-to-energy should be created within the circular economy framework. The chemical and fuel sectors actively seek renewable resource-based "green" innovations in response to the necessity for a sustainable future. A significant area of research has been the production of chemicals and energy sources from the transformation of biomass and waste, which has its roots in the goal of increasing sustainability. Restoring value from waste has recently been seen as most viable through chemical upcycling and recycling methods, providing goods with added value. Innovative catalytic pathways for the synthesis of fuels, highly valuable compounds, and novel materials have recently surfaced as potential approaches to economically and ecologically beneficial valorizing waste. To synthesize an increasing variety of beneficial bulk chemicals at economically acceptable productivities, biotechnology enables the creation of organisms and enzymes. Metabolic engineering and synthetic microbiology have allowed the development of microbial cell factories to produce goods with added value efficiently. Microbes that have been genetically engineered, including bacteria, fungi, and algae, have shown promise in degrading oil spills, camphor, and other pollutants. These engineered strains outperform their naturally occurring counterparts, have more degradative capacities, and can adapt quickly to new substrates or compete with existing contaminants. Bioremediation agents, biofuels, and biocontrol agents are all products of microbial digestion that begin from agricultural residue waste. Implementing genetic engineering to create these species for the sake of public health, the environment, and the road ahead is undoubtedly long and valuable.

Keywords: Waste, Recycling, Sustainability, Microbiology, Genetically engineered, Bioremediation.

In -Silico Study of selected *Aegle marmelos* Phytochemicals for Anti-Ulcer Treatment

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Abstract

Peptic ulcer disease (PUD) remains a prevalent gastrointestinal disorder worldwide, affecting millions annually and imposing substantial healthcare burdens. Characterized by mucosal erosions in the stomach or duodenum, PUD arises from an imbalance between aggressive factors like acid secretion, *Helicobacter pylori* infection, and non-steroidal anti-inflammatory drugs (NSAIDs). Rising antibiotic resistance in *Helicobacter pylori* further complicates therapy, necessitating novel, safer alternatives from natural sources. In current time medicinal plants have gained considerable attention as alternative therapeutic agents because of their safety, affordability, and the presence of bioactive phytochemicals capable of enhancing tissue repair. *Aegle marmelos* (Bael), a well-known medicinal plant in traditional Ayurveda and folk medicine, has emerged as a promising candidate for natural Ulcer Treatment formulations owing to its rich phytochemical composition and diverse pharmacological properties. Phytochemical investigations reveal that *A. marmelos* contains a variety of bioactive constituents including flavonoids, tannins, phenolic acids, alkaloids, and essential oils which are very much helpful to ulcer treatments. In the present study, Virtual Screening for hit molecules was exhibited by help of literature review. Five numbers of phytochemical constituents such as 8-isopropyl, Beta Ocimene, Aegelinol, Alpha Pinene, Ammijin were selected. These compounds contribute synergistically

to its antioxidant, anti-inflammatory, antimicrobial, and collagen-modulating activities, all of which are essential for effective Ulcer treatment. The therapeutic efficacy was explored through docking and druggability of the small molecules were studied through Swiss ADME through the BOILED-Egg, iLOGP and Bioavailability Radar. The docking study revealed that Aegelinol showed the highest docking result of -8.1 Kcal/ Mol. However, Ammijin depicted a result of -4.8Kcal/Mol. which infers that the small molecule has very less attraction towards the protein and cannot be selected as a novel compound. Beta Ocimene has XLogP3 (Lipophilicity) value of 3.40. Future research is needed to establish its efficacy in human Ulcer-treatment applications and to promote its integration into modern herbal therapeutics.

Keywords: Anti-Ulcer, *Aegle marmelos*, In-silico, Docking, Swiss ADME

Constitutive Expression of a Disease Resistance Protein Confers Enhanced Pathogen Defense in *Arabidopsis*

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Abstract

Plant-pathogen interaction is co-evolving and results in developed resistance in both the host and invader. Plants being sessile cannot physically escape from the pathogens and thus are armored with defense strategies resulting in neutralizing the pest effects. *Resistance (R)* genes in plants elicit a robust defense by synthesizing their protein products against pathogen effectors. Primarily, the expressions of *R* genes are tightly regulated by multiple surveillance mechanism(s). A less explored *R* gene of *Arabidopsis thaliana*, AT5G51630 (disease related protein; DRP), confers resistance against bacterial pathogen. When over-expressed, the DRP localizes in the cytoplasm and the *Arabidopsis* with ectopic expression of DRP exhibits delayed flowering phenotype aligning with the fact that immunity costs growth. The over-expression of the DRP in *Arabidopsis thaliana* results in enhanced immunity, primarily by modulating the basal immunity, as evident from the early activation of pathogenesis-related protein 1 (PR1) relative to the wild-type. Here we demonstrate that the engineered transgenic plant not only offers resistance against the *Pseudomonas syringae* but also favours the plant during drought stress.

Keywords: Pathogen, Resistance, Disease related protein, Ectopic, Immunity.

Deciphering the wound healing potential of *Homalium* species phytochemicals through integrated *in silico* approaches

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ABSTRACT

Wounds are an increasing worldwide health concern that affects patient and healthcare facilities in many significant manners on both social and commercial levels. Wound healing progress through several sequential phases including inflammation, proliferation, extracellular matrix formation and remodeling.

Homalium a medicinal tree belonging to the family Salicaceae, has a long history of ethnobotanically used among tribal communities Odisha and Andhra Pradesh for wound healing. The present investigation aimed to scientifically validate this ethnopharmacological practices using computational in silico approaches. This study provides, the first *in silico* prediction of the bioactive compounds present in the stem extract of *Homalium* sp. along with their molecular docking interactions, to evaluate their potential inhibitory effects against the possible therapeutic targets like TNF α , MMP9 and VEGF. The identification of bioactive compounds, present in our sample were identified by using GC-MS analysis. The PASS prediction revealed, high probabilities for pharmacological activities related to wound healing. We also evaluated the drug likeness, physiochemical properties and toxicity profile of bioactive compounds using Swiss ADME and Protox 3.0 software online tool. *In silico* studies uncovered that eight compounds out of 25 compounds have acceptable drug-likeness properties. The identified compound with PubChem CID (6782) exhibited strong binding affinity against TNF α (2AZ5) and MMP9 (1GKC) with binding energies of -7.33 and -7.70 kcal/mol respectively, whereas compound with PubChem CID (6423865) showed notable affinity for the VEGF (1FLT) with binding energy of -6.40 kcal/mol. The results indicated that *Homalium* sp. may have the ability to repair wounds and might serve as a promising source for the discovery of potential drug candidate. Further in vivo investigations are required to validate our findings.

Keywords: Wound healing, *Homalium*, GC-MS analysis, Molecular docking

Bacterial Infection Targets the *Arabidopsis* J-Domain Cochaperone and Decapping Factor 5

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Abstract

Plants are equipped with numerous defense strategies to combat any biotic or abiotic challenges. Several protein factors are constantly engaged in the surveillance process, thus production of any aberrant messenger RNAs (mRNAs) and proteins are restricted. Eukaryotic mRNAs go through a number of scrutiny processes, whereby several protein components including mRNA decapping factors play a critical role in degrading the non-physiological mRNAs, which would otherwise have detrimental effect when translated. Similarly, newly synthesized proteins also pass through quality control process mediated by chaperones and cochaperones harboured within the endoplasmic reticulum, ensuring proper protein folding and minimize the occurrence of protein misfolding. Interestingly, the results of the present study revealed that the decapping protein factor, DCP5 of the *Arabidopsis thaliana* physically interacts with the J domain-containing cochaperone, ERdj3B in the processing bodies (P-bodies). Upon pathogen infection by the *Pseudomonas syringae* pv. *syringae* B728a strain (PssB728a), the ERdj3B was induced for degradation via the 26S proteasome pathway as early as 120 minutes post infection (mpi). Also, under pathogen-challenged conditions, DCP5 relocates to the cytoplasm and the number of DCP5-induced P-bodies was significantly reduced at 90 and 120 mpi. The findings of the present investigation highlight the possible significance of this interaction, primarily contributing for maintaining proteostasis and their plausible role during plant defense process.

Keywords: Surveillance, mRNA, cochaperones, protein folding, decapping protein factor.

Chemotyping of *O. sanctum* volatiles from ten agroclimatic zones of Odisha revealed variation in quality constituents with antimicrobial potential against MDR strains.

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ABSTRACT

Ocimum sanctum L. (holy basil) is a medicinally important aromatic herb valued for its essential oil (EO) based therapeutic properties. The present study showed variation in oil yield, chemical composition, and antimicrobial potential of forty *O. sanctum* accessions collected from ten agroclimatic zones of Odisha, India. Hydrodistillation method of oil yield varied from 0.3% to 1.25 % (v/w) in fresh weight basis. The highest oil yield ($1.25 \pm 0.02\%$) was recorded in the South Eastern Ghat Zone accession (OS1), whereas the lowest yield ($0.30 \pm 0.06\%$) was observed in the Mid-Central Table Land accession (OS38). GC–MS analysis identified 33 volatile constituents dominated by phenylpropanoids and sesquiterpenes. The major constituent in OS1 accession was eugenol (50.379%) followed by β -caryophyllene (16.932%), β -elemene (15.351%), germacrene A (3.458%), germacrene D (2.319%), α -humulene (1.216%) etc. The low-yielding OS38 accession also showed eugenol (47.922%) as major constituent followed by β -elemene (19.143%), β -caryophyllene (15.383%), germacrene A (3.247%), germacrene D (2.180%), α -humulene (1.162%) etc. GC-MS analysis categorised all forty accessions in to two chemotypes based on major constituents like eugenol and methyl eugenol. Multivariate analyses like PCA, PLS-DA, sPLS-DA, hierarchical clustering, and K-means resolved distinct chemotypic patterns, primarily eugenol-rich and methyl-eugenol-dominant groups. Antimicrobial activity of identified two chemotypes were further studied against multidrug-resistance (MDR) bacteria strains. The eugenol rich chemotype exhibited superior antimicrobial activity against (MDR) strains, with low MIC values against *Staphylococcus aureus* (0.781 $\mu\text{g/mL}$), *Escherichia coli* (0.39 $\mu\text{g/mL}$), *Klebsiella pneumoniae* (1.56 $\mu\text{g/mL}$), and *Acinetobacter baumannii* (3.125 $\mu\text{g/mL}$). In contrast, methyl eugenol rich chemotype displayed significantly lower activity with higher MICs against *S. aureus* (6.25 $\mu\text{g/mL}$), *E. coli* (6.25 $\mu\text{g/mL}$), *K. pneumoniae* (12.5 $\mu\text{g/mL}$), and *A. baumannii* (12.5 $\mu\text{g/mL}$). The enhanced antimicrobial efficacy of the elite eugenol rich chemotype may be associated with a favourable synergistic balance of eugenol and membrane-active sesquiterpenes (β -caryophyllene, α -humulene, germacrene derivatives), which are known to enhance bacterial membrane permeabilization and reduce tolerance mechanisms in MDR pathogens. Overall, the study demonstrates that agroclimatic conditions strongly influence essential oil yield, chemodiversity, and antimicrobial potential of *O. sanctum* towards selection of elite chemotype with promising pharmaceutical applications.

Keywords: Essential oil, *Ocimum sanctum*, Agroclimatic zone, Multivariate analysis, MDR strains

Role of *Salvinia cucullata* Bory in Domestic Wastewater Treatment and Sustainable Agriculture

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ABSTRACT

Phytoremediation represents a promising, eco-friendly, and sustainable biological approach for the treatment of various types of waste-water, relying on the natural ability of plants to remove, stabilize, or detoxify harmful contaminants. This green technology has gained considerable attention as an alternative to conventional wastewater treatment methods, which are often costly and energy-intensive. A wide range of hyperaccumulator plants, particularly aquatic macrophytes and hydrophytes, have been extensively explored for their potential to absorb pollutants from contaminated water bodies. The present study focuses on the treatment of wastewater generated from domestic activities using phytoremediation, with special emphasis on the effective hydrophyte *Salvinia cucullata* Bory. The selected plant species was collected from its natural habitat and carefully isolated from associated organisms to establish a pure and healthy culture. Laboratory-scale phytoremediation experiments were conducted by cultivating *S. cucullata* for a period of 49 days in a composite sample prepared from sewage wastewater. To assess the remediation efficiency, physicochemical parameters of both the wastewater and the plant biomass were analyzed at regular intervals of seven days. The results demonstrated that *S. cucullata* exhibited a high capacity for wastewater treatment, leading to a significant reduction in heavy metal concentrations, as well as marked decreases in biochemical oxygen demand (BOD) and chemical oxygen demand (COD) levels. In addition to pollutant removal, the plant effectively absorbed essential nutrients such as nitrogen, phosphorus, and sulphur, along with certain trace metals, which accumulated within the plant biomass. Furthermore, the phytoremediated biomass of *S. cucullata* was reused as compost to evaluate its potential as a fertilizer. When applied to the growth and germination of *Macrotyloma uniflorum* (Lam.) Verdc., the composted biomass showed a positive growth response compared to the control. These findings suggest that *Salvinia cucullata* not only serves as an efficient agent for wastewater treatment but also holds significant potential for reuse as a fertilizer in agricultural practices.

Key words: *Salvinia*, Wastewater, Phytoremediation, fertilizer, crop growth.

Integrative computational and experimental insights into the multitargeted anticancer potential of *Curcuma caesia* against triple-negative breast cancer: molecular docking and pharmacokinetic assessment

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ABSTRACT

Triple-negative breast cancer (TNBC) is an aggressive and heterogeneous breast cancer subtype lacking estrogen, progesterone, and HER2 receptors, targeted therapeutic options and contributes to poor clinical outcomes. The present study investigates the multitargeted anticancer potential of *Curcuma caesia* Roxb. methanolic rhizome extract (CCMRE) through an integrative framework combining transcriptomic analysis, molecular docking, pharmacokinetic prediction, and *in vitro* cytotoxic validation. RNA-Seq analysis of breast cancer cell lines (MDAMB-231 and MCF-7) identified key dysregulated genes associated with tumor proliferation and metabolic reprogramming. Network and pathway enrichment analyses highlighted the androgen receptor (AR) and phosphoglycerate dehydrogenase (PHGDH) as central therapeutic targets due to their roles in hormone-driven signaling and serine biosynthesis, respectively. High-throughput virtual screening of 40 phytocompounds reported from *C. caesia* identified six candidates, curcumenol, α -terpineol, trans-carveol, trans-sesquisabinene hydrate, a 2-cyclohexen-1-one derivative, and curzerenone, with strong dual-binding affinity toward AR (PDB ID: 1E3G) and PHGDH (PDB ID: 7DKM). Molecular docking and MMGBSA analyses revealed stable ligand–protein interactions, with binding energies comparable to or exceeding those of the reference chemotherapeutic drug doxorubicin. Residue-level interaction analysis demonstrated overlapping binding pockets and conserved interaction profiles between the phytocompounds and doxorubicin, supporting their potential as effective multitarget inhibitors. *In silico* ADME/T profiling indicated favourable drug-likeness for all six compounds, including compliance with Lipinski’s rule of five, good aqueous solubility, high intestinal permeability, low predicted cardiotoxicity, and acceptable blood–brain barrier penetration. Experimental validation using the MTT assay confirmed the cytotoxic potential of CCMRE against MCF-7 and MDAMB-231 cell lines, with IC₅₀ values of approximately 131.6 μ g/mL and 131.77 μ g/mL, respectively, after 48 hours of treatment. Overall, this study provides the first integrated computational and experimental evidence supporting the multitargeted anticancer potential of *C. caesia* against TNBC via concurrent inhibition of AR and PHGDH. The findings highlight the promise of *C. caesia*–derived phytochemicals as lead candidates for further preclinical development and underscore the utility of systems-based approaches in natural product–driven cancer drug discovery.

Keywords: Triple-negative breast cancer, *Curcuma caesia*, PHGDH, molecular docking, pharmacokinetics

Plant-based antidengue lead discovery: Docking and ADMET analysis of *Carica papaya* phytochemicals against DENV targets

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ABSTRACT

Dengue fever is a rapidly expanding mosquito-borne viral disease and represents a major global public health challenge, affecting nearly 2.5 billion people at risk worldwide. Dengue virus (DENV), a member of the family “Flaviviridae”, is a positive-sense single-stranded RNA virus (~11 kb genome) encoding three structural and seven non-structural proteins. Five serotypes of DENV (DENV-1 to DENV-5) are reported, and transmission occurs mainly through “*Aedes aegypti*” and “*Aedes albopictus*”. Although several synthetic antiviral compounds have been evaluated, their use is limited due to side effects and lack of highly effective targeted anti-dengue drugs. Therefore, medicinal plant-based phytochemicals may serve as safer and promising alternatives. In this study, an *in silico* workflow was employed to evaluate 56 phytochemical compounds from “*Carica papaya*” leaf extract for anti-dengue activity against five viral targets: NS1, NS2B - NS3 protease, NS3 helicase, NS5, and Glycoprotein E. Docking performance of phytochemicals was compared with eight reported antiviral drugs using PyRx-based virtual screening and AutoDock 4.2 docking. Homology modelling was performed for NS1 and NS5, and the resulting protein structures were validated using Ramachandran plot analysis and structure quality evaluation scores. ADMET profiling and drug-likeness analysis identified only a subset of phytochemicals as suitable leads, supported further by toxicity prediction. Docking results revealed superior binding affinities for several phytochemicals: Saponin against NS1 (–13.49 kcal/mol), NS3 helicase (–14.12 kcal/mol) and NS5 (–16.36 kcal/mol). For NS2B–NS3 protease, Stigmast-5-en-3-ol (–12.27 kcal/mol), 1-Sitosterol (–12.18 kcal/mol) and 9-cis-Violaxanthin (–10.44 kcal/mol) demonstrated strong interactions. Against Glycoprotein E, Dicoumarol exhibited the highest binding affinity (–11.19 kcal/mol), followed by Flavanone (–9.62 kcal/mol), Terpin (–9.55 kcal/mol) and 9-cis-Violaxanthin (–9.50 kcal/mol). Based on binding affinity, ADMET characteristics, toxicity prediction and bioactivity, Flavanone, Dicoumarol and Terpin were identified as the most promising anti-dengue lead candidates. The study strongly supports “*Carica papaya*” phytochemicals as potential antiviral agents, requiring further validation through *in vitro* and *in vivo* experimental studies.

Keywords: Dengue virus (DENV), *Carica papaya*, Phytochemicals, Molecular docking, ADMET.

In-Silico unveiling of *Embilica officinalis* and *Curcuma zedoria* phytoconstituents targeting PTPN1 gene: A breakthrough computational framework for integrated management of Type 2 Diabetes and Oncogenic Diseases

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ABSTRACT

Type 2 diabetes mellitus (T2DM) is a major global health burden driven by lifestyle transitions, urbanization, and aging, and its management remains challenging due to adverse drug effects, resistance, and associated metabolic complications, including cancer. Protein tyrosine phosphatase non-receptor type 1 (PTPN1/PTP1B) is a key negative regulator of insulin signalling, promoting insulin resistance and chronic hyperglycaemia, and is also implicated in the progression of several cancers through dysregulated growth-factor signalling. Medicinal plants offer structurally diverse phytochemicals with multitarget metabolic and cytoprotective properties. This study employed an AI-assisted in silico drug discovery approach to evaluate phytoconstituents from *Embilica officinalis* and *Curcuma zedoria* against PTPN1. Molecular docking revealed ellagic acid and curcumin as the top-scoring ligands, exhibiting higher binding affinity than metformin. Molecular dynamics simulations confirmed stable protein–ligand interactions. These findings highlight the potential of computational phytochemical screening to identify safer, multitarget therapeutic candidates for T2DM and cancer management.

Keywords: molecular docking, natural compounds, diabetes, molecular dynamics simulation

Integrated in vitro and in silico evaluation of *Morinda tinctoria* phytochemicals reveals a benzofuroxan derivative targeting OmpC, OmpF, and HisC of MDR uropathogenic *Escherichia coli*

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ABSTRACT

The emergence of multidrug-resistant (MDR) uropathogenic *E. coli* has intensified the need for novel antimicrobial alternatives, emphasizing the quest for antimicrobial compounds from different unexplored medicinal plants. *Morinda tinctoria*, an unexplored medicinal plant sharing a phytoconstituent similarity with *Morinda citrifolia*, a widely known medicinal plant for its anti-bacterial, anti-inflammatory and antioxidant activity, remains unexplored for its potential against MDR urinary pathogens. Our objective is to identify the phytochemical profile of *Morinda tinctoria* leaves collected from Eastern India, and the

anti-MDR bacterial activity of clinically isolated *E. coli* strains through in vitro analysis and in silico molecular docking. The result revealed that methanolic and ethanolic extracts had the highest number of secondary metabolites as compared to other solvent extracts. Headspace GC-MS analysis identified 23,9 and 10 volatile and semi-volatile bioactive compounds in petroleum ether, acetone and methanolic extracts, respectively. Antibacterial assays showed that methanolic and acetone extracts exhibited the highest inhibition zones, with MIC values as low as 6.25 mg/ml and MBC values of 25 mg/ml against MDR strains. 24 selective phytochemicals, which is found common in 3 different solvent extracts, were docked against three essential *E. coli* proteins (HisC, OmpC, OmpF), revealing strong binding affinities, with 4-(N, N-dimethylaminomethyleneamino)-5,7-dinitrobenzofuroxane showing the most potent interaction (−6.4 to −6.5 kcal/mol). ADMET profiling confirmed drug-likeness for the majority of ligands. Overall, the study highlights *M. tinctoria* leaves as a promising source of antibacterial agents, supporting their potential application in the development of plant-based therapeutics against MDR uropathogenic *E. coli*.

Keywords: *Morinda tinctoria*, Phytochemical analysis, Anti-MDR, Uropathogenic, *Escherichia coli*
Phytochemical Profiling of *Embelia tsjeriam* Cottam with In Silico Evaluation of Phytoconstituents against multidrug-resistant *Pseudomonas aeruginosa*

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ABSTRACT

Embelia tsjeriam cottam is an endangered medicinal plant extensively used in traditional medicine for its anti-microbial, anti-inflammatory and therapeutic properties and contains embelin and a wide range of secondary metabolites as phytoconstituents. The present study aimed to investigate the phytochemical composition of *E. tsjeriam* Cottam leaf extracts and evaluate the anti-MDR potential of its bioactive compounds against *Pseudomonas aeruginosa* using an in-silico approach. The leaf extracts using different solvents such as petroleum ether, n-hexane, ethyl acetate, acetone, methanol, ethanol, and water revealed the presence of alkaloids, flavonoids, tannins, steroids, terpenoids, anthraquinone, glycosides and carbohydrates in varying concentrations upon phytochemical screening. Among these, the methanolic extract was further characterised, as it showed better result in preliminary qualitative phytoconstituent analysis, by gas chromatography- mass spectrometry (GCMS), which identified 35 bioactive constituents based on distinct peaks in the total ion chromatogram. The major phytoconstituents were docked against the target virulent proteins of *P. aeruginosa* to assess the inhibitory potential of the identified compounds. The interaction of 4-(N,N-dimethylaminomethyleneamino)-5,7-dinitrobenzofuroxane with protein CatB7, with binding affinity: −7.1 kcal/mol is the best among all. Irrespective of that, interaction of N₂N₂N₂, N₂-tetramethyl-4,6-bis(trifluoromethyl)-1,3,5,2λ⁵-triazaphosphinine-2,2-diamine with MexI protein and 4-(N,N-dimethylaminomethyleneamino)-5,7-dinitrobenzofuroxane with rsmA protein showed binding affinity of −6.9 kcal/mol and −5.1 kcal/mol, respectively. These strong binding interactions suggest the

potential inhibitory activity of *E. tsjeriam* cottam phytoconstituents against critical bacterial targets. Overall, the findings highlight *E. tsjeriam* cottam as a promising source of natural antibacterial agents and provide a foundation for further experimental validation against multidrug-resistant *P. aeruginosa*.

Keywords: *Embelia tsjeriam-cottam*, phytoconstituents, *P. aeruginosa*, anti-MDR evaluation

LINKING EUTROPHICATION TO THE GLOBAL PROLIFERATION OF CYANOBACTERIAL BLOOMS

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ABSTRACT

Cyanobacterial blooms are increasingly recognized as a critical threat to freshwater ecosystems, biodiversity and public health worldwide. Eutrophication, largely caused by excessive nutrient inputs from agricultural runoff, urban wastewater discharge, and industrial effluents, is widely recognized as a major driver of cyanobacterial blooms. Elevated nitrogen and phosphorus concentrations enhance bloom frequency, increase their intensity, and facilitate the expansion of harmful cyanobacteria across diverse freshwater ecosystems worldwide. This review synthesizes current knowledge on the mechanisms by which elevated nitrogen and phosphorus concentrations, in combination with environmental factors such as temperature, light availability and hydrological conditions, facilitate cyanobacterial dominance in aquatic ecosystems. Global case studies are analyzed to demonstrate regional variability in cyanobacterial bloom occurrence and to clarify how human-driven nutrient enrichment interacts with climatic factors such as temperature, precipitation and hydrological changes to influence bloom frequency, intensity and spatial distribution across diverse freshwater ecosystems. The review also evaluates monitoring strategies, predictive models, and management practices aimed at mitigating eutrophication-driven bloom events. By linking nutrient enrichment to the global proliferation of harmful cyanobacteria, this study provides a comprehensive and integrative assessment of the resultant ecological degradation, socio-economic impacts, and public health threats. It underscores the critical necessity for coordinated, evidence-based management strategies aimed at reducing nutrient loading, enhancing water governance, and safeguarding freshwater ecosystems to ensure long-term environmental resilience and human well-being.

Keywords: Cyanobacteria, environmental factors, Global case studies, Eutrophication

Curcumin Nano-Formulations as Natural Preservatives for Enhancing Food Safety and Shelf Life

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Food spoilage and contamination represent an enormous global issue impacting food safety, food security and causing agricultural and economic losses. Traditional preservation techniques used for preserving food (such as heat treatment, refrigeration, and synthetic additives) have been shown to reduce the nutritional value of preserved foods and cause concerns regarding the sustainability of food preservation; therefore, there is a need for more natural and effective options for preserving food. Curcumin is a polyphenolic compound sourced from the root of *Curcuma longa* L., which has exhibited strong antimicrobial, antioxidant and anti-inflammatory activities; thus, it has great potential as a natural food preservative. However, due to its poor solubility, instability, and low bioavailability (poor absorption in the body), curcumin cannot be used directly in foods. With continuing advances in nanotechnology, curcumin has now been formulated into a nano-structured product that increases its solubility and stability, and provides controlled release and enhanced efficacy in protecting food products. As a result of the many recent studies focusing on the use of curcumin in active, smart packaging, where nano-formulation will enhance shelf life and allow consumers to track the freshness of the product by pH-triggered colour changes. The overall benefits of using curcumin in nano-formulations for food preservation are improved microbial safety, improved oxidative stability and improved sensory characteristics of preserved foods and beverages. The benefits of using curcumin nano-formulation as a food preservative would provide a natural, versatile and environmentally friendly alternative to food preservatives that are of interest to clean label consumers.

Keywords: Shelf-life extension, Oxidative stability, Nanoencapsulation, Nanocurcumin.

Comparative GC–MS profiling and biological activities of leaf essential oils from *Syzygium schmidii* and *Syzygium salicifolium*, two endemic species of the Indian Subcontinent

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ABSTRACT

This study presents a comparative investigation of the chemical composition and biological activities of leaf essential oils obtained from *Syzygium schmidii* Rathakr. & N. C. Nair (SCLEO) and *Syzygium salicifolium* J. Graham. (SSLEO), two endemic species of the Indian subcontinent. Gas chromatography–mass spectrometry (GC–MS) analysis revealed sesquiterpene hydrocarbons as the predominant chemical class in both oils, comprising 60.55% of SCLEO and 80.60% of SSLEO. β -Caryophyllene (40.27%) was identified as the major constituent of SCLEO, whereas β -vetivenene (35.26%) dominated SSLEO. Both essential oils demonstrated strong antioxidant potential in DPPH, ABTS, and FRAP assays, with IC₅₀ values ranging from 7.51 $\pm$ 0.31 to 18.05 $\pm$ 0.82 μ g/mL. Antibacterial activity was assessed against four

Gram-positive and four Gram-negative bacterial strains. SCLEO exhibited the highest activity against *Bacillus cereus* based on the zone of inhibition (22.33 ± 0.47 mm) and against *Bacillus subtilis* in terms of minimum inhibitory concentration (MIC; $15.62 \mu\text{g/mL}$). SSLEO showed maximum sensitivity against *Bacillus cereus* in both zone of inhibition (23.54 ± 0.52 mm) and MIC assays ($15.62 \mu\text{g/mL}$). Evaluation of melanogenesis inhibition using mushroom tyrosinase indicated moderate anti-tyrosinase activity for SCLEO ($\text{IC}_{50} = 41.95 \pm 1.72 \mu\text{g/mL}$), while SSLEO exhibited stronger inhibitory activity with an IC_{50} value of $24.88 \pm 1.25 \mu\text{g/mL}$. Furthermore, both essential oils displayed significant cytotoxic effects in the MTT assay against human breast adenocarcinoma (MCF-7), human alveolar lung adenocarcinoma (A549), and normal human embryonic kidney (HEK-293) cell lines, with IC_{50} values ranging from 105.15 ± 4.41 to $458.79 \pm 18.81 \mu\text{g/mL}$. This study represents the first comprehensive evaluation of the bioactivities of *S. schmidii* and *S. salicifolium* leaf essential oils and highlights their potential as promising alternative sources for the development of novel herbal therapeutic agents.

Keywords: GC–MS profiling, *Syzygium schmidii*, *Syzygium salicifolium*, *Bacillus subtilis*, Leaf essential oil

Effect of Priming on Rice Plants infected with Biotrophic Pathogen

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ABSTRACT

Rice is an important cereal crop of world mainly cultivated in Asia, Latin America and Africa. Approximately 20-25 % of rice yield is reduced annually due to bacterial blight disease caused by a biotrophic pathogen named *Xanthomonas oryzae* pv. *oryzae* (*Xoo*). Bacterial blight mainly impairs the photosynthetic machinery of rice leaves. In the present study, the effect of priming with *Bacillus* spp. on the photosystem II function of *Xoo*-infected rice plants has been investigated by using Chl *a* fluorescence analysis. The bioprimered and *Xoo*-infected rice plants showed significant increase in grain yield, pigment content, reactive oxygen species scavenging enzymes activity, quantum yield and efficiency parameters. Notably, significant increase in maximal quantum yield of primary photochemistry of photosystem II (ϕP_0), quantum yield of electron transport flux from Q_A to Q_B of photosystem II (ϕE_0), maximum electron transport flux (further than Q_A^-) per photosystem II reaction center (at $t = 0$) (ET_0/RC) and photosynthetic performance index up to the reduction of photosystem I end acceptor (PI_{TOT}) have been observed. Conversely, significant decrease in disease severity (%), relative variable fluorescence at the phase J of the fluorescence induction curve (V_J) and approximate value of the initial slope of relative variable Chl fluorescence curve V_t (M_0), dissipation energy flux per photosystem II reaction center (DI_0/RC) and maximum trapped energy flux leading to Q_A reduction per reaction center (TR_0/RC) has been recorded. These results demonstrate the effectiveness of *Bacillus* spp. priming in inducing defense in rice plants challenged with *Xoo* by altering the photosystem II activity.

Keywords: Rice Plants, *Xanthomonas oryzae*, Chl *a* fluorescence analysis, *Bacillus* spp, photosystem II

Assembly and annotation of the chloroplast genome of *Asteracantha longifolia* (L.) Nees and its comparative analysis within the members of Acanthaceae

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Abstract

Asteracantha longifolia is a thorny, upright and sturdy herb that grows 2-5 feet tall belonging to family Acanthaceae. It is a predominant species distributed throughout tropical and subtropical environments, preferring the warm and humid climate. It holds significant value as a medicinal plant. Despite this, there is a lack of genetic and genomic research. Illumina and GetOrganelle v. 1.7.7.1 were used for the sequencing of entire cp DNA, and assembly of the organellar genome, respectively. The CpGAVAS2 and Chlorobox webserver were used to annotate the genome. MISA and REPUTOR online programs were employed to identify the repetitive sequences. For sequence divergence analysis, the Vista web server running the mVista function in Shuffle-LAGAN mode was used. Using the MAFFT online server, the chloroplast genomes of *Asteracantha longifolia* were compared with chloroplast genomes of 54 species belong to family Acanthaceae and a phylogenetic tree was established between them. IRScope online tools were used to analyse boundary shifts between quadripartite chloroplast genomic regions. Codon usage frequency and relative synonymous codon usage values were calculated and plotted using “ggplot” package of R programme. Assembly, annotation and analysis of the chloroplast genome of *Asteracantha longifolia* as well as its comparison with related species was performed. The assembled chloroplast genome has a length of 145475 bp with a typical quadripartite structure (LSC-IRA-SSC-IRB). The calculated GC content was 38.39%. A total of 131 genes were annotated – 87 protein coding genes, 36 tRNAs and 8 rRNAs. Amongst them, 15 duplicate genes and 21 splitting genes were present. 46 SSRs were identified alongside 25 tandem repeats. The phylogenetic relationship between *Hygrophila ringens* and *Asteracantha longifolia* was the closest. The analysis of sequence divergence between the chloroplast genomes of *Asteracantha longifolia*, *Hygrophila ringens*, *Strobilanthes cusia*, and *Andrographis paniculata* revealed a high degree of similarity. These findings can be of great potential for further diversity studies and genetic improvement of *A. longifolia*.

MINT (*Mentha spp.*) PRODUCTION USING DUTCH BUCKET BASED HYDROPONICS SYSTEM AS A SUSTAINABLE SOLUTION FOR URBAN POPULATION

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ABSTRACT

Mint (*Mentha spp.*) is a member of the Lamiaceae family of herbs. It thrives in conditions that are damp and somewhat shaded. Its antimicrobial qualities support dental health, improve respiratory health and digestive health. Due to its many health advantages, ease of cultivation in small spaces, low maintenance and high yield, mint production is crucial, particularly for urban populations. As it also improves air

quality, increases greenery and lowers carbon emissions. Dutch Bucket Hydroponic system (also called **Bato Bucket system**) is a soilless plant cultivation method that can be utilised when there is a lack of space and presence of challenging environmental condition that are mostly found in urban environments. Mint production can be increased in urban environments by using Dutch bucket hydroponic system. The Dutch bucket hydroponic system is considered sustainable as it uses water efficiently, recycles nutrients, reduces pesticide use, uses reusable materials like the buckets and media, prevents soil degradation, and enables high yield in small spaces with minimal environmental impact. In this setup, each plant is present in an individual bucket filled with soilless media that are perlite, vermiculite or coco-peat which safeguards the plant from soil borne diseases. A central reservoir supplies a nutrient solution maintained at pH 5.5-6.5 and EC (Electrical conductivity) 1.2 to 1.8 mS/cm, while a pump distributes the solution via drip emitter into the individual Dutch buckets separately. About 80% of the applied water is conserved as excess runoff returns to the central reservoir. This helps in optimal use of water and the nutrients. Since various media are being used in place of soil, the root zone is better aerated, which promotes vegetative growth. As a result, the mint's leaves expand quickly and its quality improves for additional medicinal advantages. This Dutch bucket hydroponic system can be easily installed on rooftops and balconies allowing urban people to produce fresh mint year round. Also, this system offers flexibility in scaling the size of the setup according to your choice. Compared to the conventional soil cultivation, the Dutch bucket system shortens the production cycle, lower water usage up to 80%, diminishes the need for pesticides and shows increased growth rate which supports both environmental sustainability and public health. By using this system mint can be easily accessible to the urban population in a sustainable way.

KEYWORDS: *Mentha* spp., Dutch-bucket hydroponic system, Soilless media, Year-round production, Environmental sustainability, public health.

Heal the Earth of Climate Change with *Azadirachta indica* (Neem)

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Abstract

Azadirachta indica, commonly called Neem in India, is one of the most ecologically valuable tree with immense medicinal value, and is native to tropical and subtropical regions in the country. Neem has good carbon sequestration power and will mitigate global warming and climate change. Neem is a fast-growing, evergreen species with a dense canopy and high biomass yield. Neem thrives in poor, dry, salty, or eroded soils and places where many other species fail. This makes it ideal for reforestation of degraded lands such as mine overburden dumps. Neem contributes to agroforestry and permaculture systems, helping farmers adapt to climate change. Benefits include, purified air, shade for crops and livestock, soil enrichment, windbreak formation, sustainable fodder and biomass. Neem trees improves ecosystem resilience in the face of climate shocks. Neem's canopy reduce evaporation from soil and provides cool microclimates. Forest of neem trees can thus control the increasing moisture content in air and south west monsoon winds, which is being caused due to global warming and climate change. Forest of Neem trees planted in plains i.e. North East India, will help regulate the moisture content of south west monsoon winds, which has vastly increased due to global warming. Forest of neem trees, by

decreasing the moisture content of south west monsoon winds, will save the Himalayas from any further environment disasters and tragedies in future due to climate change, such as very heavy rainfall leading to glacial lake outburst floods (GLOFs) which occurred in Kedarnath in 2013, Chamoli (2021), Sikkim (2023) and very recently in Dharali in August, 2025. Planting Neem trees where it ecologically belongs, while protecting native biodiversity, is a sustainable step towards healing our planet. While it cannot cure climate change alone, Neem *can* play a meaningful role in climate mitigation, ecological restoration, air purification by absorbing particulate matter from air, regulating monsoon rains in plains as well as in Himalayas, and environmental health especially in regions where it naturally thrives, i.e. in NE India plains, by controlling heatwaves in hot summers. The only one problem that is anticipated is air pollution due to release of huge amount of neem pollen in air, causing pollinosis, and related allergic diseases, and for that a strategy to deal with it, has to be developed. Neem trees can be grown in pots and kept indoors, inside homes, to purify the air, and this is sustainable living, and it enhances interior décor and grandeur, and which is being promoted through Mission LIFE.

Keywords: *Neem tree, Climate change, global warming, mitigation, ecorestoration, carbon sequestration, afforestation, degraded lands, air purification, particulate matter, heatwaves, South West monsoon rains, Himalayas, environmental disasters, pollinosis, sustainable living.*

Chemotypic diversity of *Anisomeles indica* leaf essential oil from Eastern India revealed by GC–MS and multivariate chemometric analysis

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ABSTRACT

The present study aims at exploring the chemical variability of leaf essential oils of *Anisomeles indica* (L.) Kuntze (Lamiaceae) from 4 phytogeographical regions of Eastern India by employing an integrated GC-MS analysis and chemometric resolution methods. Group-1: East coast plains and hill regions; Group-2: Eastern plateau and hill regions; Group-3: Lower Gangetic plain regions; and Group-4: Middle Gangetic plain regions, enjoying varying climatic and edaphic characteristics. *A. indica* leaf essential oil (AIL), yield varied in the range of 0.04% to 0.34% and a total of 88 constituents were identified in all 40 samples. GC-MS analysis of essential oils broadly classified these accessions into two major classes, which aligned with the hierarchical cluster analysis (HCA), revealing two chemotypes; one with dominance of phytol (35.07%) and hexahydrofarnesyl acetone (8.31%) and other was rich in abietatriene (51.36 %) and (2E,6E)-farnesyl acetate (10.55%). In PCA and PLS-DA analysis, the top five principal components (PCs) explained 94.6% and 94.2%, respectively. Similarly, the first two components in PLS-DA, PC1 and PC2, explained 81.2% and 3.6% of the total variations, respectively. The PCA score plot revealed moderate dispersion and partial overlap of Group-1 with others, reflecting the sharing of multiple constituents. Group-2 was separated along PC1, and while Groups-3 and -4 exhibited overlapping distributions along PC2, suggesting close compositional similarity. The PLS-DA score plot revealed a similar distribution pattern, but with more definite and distinct separation amongst *A. indica* accessions. The PCA and PLS-DA biplots further showed that Group-2 separation was primarily driven by abietatriene and (2E,6E)-farnesyl acetate, while the overlapping between Group-3 and Group-4 resulted from shared constituents of phytol and hexahydrofarnesyl acetone. Group-1 distribution

overlapped with multiple groups due to the presence of several common constituents, including abietatriene, phytol, (5E,9E)-farnesyl acetone, and caryophyllene oxide. The combined approach of GC-MS and chemometric analysis effectively explained the phytochemical variability among *A. indica* leaf accessions sampled across Eastern India, confirming the presence of two distinct chemotypes, one enriched in phytol and hexahydrofarnesyl acetone, and the other dominated by abietatriene and (2E,6E)-farnesyl acetate.

Keywords: *Anisomeles indica*, Chemometrics, Essential oil, GC-MS, PCA and PLS-DA

Structural Engineering of a Nuclear Apyrase Enhances Growth

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ABSTRACT

Apyrases (NTPDases) are conserved regulators of growth whose functions extend beyond nucleotide hydrolysis to transcriptional control. We previously showed that ectopic expression of psNTP9 (PS), a chromatin-associated apyrase from *Pisum sativum*, enhances phosphate (Pi) uptake and growth in yeast and *Arabidopsis thaliana*. Here, we introduce two targeted substitutions (S208L and P216R) within the DNA-binding domain of PS to generate a double mutant (DM) and assess the impact of altered protein–chromatin interactions. DM expression further increased growth, Pi accumulation, and seed yield in *Arabidopsis*, as well as growth in yeast, relative to PS. Both PS and DM localized to the nucleus and associated with chromatin; however, transcriptomic profiling revealed distinct transcriptional programs linked to Pi acquisition and growth. Consistent with these differences, ChIP-seq analyses showed that PS and DM bind largely non-overlapping chromatin regions, including promoters of differentially expressed genes. These findings demonstrate that subtle structural modification of a nuclear apyrase redirects chromatin targeting and transcriptional outputs, providing a mechanistic basis for enhanced nutrient acquisition and growth in eukaryotes.

Keywords: Apyrase, calmodulin, DNA-binding, phosphate, point mutation, seed yield

Enhancement of Crop Yield through Nano-fertilizer Application: Experimental Evidence from Indian Agricultural Crops

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ABSTRACT

Nano-fertilizers are gaining significant attention as efficient nutrient delivery systems for improving crop productivity under field and controlled experimental conditions. In the present experimental approach, nano-formulations of essential macro- and micronutrients were evaluated for their effects on growth, physiological performance, and yield of major Indian agricultural crops such as rice (*Oryza sativa*), wheat (*Triticum aestivum*), maize (*Zea mays*), and pulses including chickpea (*Cicer arietinum*). Nano-fertilizers were applied through soil and foliar treatments at different concentrations and compared with recommended doses of conventional fertilizers. Experimental observations revealed significant improvements in seed germination, root and shoot length, leaf area index, chlorophyll content, and photosynthetic efficiency in nano-fertilizer-treated plants. Enhanced nutrient uptake efficiency, particularly of nitrogen, phosphorus, zinc, and iron, was recorded, resulting in increased biomass accumulation and grain yield. In rice and wheat, nano-nitrogen and nano-zinc treatments showed improved tillering, grain filling, and yield attributes, while in pulses, enhanced nodulation and nitrogen fixation were observed. Yield improvements ranging from 10–25% were recorded under nano-fertilizer treatments compared to conventional fertilizer applications. Additionally, reduced nutrient losses through leaching and volatilization were observed, indicating improved fertilizer use efficiency and reduced environmental impact. The experimental results highlight the potential of nano-fertilizers as a sustainable input for Indian agriculture. However, long-term field trials and soil ecological studies are essential to assess their residual effects and biosafety. Overall, nano-fertilizers offer a promising strategy for increasing crop yield and ensuring sustainable agricultural productivity in India.

Keywords: Nano fertilizer, crops, nano-enzymes, silver nanoparticles, biosafety

Global Regulatory Guidelines for Quality Control of Herbal Products

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ABSTRACT

Herbal medicine has served as a cornerstone of healthcare systems worldwide, with its utilization experiencing substantial global expansion in recent decades due to minimal adverse effects and compatibility with human biological systems compared to synthetic allopathic drugs. However, this increasing demand necessitates rigorous standardization of quality control measures, formulation protocols, and product compliance standards across international markets. The World Health Organization has established comprehensive regulatory guidelines to assist member states in regulating

herbal medicines and ensuring their safety through scientifically validated methodologies. These guidelines address critical quality assurance parameters including the identity, potency, purity, and stability of both raw herbal materials and finished products. Particular emphasis is placed on the prevention, detection, and control of potential contaminants such as heavy metals, pesticide residues, microbial contamination, aflatoxins, residual solvents, and radioactive substances that may be introduced during cultivation, harvesting, processing, storage, and manufacturing stages. The framework recommends validated analytical techniques including microscopic examination, chromatographic fingerprinting, physicochemical evaluation, pharmacological assessment, and toxicological testing for comprehensive qualitative and quantitative analysis of phytochemical formulations. Furthermore, adherence to Good Agricultural and Collection Practices, Good Manufacturing Practices, and appropriate storage and distribution protocols is emphasized as essential for maintaining product consistency and therapeutic integrity. Standardization not only ensures the safety and reproducibility of herbal medicines but also promotes sustainable conservation of medicinal plant biodiversity. These guidelines provide a scientifically robust regulatory framework for harmonizing traditional herbal knowledge with modern pharmaceutical standards.

Keywords: Herbal Medicine, Quality Control, WHO Guidelines, Standardization, Phytochemical Analysis

A Review of sources, distribution, and adverse effects of Microplastics (MPs) on Plants

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ABSTRACT

Microplastic (MP) pollution is becoming a global issue because due to the resilience, long-term persistence, and robustness nature of these particles. Plastic manufacturing is anticipated to exceed 34 million metric tons per year by 2050, resulting in the extensive dissemination of microplastics in both terrestrial and aquatic environments. MPs, which are fewer than 5 mm in diameter, originate from a variety of sources, mainly from synthetic garments. These tiny particles have been detected in all the ecosystems on Earth. Present investigation summarizes the sources, transportation modes, distribution, and adverse effects of microplastics on plants. Microplastics enters the soil from sources such as the breakdown of plastic mulch films, application of sewage sludge or organic fertilizers containing plastic residues, and irrigation with MP contaminated water. These particles come in contact with plants and are absorbed into their tissues primarily through plant roots from contaminated soil. MP stress-induced decrease in plant physical development and is accompanied by two complimentary effects: (i) obstruction of pores in seed coat or roots, altering water and nutrient absorption, and (ii) induction of drought owing to increased soil cracking caused by MPs. Loss in physiological development caused by MP stress is accompanied by four complementing effects: (i) increased ROS generation, (ii) alterations in the leaf and root ionome, (iii) altered hormonal control, and (iv) a decrease in chlorophyll and photosynthesis. This review addresses critical knowledge gaps in how microplastics affect terrestrial plant development

Keywords: Microplastics, Sources, Distribution , Adverse, Effects, Plants

In vitro* Assessment of the bioactive compounds present in *Curcuma caesia

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ABSTRACT

Curcuma caesia Roxb. (Black turmeric), a medicinal plant belonging to the family Zingiberaceae, has been traditionally used in various indigenous systems of medicine for the treatment of inflammation, microbial infections, pain, and metabolic disorders. Despite its ethnomedicinal importance, systematic scientific validation of its bioactivity remains limited. The present study investigates the in vitro bioactivity of ethanolic rhizome extracts of *Curcuma caesia*, with emphasis on antioxidant activity supported by experimental observations and previously reported data. Qualitative phytochemical analysis of Ethanolic extract of *C. caesia* rhizomes, confirmed the presence of phenols, flavonoids, tannins, alkaloids, saponins, and glycosides, which are widely associated with pharmacological activities. These findings support earlier reports describing the phytochemical richness of Black turmeric and its potential therapeutic relevance. The antioxidant activity of the extract was evaluated using the DPPH (2,2-diphenyl-1-picrylhydrazyl) free radical scavenging assay. In addition, metal chelating activity was assessed to determine the ability of the extract to bind with pro-oxidant metal ions. The ethanolic extract exhibited notable ferrous ion chelating capacity, suggesting an additional antioxidant mechanism through the prevention of metal-catalyzed free radical formation. The combined results of DPPH and metal chelating assays indicate that *C. caesia* possesses multifaceted antioxidant properties. These findings provide scientific validation for its traditional medicinal use and highlight its potential as a natural source of bioactive compounds. Future investigation will be conducted to study the anti-inflammatory, antimicrobial, and antidiabetic potentiality of *C. caesia*. Additionally, Further studies involving compound isolation, mechanistic evaluation, and in vivo validation are required to fully explore its applications in pharmaceutical industries.

Keywords: *C.caesia*, In-Vitr, Bioactive compounds, Antioxidant activity, 2,2-diphenyl-1-picrylhydrazyl, metal chelating assays

***Curcuma caesia* vs. *Curcuma longa*: A Comparative Phytochemical analysis**

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ABSTRACT

For generations, people have utilized medicinal herbs to treat illnesses. Thousands of years before the documented scientific literature, sophisticated traditional medicine was founded on the usage of diverse herbs for treatment. A chemical compound that has a specific physiological effect on the human body is what gives plants their therapeutic worth. Current investigation presents a comparative phytochemical investigation of *Curcuma longa* L. (turmeric) and *Curcuma caesia* Roxb. (black turmeric), both of which are commercially and pharmacologically significant members of the Zingiberaceae family. For our experiment rhizomes of black turmeric plants were collected from Kandhamal district of Odisha, India.

Methanolic extracts of the rhizomes of black turmeric were subjected to qualitative phytochemical screening, Fourier Transform Infrared Spectroscopy (FTIR), and Gas Chromatography–Mass Spectrometric (GC–MS) analysis. Phytochemical evaluation revealed the presence of alkaloids, glycosides, saponins, and carbohydrates in both species, while phenolics and flavonoids were predominantly detected in *C. caesia*. FTIR spectra confirmed the occurrence of diverse functional groups including O–H, N–H, C=O, C=C, and C–O, indicating structural diversity of bioactive constituents. GC–MS profiling identified several pharmacologically significant compounds in *C. longa*, such as 9-tricosene (Z), 1-heptadecene, and 1-undecene, associated with antimicrobial, pesticidal, and industrial applications. In contrast, *C. caesia* exhibited bioactive molecules including oleic acid, octanol, and sulfur-containing compounds, known for anti-inflammatory, antioxidant, and antimicrobial properties. Notably, *C. caesia* demonstrated a richer secondary metabolite profile, suggesting superior medicinal efficacy. The findings highlight the biochemical diversity and therapeutic relevance of both species and support their potential utilization in pharmaceutical, nutraceutical, and functional food industries. This comparative analysis contributes to value addition, conservation, and evidence-based utilization of indigenous medicinal plants.

Keywords: Comparative; Phytochemical; Investigation; *Curcuma longa* L. (turmeric); *Curcuma caesia* Roxb.

Evaluating Forest Ecosystem Structure from Space: A Landscape-Scale Perspective

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ABSTRACT

Forest ecosystems represent complex ecological communities where distribution of species determine ecosystem functioning. Climatic conditions, topographic, edaphic and anthropogenic factors are collectively influencing the species composition resulting distinct structural pattern across the forest ecosystem. Forest ecosystem supports diverse communities, where diverse communities have species with different functional roles, which can efficiently control ecosystem processes. A key aspect of understanding the community structure is the vertical stratification of the forest by analyzing tree height class distribution which results the regeneration status of the forest. Forest community studies are largely based on plot-level field observations, which provides detailed information but assessment at broader level through ground data is critical. The study emphasizes the importance of landscape-scale perspectives in forest community ecology and demonstrates the potential of satellite-derived information as a supportive tool in community structure analysis. Satellite observations do not directly identify species composition; they provide critical information that enhances the assessment of forest community structure across scales. At the landscape scale, spatial metrics derived from satellite data reveal variations in forest patchiness and structural organization, which are the key component in community ecology. A remote sensing-based analysis in Sonitpur and Udalguri district of Assam resulted a forest cover loss of 7.47% (1990 - 2000) and 7.11% (2000 - 2010), followed by a slight gain of 2.34% during 2010 to 2020. The ecological evaluation of community structure will help to track changes in species distribution under climate variability and anthropogenic activities. It provides a strong foundation for long-term forest restoration strategies, biodiversity conservation and forest management aimed at mitigating global climate

change. Long-term monitoring of tree communities can contribute to the prediction of ecosystem responses to rapid environmental changes.

Keywords: Community, Species composition, Remote sensing, Vertical stratification, Spatial metrics

Analysis of cinnamaldehyde and eugenol from cinnamon extract using HPTLC technique

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Abstract

The polarity of the mobile phase plays a critical role in the chromatographic separation and fingerprinting of phytochemicals. In this study, high-performance thin-layer chromatography (HPTLC) was employed to investigate the impact of mobile-phase polarity on the separation of phytochemicals extracted from cinnamon bark and leaf (*Cinnamomum verum*). Different solvent systems with varying polarities were assessed to enhance the resolution and visibility of distinct chemical profiles in cinnamon extracts obtained through solvents of different polarities. Results showed that the polarity of the mobile phase significantly affected the migration behaviour of different compounds, with more polar solvents providing better separation of hydrophilic compounds, while non-polar phases enhanced the separation of lipophilic constituents. The optimized solvent system yielded well-defined and reproducible fingerprints, providing a reliable method for identifying the key phytochemicals. This study highlights the importance of selecting an appropriate mobile phase polarity for HPTLC fingerprinting, thereby facilitating the accurate identification of bioactive components for use in nutraceutical and pharmaceutical formulations. Numerous analytical methods have been reported for quantifying cinnamaldehyde (CCHO) and eugenol (EOH) in plant extracts and herbal formulations, whether assessed individually or in combination. However, reports on eco-friendly or green analytical approaches for estimating CCHO and EOH—either separately or in combination—remain limited in the existing literature. The hexane/ethyl acetate (9:1 and 8:2 v/v) was used for mobile phase for the estimation of cinnamaldehyde and eugenol respectively. The detection wavelength for cinnamaldehyde is 292nm and for eugenol is 280nm.

Keywords: HPTLC, solvent polarity, phytochemicals, cinnamaldehyde, eugenol, mobile phase

Circular Bioresource Management: Coupling Microalgal Cultivation with Aquaculture Wastewater Remediation

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ABSTRACT

Aquaculture produces nutrient-rich wastewater that, if released untreated, can lead to eutrophication. However, its high nutrient content offers a chance for resource recovery through microalgal cultivation.

This study assessed the feasibility of utilizing aquaculture wastewater as a nutrient source for sustainable microalgal biomass production and bioremediation. Microalgal samples were collected from local aquaculture ponds in Dhenkanal, Odisha, India, and the dominant strains were identified and confirmed through thorough examination. The selected isolates were cultivated in photobioreactors containing axenic aquaculture waste water under controlled laboratory conditions (26 ± 2 °C, 16:8 h light–dark cycle subsequently changed to 12:12 h light–dark cycle, and $180 \mu\text{mol m}^{-2} \text{s}^{-1}$ light intensity). The growth rate, nutrient removal efficiency, and biochemical composition of biomass were analyzed. *Scenedesmus* and *Selenastrum* were chosen for their significance and subjected to further examination. The concentrations of total nitrogen and total phosphorus in the wastewater were significantly reduced by 90% and over 95%, respectively. The following parameters of the algae species were investigated: specific growth rate, biomass yield, and lipid content. The research demonstrated that the nutrients present in aquaculture waste water are ideal for cultivating algal biomass for biodiesel production. aquaculture waste water serves as a cost-effective and nutrient-dense medium for growing microalgae, providing opportunities for both wastewater treatment and biomass production. Incorporating microalgal bioremediation into aquaculture systems enhances sustainable and circular bioresource management.

Keywords: Microalgae, Bioremediation, Biomass production, Biofuel potential, Nutrient recovery

Decoding Pathogenesis-Related Proteins: Functional Genomic Insights into Plant Defense Responses under Biotic Stress

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ABSTRACT

Plants are constantly exposed to diverse biotic stresses caused by bacteria, fungi, viruses, nematodes, and insects, and to overcome these challenges they have developed a sophisticated innate immune system in which Pathogenesis-Related (PR) proteins play a central role. PR proteins are a diverse group of defense-associated proteins induced during pathogen attack and contribute to both localized defense and systemic acquired resistance (SAR). This review focuses on the molecular mechanisms responsible for PR protein activation and their functional genomic characterization during plant–pathogen interactions under biotic stress conditions. PR proteins are grouped into multiple families (PR-1 to PR-17) based on their structure, subcellular localization, and biological roles such as antimicrobial action, strengthening of the cell wall, signal transduction, and programmed cell death. Their expression is regulated through complex defense signaling pathways involving salicylic acid, jasmonic acid, and ethylene, which coordinate immune responses depending on the nature of infection. With the rapid progress in functional genomics tools including transcriptomics, proteomics, and genome-wide association studies, significant advances have been made in understanding PR gene regulation, expression patterns, and functional diversification during pathogen invasion. Recent research using RNA sequencing, gene knockout studies, and overexpression experiments has demonstrated that PR proteins strongly influence host resistance or susceptibility, while their cross-talk with other defense-related genes further refines immune signaling to combat a wide range of pathogens. Overall, exploring the molecular and genomic regulation of PR proteins provides deeper

insights into plant defense responses and supports the development of disease-resistant crop varieties through molecular breeding and genetic engineering.

Keywords: Pathogenesis-Related proteins, Plant immunity, Biotic stress, Plant–pathogen interaction, Functional genomics

Assembly and annotation of the chloroplast genome of *Clitoria ternatea* single blue and single white and its comparative analysis within the members of Fabaceae.

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ABSTRACT

Clitoria ternatea is a perennial, twining herbaceous plant belonging to the family Fabaceae, widely cultivated in tropical and subtropical regions. The species is well known for its medicinal, ornamental, and nutritional importance, with distinct floral colour variants such as single blue and single white forms. Despite its economic and ethnopharmacological relevance, comprehensive information on the chloroplast genome of these variants and their comparative genomic relationships within Fabaceae remains limited. In the present study, high-throughput sequencing was performed using the Illumina platform, and the chloroplast genome was assembled using GetOrganelle (v1.7.7.1). Genome annotation was carried out through the CpGAVAS2 and Chlorobox web servers. Repetitive elements, including simple sequence repeats and tandem repeats, were identified using the MISA and REPuter programs, respectively. Comparative sequence divergence analysis was conducted using the mVISTA tool in Shuffle-LAGAN mode. Chloroplast genomes of *C. ternatea* were compared with those of 133 representative species from the family Fabaceae following multiple sequence alignment using MAFFT, and a phylogenetic tree was reconstructed. Boundary variation among quadripartite regions was examined using IRscope. Codon usage patterns and relative synonymous codon usage were computed and visualized using the ggplot package in R. The assembled chloroplast genome of *C. ternatea* single blue was 151687 bp and *C. ternatea* single white was 151697 bp in length and exhibited the canonical quadripartite organization comprising large single-copy, small single-copy, and two inverted repeat regions. The overall GC content was 34.55% and 34.55% for single blue and single white respectively. A total of 125 genes were annotated, including 59 protein-coding genes, 37 transfer RNAs, and eight ribosomal RNAs. Among these, 18 genes were duplicated and 18 contained introns. Additionally, 83 and 87 simple sequence repeats and 44 and 45 tandem repeats were detected. Phylogenetic analysis indicated a close evolutionary relationship between *C. ternatea* and *Erythrina sandwicensis*. These results provide a valuable genomic resource for future studies on genetic diversity and improvement of *C. ternatea*.

Keywords: *Clitoria ternatea*, Chloroplast Genome, Gene Annotation, Repetitive sequence

Targeting the Metabolic-Oncogenic Axis Using Coffee Phytochemicals: A Multi-Pathway Perspective

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ABSTRACT

The metabolic–oncogenic axis represents a critical interface where dysregulated metabolic pathways converge with oncogenic signaling to drive cancer initiation, progression, and therapeutic resistance. Metabolic disorders such as hyperlipidemia are increasingly recognized as key contributors to this axis, particularly through altered lipid signaling, chronic inflammation, and oxidative stress. Earlier common gene signature analysis revealed that 80% of lipid regulating-genes overlapped with cancer pathways, more significantly with liver and breast cancer. As per WHO statistics, breast cancer has been reported as the leading contributor to the increasing surge of cancer world-wide and limitations in current synthetic mediations necessitate exploration of safer, cost-effective natural products as an alternative therapeutics. This study aims to explore the potential of Koraput Coffee phytochemicals in modulating hyperlipidemia and breast cancer-related molecular networks. Identified coffee compounds through LC-HRMS were mapped to predicted protein targets using Swiss-Target Prediction. Hyperlipidemia and breast cancer genes were extracted from DisGeNET and Genecard. The shared gene set was analyzed using STRING-based PPI networks, Cytoscape, and KEGG/GO enrichment. Key overlapping targets included **AKT1, PIK3CA, EGFR, PPARG, HMGCR, and SREBF1**, reflecting cross-talk between lipid metabolism and oncogenic signalling. Enrichment revealed involvement of PI3K–AKT signalling, endocrine resistance, cholesterol biosynthesis, inflammation, and oxidative stress modules. Majorly polyphenols, alkaloids and diterpenes were found to be the most influential compounds. Therefore, Koraput coffee phytochemicals might act on both metabolic dysregulation and breast cancer progression, supporting their potential as dual-functional agents for addressing hyperlipidemia-associated breast carcinogenesis. However, both *In-vitro* and *In-vivo* experiments are essential to validate these computational predictions and explore their feasibility in developing these natural compounds into drugs.

Keywords: *Coffea arabica*, Koraput, CETP, *In-silico*, Hyperlipidemia

Meta-Analysis of Herbal Interventions for Managing PCOS

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Abstract

Polycystic Ovary Syndrome (PCOS) is a complex endocrine and metabolic condition defined by hyperandrogenism, ovulatory failure, and the presence of polycystic ovarian morphology. It impacts a significant percentage of women of reproductive age and has extensive effects on reproductive function, metabolic equilibrium, and psychological health. In addition to reproductive issues like menstrual irregularities, anovulation, and infertility, PCOS is commonly linked to insulin resistance, hyperglycemia, obesity, dyslipidemia, chronic low-grade inflammation, oxidative stress, and a heightened vulnerability to mood disorders, anxiety, and stress. The interrelated pathophysiological pathways underscore the complexity of the condition and the inadequacies of single-target treatment strategies. Traditional

management approaches for PCOS predominantly include symptomatic alleviation by hormonal modulation, insulin sensitizers, and lifestyle alterations. However, these treatments frequently neglect the fundamental metabolic and inflammatory abnormalities and may be linked to negative effects with prolonged use. As a result, there has been increasing scientific interest in botanical and plant-derived therapies that have multi-targeted therapeutic potential with enhanced tolerability. This study presents a thorough meta-analysis of medicinal plants historically employed in the treatment of PCOS. Data from clinical and preclinical studies were systematically compiled and analysed to evaluate the effects of these herbal interventions on critical PCOS-related outcomes, including menstrual cyclicity, ovulatory function, hormonal dysregulation, insulin resistance, glycemic control, adiposity, lipid metabolism, inflammatory mediators, oxidative stress markers, and psychological parameters. The meta-analysis data indicate that several plant extracts significantly enhance serum insulin sensitivity, normalize the LH/FSH ratio, decrease circulating testosterone levels, and restore monthly regularity. Moreover, herbs abundant in antioxidant and anti-inflammatory phytochemicals were linked to significant decreases in inflammatory biomarkers and oxidative stress, which are pivotal to the pathogenesis of PCOS. Despite the variety among the included studies regarding study design, dose, duration, and outcome measures, the cumulative evidence endorses the therapeutic potential of plant-based therapies as supplemental or adjunctive techniques in the therapy of PCOS. yet meticulously prepared, standardized, and extensive clinical trials are needed to determine optimal dose regimens, long-term safety, and sustained efficacy of these herbal formulations prior to their wider clinical integration.

Keywords: Polycystic ovary syndrome (PCOS), Hypothalamic-pituitary-ovarian axis (HPO axis), Insulin resistance (IR), Sex hormone-binding globulin (SHBG), Anti-Mullerian hormone (AMH)

Phytochemical Profiling and Antimicrobial Potential of *Globba orixensis* Roxb. Leaf extracts using Successive Solvent Extraction

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Abstract

Phyto-based remedies remain a mainstay of conventional medicinal systems and are increasingly recognised in modern alternative therapies for their promising efficacy and lower toxicity. *Globba orixensis* Roxb. is an erect, mildly aromatic, perennial herb belonging to the family Zingiberaceae, commonly distributed in the tropical and subtropical regions of South Asia, and is traditionally used to treat respiratory, skin, and digestive afflictions. The present study intended to explore the phytochemical profile and antimicrobial activity of *Globba orixensis* Roxb. Leaf extracts against selected microbes and to ascertain phytochemicals with potent antimicrobial properties. Leaves were subjected to successive solvent extraction using nonpolar to polar solvents. Antimicrobial activity was evaluated against

Staphylococcus aureus, *Pseudomonas aeruginosa*, *Vibrio cholerae*, and *Candida albicans* using a disc diffusion assay, followed by determination of minimum inhibitory concentration and minimum bactericidal/fungicidal concentration (MBC/MFC). Phytochemical profiling was accomplished using both qualitative and quantitative analyses, encompassing GC-MS and FTIR spectroscopy. Qualitative phytochemical analysis of leaf extracts revealed the presence of primary metabolites and several secondary metabolites, including terpenoids, Phenolics, flavonoids, Steroids, saponins, etc. GC-MS analysis identified 159 bioactive compounds, including 45 in n-hexane, 57 in acetone, and 57 in methanol extracts. FT-IR spectroscopy revealed functional groups corresponding to Hydroxyl Groups (–OH), Carbonyl Groups (C=O), Aliphatic C–H Groups, and Aromatic Rings (C=C). Among the tested extracts, acetone and methanol extracts demonstrated strong antimicrobial activity, with conspicuous zones of inhibition. This finding unearths the potential bioactive role of *Globba orixensis* Roxb. and highlights it as a source of natural antimicrobial agents.

Keywords: *Globba orixensis* Roxb, Antimicrobial activities, GC-MS, FTIR

Nutritional composition of two wild varieties seeds of *Nelumbo nucifera* Gaertn. from Khordha districts

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Abstract

Nelumbo nucifera Gaertn. is commonly called as ‘Sacred Lotus’ belonging to the family Nelumbonaceae, an aquatic ornamental plant and is the National flower of India, having spiritual, cultural significance and is bestowed with many therapeutic and nutritional values. This plant is a recognised plant in ancient medical sciences and each parts of the plant are known for the nutritional and medicinal values. Tuber, seeds, lotus stem are used as food supplements for its nutritional content. Lotus seeds are enriched with macro and micronutrients, carbohydrates, proteins and vitamins especially Vitamin B complexes including minerals and therefore used in various culinary preparations. Lotus seeds, the oldest known plant seeds, bestowed with many potent phyto-constituents and are commonly used as food and medicine. In the present studies, the nutritional composition of seeds of two varieties of lotus plant were analysed using XRF spectroscopy. The enriched mineral composition of both the varieties are estimated and could be added as important dietary ingredients.

Keywords: Lotus, *Nelumbo nucifera*, nutritional composition, seeds

Morphological variations of some exotic varieties of *Nelumbo nucifera* Gaertn.

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Abstract

Nelumbo nucifera Gaertn. is commonly called as 'Sacred Lotus' belonging to the family Nelumbonaceae, an aquatic ornamental plant and is the National flower of India. *N. nucifera* exhibits wide morphological diversity, particularly among exotic varieties introduced into new agro-climatic regions. The present study aims to document and compare the morphological variations among selected exotic cultivars of *N. nucifera* grown under uniform environmental conditions. Detailed observations were recorded on vegetative and reproductive traits, including rhizome characteristics, leaf size and shape, petiole length, flower colour, flower diameter, number of petals, receptacle form, and seed morphology. Considerable variation was observed among the varieties with respect to plant height, leaf lamina diameter, waxiness of leaf surface, and pigmentation of floral parts. Floral traits showed the highest degree of diversity, especially in petal arrangement, colour intensity, and flower longevity, indicating strong genetic influence. Some varieties exhibited compact growth with smaller flowers, while others showed vigorous growth and large, multi-petalled blooms. The observed morphological differences highlight the adaptability and ornamental potential of exotic *N. nucifera* varieties under local conditions. These findings contribute to better characterization of lotus germplasm and can support future efforts in conservation, breeding programmes, and selection of suitable varieties for ornamental, medicinal, and ecological applications.

Keywords: Flowers, morphological variations, *Nelumbo nucifera*, pigmentation, varieties

Therapeutic values of seeds of different varieties of *Nelumbo nucifera* Gaertn.

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Abstract

Nelumbo nucifera Gaertn. (sacred lotus) is an aquatic medicinal plant widely valued in traditional systems of medicine, particularly for the therapeutic potential of its seeds. Seeds from different varieties of *N. nucifera* exhibit remarkable variation in their phytochemical composition, which contributes to diverse pharmacological activities. Lotus seeds are rich in bioactive compounds such as alkaloids (liensinine, isoliensinine, neferine), flavonoids, phenolic acids, proteins, polysaccharides, and essential minerals. These constituents are responsible for multiple therapeutic properties, including antioxidant, anti-inflammatory, antidiabetic, cardioprotective, neuroprotective, hepatoprotective, and immunomodulatory effects. Comparative studies among white, pink, and exotic cultivated varieties indicate significant differences in antioxidant capacity, total phenolic content, and alkaloid profiles, suggesting varietal influence on medicinal efficacy. Traditionally, lotus seeds have been used to manage gastrointestinal

disorders, insomnia, diarrhea, reproductive health issues, and metabolic imbalances. Recent scientific investigations further validate their role in regulating blood glucose levels, improving lipid metabolism, reducing oxidative stress, and protecting against age-related neurological disorders. Additionally, seed polysaccharides have shown promising prebiotic and anti-aging properties. The therapeutic versatility of *N. nucifera* seeds, coupled with varietal diversity, highlights their potential as a natural source for functional foods and phytopharmaceutical development. Systematic evaluation of different varieties is essential to identify superior genotypes with enhanced therapeutic value, supporting their sustainable utilization in modern medicine and nutraceutical applications.

Keywords: Lotus, *Nelumbo nucifera*, nutritional composition, seeds, therapeutic value

Therapeutic properties and nutritional values of different varieties of *Nelumbo nucifera* Gaertn.

Stems and tubers

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Abstract

Nelumbo nucifera Gaertn. (sacred lotus) is an important aquatic plant valued for its nutritional and therapeutic significance, particularly its edible stems and underground tubers (rhizomes). Different varieties of *N. nucifera* exhibit considerable variation in nutrient composition and bioactive constituents, influencing their health-promoting properties. Lotus stems and tubers are rich in carbohydrates, dietary fiber, vitamins (notably vitamin C and B-complex), and essential minerals such as potassium, calcium, iron, and phosphorus. They also contain bioactive compounds including flavonoids, phenolic acids, tannins, and alkaloids, which contribute to their pharmacological potential. Scientific studies have demonstrated that extracts from lotus stems and tubers possess antioxidant, anti-inflammatory, antimicrobial, antidiabetic, and cardioprotective activities. High fiber content supports digestive health and glycemic control, while potassium-rich tubers aid in maintaining cardiovascular function and electrolyte balance. Varietal differences significantly affect starch quality, mineral accumulation, and antioxidant capacity, suggesting that genetic diversity plays a key role in determining nutritional and therapeutic efficacy. Traditionally, lotus stems and tubers have been used to manage digestive disorders, fever, bleeding conditions, and metabolic ailments. Contemporary research further supports their role in reducing oxidative stress, enhancing immunity, and improving lipid metabolism. The combined nutritional richness and therapeutic potential of *N. nucifera* stems and tubers highlight their value as functional foods. Systematic evaluation of different varieties is essential for identifying nutritionally superior and therapeutically potent genotypes, thereby promoting their sustainable utilization in food, nutraceutical, and medicinal applications.

Keywords: Antioxidant properties, lotus, *Nelumbo nucifera*, stem, therapeutic value, tuber

Beyond the waste: Crosstalk between Photorespiration and Submergence

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Abstract

Hypoxia is a major abiotic stress that plants experience during submergence, flooding, and various developmental stages such as seed development, apical meristem maintenance, stem cell homeostasis, lateral root development etc. Prolonged hypoxia due to submergence severely affects energy metabolism causes cell death. To cope with these adverse consequences of hypoxia, plants have adapted to alter various morphological and metabolic features such as hyponasty, aerenchyma development, shoot elongation, adventitious root formation, anaerobic respiration, sucrose metabolism and generation of ROS and nitric oxide (NO). Hypoxia induced nitric oxide production, plays a crucial for metabolic reprogramming and morphological adaptation where, nitrate reductase and mitochondrial electron transport chain play role. The operation of these pathways for NO production requires NADH. Earlier photorespiration is considered as waste mechanism. However, the potential role of photorespiration in hypoxia tolerance was not yet discovered. Glycine Decarboxylase P-Protein (GLDP) photorespiration protein play role in energy metabolism via generation of NADH. In this study, we discovered that *GLDP1* positively regulates hypoxia tolerance by modulation of nitric oxide metabolism in *Arabidopsis thaliana*. In hypoxia tolerance assay, the *gldp1* T-DNA mutant showed lower survival to hypoxia stress, whereas overexpression of GLDP1(*GLDP1-OE*) enhanced survival. The hyponasty response of *gldp1* mutant was significantly reduced in comparison to WT and more elevated in *GLDP1-OE* lines. In agreement with this observation, nitric oxide measurement by DAF-FM and chemiluminescence of *gldp1* mutant, *GLDP1-OE* and WT demonstrated decreased NO production in *gldp1* mutant compared to WT, where *GLDP1-OE* slightly enhanced NO production. Interestingly, NR and *Pgb1* activity was reduced in the *gldp1* mutant compared to WT, and treatment of NADH fully restored both NR and *Pgb1* activity. Furthermore, the hypoxia tolerant phenotype of *gldp1* was rescued in *gldp1/35S:GLDP1* complement lines. In order to validate the interlinked role *Pgb1* and *GLDP1* in hypoxia tolerance, we generated transgenic co-overexpression line (*Pgb-OE^XGLPD-OE*) of *Pgb1* and GLDP1. Hypoxia tolerance assay suggested *Pgb-OE^XGLPD-OE* lines survived better than *GLDP1-OE* line. Thus, we have uncovered the functional role of the photorespiratory enzyme *GLDP1* in hypoxia tolerance by modulating *Pgb*-NO cycle mediated energy metabolism in *Arabidopsis*.

Keywords: GLDP1, *Pgb*-NO, NADH, Hyponasty, Hypoxia

Computational Profiling of selected *Aegle marmelos* Phytochemicals for Diabetes

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Abstract

Diabetes prevalence escalates globally, urging novel therapies beyond synthetic drugs with side effects. *Aegle marmelos* rich in alkaloids, flavonoids, and coumarins, shows hypoglycemic effects in preclinical models via enzyme inhibition and antioxidant action. This computational study profiles its

phytochemicals against antidiabetic targets for lead identification. *Aegle marmelos* (Bael), a well-known medicinal plant in traditional Ayurveda and folk medicine, has emerged as a promising candidate for natural wound-healing formulations owing to its rich phytochemical composition and diverse pharmacological properties. Phytochemical investigations reveal that *A. marmelos* contains a variety of bioactive constituents including flavonoids, tannins, phenolic acids, alkaloids, and essential oils which are very much helpful to wound healing. In the present study ten numbers of phytochemical constituents such as α -Pinocarvone, 2-(4-Methylphenyl) propan-2-ol, Aegeline, Myrtenol, Carotol from IMPPAT were chosen by help of literature review. These compounds contribute synergistically to its antioxidant, anti-inflammatory, antimicrobial, and collagen-modulating activities, all of which are essential for effective wound healing. An in silico investigation was carried out for establishing the efficacy of phytoconstituents through docking and drug likeness properties of the small molecules were studied through Swiss ADME. 4KDS was taken for the study of docking. Basically, The BOILED-Egg, iLOGP and Bioavailability Radar were estimated to find out the best small molecule which can be evolved as a lead molecule for treating the disease. Among the immunological markers involved in its pathogenesis are protein antibody (Nrf2) which is play the crucial role in signalling. The docking study revealed that Aegeline showed the highest docking result of -5.03 Kcal/ Mol. which shows a close affinity with selected protein followed by Carotol -4.9 Kcal/Mol. However, 2-(4-Methylphenyl) propan-2-ol depicted a result of -1.4 Kcal/Mol. which infers that the small molecule has very less attraction towards the protein and cannot be selected as a novel compound. Pinocarvone value of 1.98. Future research is needed to establish its efficacy in human wound-care applications and to promote its integration into modern herbal therapeutics.

Keywords: Wound Healing, *Aegle marmelos*, Insilico, Docking, 4KDS, Swiss ADME

GC–MS Derived Phytochemicals from *Cynodon dactylon* Against TNF- α for Arthritis: An in-silico Study

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Abstract

Arthritis encompasses a diverse group of chronic inflammatory and degenerative joint disorders, with rheumatoid arthritis (RA) being one of the most debilitating forms. Among the key immunological markers involved in RA pathogenesis are **anti-citrullinated protein antibodies (TNF- α)**, which target citrullinated collagen and play a crucial role in inflammatory signaling and joint degradation. The **Anti-citrullinated Collagen Type II Antibody (TNF- α)** is particularly significant, as its binding to modified collagen triggers inflammatory cascades that accelerate cartilage deterioration. Plant-derived phytoconstituents, known for their anti-inflammatory, antioxidant, and immunomodulatory properties, have gained attention as potential anti-arthritic agents. In this study, seven phytochemical ligands were from *Cynodon dactylon* by the help of GCMS data. Molecular docking against the **TNF- α antibody (PDB ID:1TNF)** followed by extensive in silico ADMET profiling were carried out to test for druggability of the ligands. Docking analysis revealed that **PubChem CID 12308619 (-7.60 kcal/mol)** and **CID 638014 (-6.01 kcal/mol)** exhibited the strongest binding affinities toward TNF-alpha,

suggesting stable interactions capable of inhibiting antibody binding or modulating downstream inflammatory events. Other compounds CID 7362, CID 8468, and CID 135 showed moderate affinities ranging from -5.60 to -4.22 kcal/mol, indicating potential supportive roles in attenuating TNF-alpha-mediated inflammatory responses. ADMET predictions further enhanced the therapeutic potential of several ligands. Most compounds showed high intestinal absorption (64–98%) and acceptable Caco-2 permeability, indicating good oral bioavailability. The absence of AMES toxicity, hepatotoxicity, and hERG inhibition in compounds such as **CID 638014**, **CID 445858**, and **CID 445858** validated their safety and reduced cardio toxic potential. The majority of ligands demonstrated minimal inhibitory effects on major CYP450 iso enzymes, suggesting a lower likelihood of metabolic drug–drug interactions. In addition, ecological toxicity indicators such as *T. pyriformis* and minnow toxicity were low for most compounds, highlighting their environmental compatibility. Among all screened phytoconstituents, **CID 445858** and **CID 10742** emerged as the most promising anti-arthritic candidates, showing strong affinity for TNF-alpha coupled with favorable pharmacokinetic and toxicity profiles.

Keywords: *Cynodon dactylon*, TNF- α , Rheumatoid Arthritis, Phytoconstituents, ADMET Profiling

Antibacterial and In Silico COX-2 Inhibitory Evaluation of *Azadirachta indica* Leaf Phytoconstituents

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Abstract

Plant derived phytoconstituents having an increasing prevalence to production of novel multifunctional medicines due to its excellent antimicrobial resistance along with healing of long-term inflammatory disorders. The aim of our study determines the potential antimicrobial activity of *Azadirachta indica* methanolic leaf extract against *Escherichia coli* and *Staphylococcus aureus*. Additionally, the anti-inflammatory activities profiling study was carried out by using molecular docking using the active ligands through the help of literature review against inflammatory enzyme cyclo-oxygenase-2(COX-2, PDB ID:5IKR). There is a clear zone of inhibition were observed in triplicate assays, demonstrating significance antimicrobial activity i.e. a 15 ± 0.6 mm zone of inhibition (ZOI) for *E. coli* at 100 μ L concentration, whereas *S. aureus* exhibited 18 ± 0.7 mm at 100 μ L dosage and 14 ± 0.5 mm at 50 μ L concentration determine a potential inhibition activity against both Gram-negative and Gram-positive bacteria. Small molecules were downloaded from IMPPAT database. Out of the nine selected hit molecule Vilasinin shows the highest binding affinity (-9.0 kcal/mol) towards the COX-2 (5IKR). Similarly, Azadirachtin shows (-8.1 kcal/mol), Beta-Elementene (-7.8 kcal/mol), Beta-Sitosterol (-7.5 kcal/mol), Humulene (-7.3 kcal/mol) and Nicotiflorin (-7.4 kcal/mol) which exhibit good binding affinity towards COX-2 (5IKR), while others show a moderate affinity towards COX-2 (5IKR) i.e. Quercitrin and Rutin (-6.8 kcal/mol). These findings imply beneficial interactions between the phytoconstituents towards inflammatory target. These results support further research into purification, mechanism elucidation, and development of neem-based agents with dual antimicrobial and anti-inflammatory activities.

Key words: *Azadirachta indica*, antibacterial activity, COX-2 (5IKR), molecular docking, anti-inflammatory activity

Fabaceae-Mediated Phytoremediation: A Green Strategy for Nickel Removal

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Abstract

Nickel (Ni) contamination in soil and water systems has intensified due to industrial activities such as mining, electroplating, battery manufacturing, and excessive use of chemical fertilizers. Nickel is a persistent heavy metal that poses toxic effects on plants, microorganisms, animals, and human health when present above permissible limits. In response to this growing environmental challenge, phytoremediation has emerged as a sustainable, cost-effective, and eco-friendly alternative to conventional remediation techniques. Among various plant families evaluated for this purpose, Fabaceae (Leguminosae) has proven to be one of the most efficient groups for nickel phytoremediation due to its physiological adaptability, high biomass production, and beneficial plant-microbe interactions. Their ability to tolerate and translocate nickel allows them to function effectively in phytoextraction and phytostabilisation processes. A key advantage of Fabaceae plants is their symbiotic association with nitrogen-fixing rhizobia, which improves soil fertility and supports plant growth under metal-stressed environments. This symbiosis enhances nickel bioavailability in the rhizosphere through microbial activity, organic acid secretion, and chelation, thereby increasing metal uptake efficiency. Species such as *Vigna radiata* (mung bean) have demonstrated significant potential for nickel phytoremediation due to their rapid growth, short life cycle, and tolerance to moderate nickel concentrations. *Vigna radiata* accumulates nickel primarily in its roots and shoots, making it suitable for phytoextraction while maintaining physiological stability. Similarly, *Pisum sativum* (garden pea) has been reported to tolerate nickel stress by activating antioxidant defence mechanisms and compartmentalizing nickel within plant tissues. Its moderate biomass and effective root system contribute to the stabilization and gradual removal of nickel from contaminated soils. In conclusion, Fabaceae species particularly *Vigna radiata*, *Pisum sativum*, and other leguminous plants, represent a highly effective biological approach for the phytoremediation of nickel-contaminated environments. Their combined attributes of metal tolerance, nitrogen fixation, and soil improvement make them ideal candidates for large-scale, sustainable remediation programs. Future research should focus on field-scale applications, genetic enhancement, and synergistic plant-microbe interactions to optimize nickel removal efficiency.

Keywords: Nickel, Fabaceae, Phytoremediation, Soil

Impacts of land use land cover on diatoms, zooplanktons and water quality of the Mahanadi basin

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Abstract

The present study investigates the latitudinal distribution of phytoplankton species along a 19° N to 23° N gradient. Analysis of the percentage occurrence of phytoplankton species reveals a distinct peak at 20° N (33.96%), indicating an optimal environmental niche for species diversity at this latitude. The data also show a sharp decline in species percentage toward higher latitudes, with the lowest value of 4.28%

recorded at 23° N. These findings suggest that small latitudinal shifts significantly influence phytoplankton community composition, likely due to variations in physicochemical water parameters. The results contribute to understanding regional biodiversity patterns of aquatic microorganisms and have implications for ecological monitoring and water-quality assessments in tropical riverine systems.

Keywords: Phytoplankton, Species diversity, Microorganisms, Biodiversity

Role of Agroforestry in Sustainable Cultivation of Medicinal Plants

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Abstract

Agroforestry integrates trees, crops, and sometimes livestock within the same land-use system, offering a sustainable approach for the cultivation of medicinal plants. This system enhances ecological stability while meeting the growing global demand for herbal raw materials. The inclusion of medicinal plants in agroforestry models improves land productivity by utilizing vertical and horizontal space efficiently and reducing pressure on natural forests. Trees in agroforestry systems create favorable microclimatic conditions, such as moderated temperature, improved soil moisture, and reduced erosion, which support the growth and quality of medicinal species. Additionally, agroforestry enhances soil fertility through organic matter addition, nitrogen fixation, and improved nutrient cycling, thereby reducing dependence on chemical fertilizers. The system also promotes biodiversity conservation by providing habitats for beneficial organisms and maintaining genetic diversity of medicinal plants. From a socio-economic perspective, agroforestry-based medicinal plant cultivation offers diversified income sources, increased livelihood security, and resilience against climate variability for small and marginal farmers. Furthermore, sustainable harvesting and in situ conservation of medicinal plants within agroforestry systems contribute to long-term resource availability. Overall, agroforestry represents a viable and environmentally sound strategy for sustainable medicinal plant cultivation, balancing economic benefits with ecological conservation.

Keywords: Agroforestry, Medicinal plants, Sustainable cultivation, Biodiversity conservation

Gene Pyramiding approaches for Enhanced Multiple Biotic Stress Resistance in Chilli (*Capsicum annuum* L.) Through Marker-Assisted Selection

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Abstract

Chilli (*Capsicum annuum* L.) is one of the most important spice and vegetable crops grown worldwide, but farmers often struggle to obtain good yields because the crop is highly vulnerable to several diseases. The tropical and subtropical regions have some versatile environmental condition that favour various

diseases, such as anthracnose, bacterial wilt, powdery mildew, and viral disease. Traditional breeding methods depend on phenotypic traits, often fail due to environmental factor. Therefore, developing a chilli varieties with stable resistance to multiple disease has become an important goal in modern breeding programs. Gene pyramiding involves bringing together two or more resistance gene or QTLs in one plant to ensuring durable and long-term resistance to multiple pathogens. Molecular markers help breeders easily find resistance genes in plants, so they can choose the right resistance parents lines for breeding. This makes whole breeding process faster and helps develop resistant varieties more quickly. Recent advances in genetics and genomics, such as better DNA markers, linkage maps, and chilli genome information have made gene pyramiding easier to combine many disease resistance genes into one plant. Using marker assisted selection, breeder have successfully developed chilli varieties resistance to major diseases. When this method is combine with new techniques, it helps create chilli plants that can stay healthy and resist disease for long term. Overall, using marker-assisted gene pyramiding in chilli breeding is a smart and eco-friendly way that reduce the need for chemicals and helps farmers get better and more stable yield in different growing conditions.

Keywords: Chilli, gene pyramiding, marker-assisted selection, biotic stress resistance, molecular breeding, genomics

Indigenous Knowledge and Utilization of Forest Flora in Athagarh Forest Division of Odisha, India

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Abstract

Athagarh Forest Division, located in Cuttack district of Odisha, India, is rich in phytodiversity and a vital repository of forest resources. About 80% of the local population, including Kondha, Kohla, Munda, Lodha, Sabar, Juang, and Patua tribes, along with non-tribal communities, rely heavily on native plants for food, medicine, and other daily needs. An ethnobotanical survey of the region documented 116 plant species from 100 genera and 60 families, used for nine major purposes, including the treatment of over 25 human ailments such as bone fractures, bronchitis, burn injuries, diarrhoea, fever, jaundice, skin diseases, and sexual disorders. The study highlights that both tribal and non-tribal inhabitants depend on forest plants for primary healthcare, dietary needs, and minor forest products like gums, resins, fibers, and wild fruits. These resources not only support subsistence consumption but also contribute to local trade and weekly markets. Most of these materials are minor forest products that can be sustainably harvested and utilized for forest-based cottage industries, including fruit processing, herbal drug preparation, mat and basket making, cordage, matchstick production, and bidi manufacturing. The findings emphasize the urgent need to educate local communities about the market value of forest resources to improve livelihoods, generate employment, and promote sustainable utilization. Modernization, industrialization, and cash economy pressures pose threats to natural flora and traditional tribal knowledge. Proper documentation and validation of ethnobotanical practices can facilitate drug development, preserve indigenous knowledge, and enhance socio-economic status of underprivileged populations. This study demonstrates that Athagarh Forest Division is a rich source of forest raw materials and medicinal plants, offering opportunities for sustainable resource use, livelihood improvement, and conservation. The results

can guide future research on under-explored plant resources, support local healthcare, and provide the foundation for forest-based industries, ensuring both ecological and societal benefits.

Keywords: Ethnobotany, Athagarh Forest Division, Forest resources, Indigenous communities, Sustainable utilization

Salt stress changes nutritional quality of green gram [*Vigna radiata* (L.) R. Wilczek] with reduced photosynthesis and chlorophyll *a* fluorescence activity

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Abstract

Mung bean is a nutrient-rich legume crop that is becoming more and more important as a food source worldwide. It is a great source of protein, dietary fiber, vitamins, and minerals that support health. With the reduction of photosynthetic activity and other metabolic processes in addition to the salt deposition in the vacuolar sap to modify the cellular homeostasis, increasing salinity has a significant impact on crop productivity and the nutritional content of food grains. The protein content, phenol chemicals, and micronutrient-dependent phytic acid all have a significant impact on the nutritional value of this cereal. In the current investigation, growth, biochemical, and photosystem-II activity were all considerably impacted by a brief (7-day) exposure to salt (NaCl) at various concentrations (control, 20mM, and 50mM). The germination rate was around 8% at 50mM and approximately 97% at 20mM, with no discernible variation from the control. But at 20mM, the phenol and carbohydrate content rose, and at 50mM, it dramatically decreased. As concentration increased, the amount of chlorophyll gradually dropped. Improved growth, chlorophyll content, and chlorophyll *a* fluorescence activity at 'J', 'I', and 'P' transient points were observed at 20mM per control, but they were decreased when treated with 50mM NaCl. In comparison to the control, the Vt curve displayed a substantial low value at the 'P' point and a steep decline at the 'J' and 'I' transient points. The increased ABS/RC, Df/RC, decreased with less electron transport (ET/RC) from PSII to PSI, and decreased photosynthetic ~2.46 fold activity (PIabs) in 50 mM NaCl compared to control and 20mM (increase ~0.93 fold) were all validated by a radar plot of several Chl *a* fluorescence transients. As one of the nutrient-rich foods for humans, the low exposure to NaCl in sprouting mung bean with high protein, carbohydrate, and phenol content as well as higher chlorophyll content and photosynthetic activity may have significant health benefits.

Keywords: Chlorophyll, OJIP transient, Salt stress, Phenolics, Protein

Role of Phytochemicals in cancer prevention and treatment in future generation

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Abstract

Phytochemicals are non-nutritive substances that are present in plants and contribute significantly to their flavor and color. These biologically active compounds are classified into five major groups, namely phenolics, carotenoids, organosulfur compounds, nitrogen-containing compounds, and alkaloids, and are known for their potential health benefits in the prevention of various diseases, including cancer. Cancer is a severe health problem that continues to be a leading cause of death worldwide. Increasing knowledge of

the molecular mechanisms underlying cancer progression has led to the development of a vast number of anticancer drugs. However, the use of chemically synthesized drugs has not significantly improved the overall survival rate over the past few decades. As a result, new strategies and novel chemoprevention agents are needed to complement current cancer therapies to improve efficiency. Naturally occurring compounds from plants known as phytochemicals, serve as vital resources for novel drugs and are also sources for cancer therapy. Some typical examples include taxol analogs, vinca alkaloids such as vincristine, vinblastine, and podophyllotoxin analogs. These phytochemicals often act *via* regulating molecular pathways which are implicated in growth and progression of cancer. The specific mechanisms include increasing antioxidant status, carcinogen inactivation, inhibiting proliferation, induction of cell cycle arrest and apoptosis; and regulation of the immune system. This study provides an overview of the epidemiological and clinical evidence supporting the potential chemopreventive and anticancer properties of phytochemicals, with a focus on the need for future generation in all over the world.

Key words: *Phytochemicals, Anticancer, Antioxidant, Chemotherapy, Immune system*

Comparative analysis of volatile profiles and antioxidant potency of three underexplored *Vitex* species from Odisha

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Abstract

The genus *Vitex* is the most predominant genus of the family Lamiaceae used traditionally in the treatment of a broad range of diseases, such as female disorders, acne, inflammatory conditions, diarrhoea, dysentery, flatulence, catarrhal fever, asthma, bronchitis, rheumatism, cancer, etc. The current study focuses on 3 underexplored species of this genus namely, *Vitex pinnata*, *Vitex peduncularis*, and *Vitex leucoxylon*, which are spread across the Asian continent. The chemical profiling of leaf essential oil of these 3 species was performed using GC-MS analysis, where the results revealed sesquiterpene hydrocarbons as the major class of phytoconstituents in *V. pinnata* and *V. leucoxylon* essential oil, whereas in *V. peduncularis* leaf essential oil, oxygenated sesquiterpenes were the major class of phytoconstituents. In terms of quantity, allo-aromadendrene (15.44%), phytol (22.80%), and longifolene (35.57 %) were identified as the major compounds of the *V. pinnata*, *V. peduncularis*, and *V. leucoxylon* essential oils, respectively. The antioxidant potential of the leaf essential oil of all these 3 species was evaluated using both DPPH and ABTS assays. The results demonstrated significant variation in antioxidant activity among the species. *V. peduncularis* exhibited the highest radical scavenging activity among the three, followed by *V. pinnata* and *V. leucoxylon*. The difference in antioxidant capacity may be attributed to the variation in phytoconstituents of the essential oils. The findings of the present study provide a valuable insight into variation in chemical constituents of *Vitex* species as well as their bioactive potency that may contribute to their future applications as natural sources of antioxidants in pharmaceutical, nutraceutical, and functional food development.

Keywords: *Vitex pinnata, Vitex peduncularis, Vitex leucoxylon, essential oil, GC-MS, Antioxidant activity*

**FORTIFICATION OF TIKHUR ii: EFFECT OF INDIAN SPICES,
CONDIMENTS AND POT-HERBS (SAAG) IN GENERAL HUMAN
AILMENTS.**

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Abstract

Tikhur (also spelled: Teekhur) or known as East Indian Arrowroot are ergastic starch substance obtained from rhizome of *Curcuma augustifolia* (Roxb.) and aerial parts (twining of *Tinospora cordifolia* (Thunb.) Miers regarded as secondary metabolite Immense and Invaluable gift of nature to the mankind. Despite the strident and glaring developments taking place in other system of health care and medicine particularly what we consider the modern Allopathic has revolutionized by the analytical and imaging techniques the traditional system (Ayurveda, Unani, Siddha and Homeopathy), the folk medicines, traditional, Grandmas prescriptions/titbits are still the first preference of the general floating or trivial population that are derived from our household and kitchen ingredients (spices, condiments and different house-hold herbs). The present communication is the mural, intramural and extramural research work based on information's collected from varied and diverse people, place in the vicinity of will highlight the significance of Tikhur as nutraceutical and treatment of various physical pathological ailments, emotional ailments. The Tikhur in Indian Cuisine are variously used in festivals and holy offering to deities from annaprasan or the first feed to infants. The spices condiments and herbs also find equal and most coveted importance in Indian Culinary. The effects of fortification of the Tikhur with Indian spices with *quantum satis* number of spices, condiments and some herbs be highlighted and discussed in this presentation.

Key words: Tikhur (=Teekhur), starchy sedimentation, nutraceutical, fortification (Q.S.). spices condiments and herbs

**COSMETOLOGY OF MUD AND MUD BATH IN ALLEVIATION OF
PHYSICAL, POSITIVE MENTAL PSYCHE AND SPIRITUAL
ATTAINMENT.**

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Abstract

The present communication is based on extra-mural interest of most enthused remote population of the West Bengal, Jharkhand, and some parts Chhattisgarh. Some of the facts that riveted our attention was not accidental but sheer providence and keen interest. Our observations were centred around the fact that the earthen wares, mud houses are prevailing in most of the villages in India to-day despite the fact that the concrete and Portland cement are rapidly taking over the Indian mind-set for its quick setting time and the so-called longevity.

Nonetheless, mud and mud based cosmetics are still in vogue at least in the remote and rural areas of Jharkhand, West Bengal and Chhattisgarh articular in rural areas which are still lack communication and connectivity with urban population. The communication will focus how mud (loamy, sandy) is gainfully used as hair conditioners and facial wash and above all healing of wounds after certain modifications of the crude muds obtained from the native places.

Keywords: Cosmetology, mud and mud bath, wound healing, facial wash and hair conditioning



THERAPEUTIC POTENTIAL OF MEDICINAL PLANTS

Anxiety and Depression treatment with Common Herbs a Natural approach to ease Stress, Anxiety and Depression.

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Abstract

Anxiety, stress, and depression are persistent mental health disorders affecting millions of people worldwide. Conventional treatments often involve pharmaceuticals with potential side effects, leading to a growing interest in natural remedies. This review investigates the anxiolytic and antidepressant properties of common herbs, including passionflower, kava, chamomile, and lavender. A comprehensive review of existing literature and experimental studies reveals that these herbs exhibit significant potential in reducing anxiety, stress, and depression. The bioactive compounds present in these herbs, such as flavonoids and terpenes, interact with neurotransmitters and hormonal pathways, promoting relaxation, improving mood, and enhancing mental function. Especially, passionflower and kava demonstrate anxiolytic effects by modulating GABA and glutamate levels, while chamomile and lavender exhibit antidepressant properties by influencing serotonin and dopamine pathways. This research provides evidence for the therapeutic potential of common herbs in mitigating anxiety, stress, and depression, offering a natural and relatively safe alternative to conventional treatments. The findings of this study have significant implications for the development of herbal-based interventions, providing a promising avenue for the management of mental health disorders.

Keywords: Anxiolytic, Antidepressant, Herbs, Passionflower, Kava, Chamomile, Lavender, Phytochemicals.

Plants Used in Ayurvedic Pharmaceutical Industries: Problems and future Directions

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Abstract

The production of Ayurvedic drugs and related formulations in India has increased manifold over the past few decades, leading to a substantial rise in the demand for raw materials, most of which are derived from plant sources. However, indiscriminate and large-scale collection of medicinal plants and their parts has resulted in the depletion of natural populations, rendering several species rare or endangered. Another major concern is the quality of raw materials, as correct identification of many Ayurvedic crude drugs remains unresolved. In several instances, multiple plant species are used interchangeably as sources for a single drug, such as Brahmi, Murva, Jeevanti, Pasanabheda, Rasna, Sankhapushpi, Mayurasikha, Ashoka, Sarpagandha, Chitraka, Bhumyamalaki, Bhringaraj, Bhunimba, Bala, and Punarnava. The use of such controversial substitutes often leads to inconsistent therapeutic efficacy. Additionally, the same medicinal plant is known by different vernacular names across regions, further contributing to confusion and misidentification. Incorrect identification or improper methods of use frequently result in reduced quality and effectiveness of Ayurvedic formulations and, in some cases, may cause serious adverse effects. Adulteration has become widespread, and the quality of raw materials is often compromised due to improper collection practices, inadequate post-harvest handling, and poor storage conditions. Therefore,

there is an urgent need to review and strengthen the identification and standardization of authentic raw drugs used in the preparation of Ayurvedic medicines. Despite long-standing recognition of the gap between demand and supply of genuine crude drugs, concrete measures to enhance the production of Ayurvedic raw materials have been limited. There is also a pressing need to develop rapid and reliable methods for assessing the authenticity and quality of crude drugs. Morphological characterization can serve as a useful preliminary tool, while the development of thin-layer chromatographic (TLC) profiles may offer a more precise and effective approach for quality evaluation of raw materials used in Ayurvedic pharmaceutical industries.

Keywords: Ayurvedic pharmaceuticals, Medicinal plants, Crude drug identification, Adulteration, Standardization, Quality control

Computational Assessment of Drug-likeness and Pharmacokinetic Profiling of Phytochemicals of *Sonneratia* Species: A Molecular Modeling Approach

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Abstract

Mangrove ecosystems represent a distinctive ecological niche that supports a wide diversity of plant species and produces structurally diverse and pharmacologically active phytochemicals. Mangrove plants have played a vital role in ethnomedicine since ancient times for the treatment of various ailments such as diarrhea, malaria, wounds, and skin disorders. Taxonomically, mangroves are broadly categorised into true mangroves, mangrove associates, and mangrove minors. The true mangroves include about 80 species consisting of 17 distinct plant families. The *Sonneratia* is a true mangrove genus belonging to the family *Lythraceae* and is known for its rich diversity of secondary metabolites with significant therapeutic and pharmacological potential. The genus comprises several species, including *Sonneratia ovata*, *S. apetala*, *S. caseolaris*, and *S. alba*. Despite their bioactive richness, *Sonneratia* species remain comparatively underexplored, highlighting their potential as valuable sources of novel therapeutic compounds. The present study aimed to evaluate the antidiabetic potential of phytochemicals derived from mangrove *Sonneratia* species using an integrated in silico approach. Bioinformatics tools, including DataWarrior, SwissADME, and PASS Online and biological activity, followed by molecular docking against disease targeted proteins. A total of 69 phytochemicals reported from various *Sonneratia* species were retrieved from the PubChem database for comprehensive computational screening. DataWarrior platform was assessment to predict toxicity risk and also cLogP and cLogS were evaluated to assess compound suitability. Based on integrated ADME, toxicity, and drug-likeness profiling, 42 phytochemicals without any predicted toxicity risk alerts from 69 compounds. SwissADME analysis evaluated key parameters, including lipophilicity, solubility, pharmacokinetics, drug-likeness, and medicinal chemistry profiles, From the SwissADME analysis, 7 were shortlisted. The selected compounds were evaluated using PASS Online study to predict their potential biological activities, result, indicating a moderate significant pharmacological potential against diabetes disorders with $P_a > 0.600$. Molecular docking studies revealing favourable binding energies and stable hydrogen-bond interactions with key amino acid residues of the respective target proteins. Each screened compounds exhibited good moderate binding energies and the bonds are within an optimal range, i.e., 2-3 Å. The top three compound were shortlisted based on their binding energies. Notably, Compounds such as

(1R,2R,5S,8S,9S,10R,11S,12S)-5,12-dihydroxy-11-methyl-6-methylidene-16-oxo-15-oxapentacyclo[9.3.2.15, 8.01, 10.02, 8]Heptadec-13-ene-9-carboxylic acid demonstrated a strong affinity for binding α -glucosidase (−9.2 kcal/mol) and DPP-4 (−8.9 kcal/mol); compound 2-(3,4-dihydroxyphenyl)-5,7-dihydroxychromen-4-one; compound (1E,3E,5E,7E,9E,11E,13E,15Z); and α -glucosidase (−9.2 kcal/mol).-1-[(2R,4S)[2,4-dihydroxy-2,6,6-trimethylcyclohexylidene]-16-(hydroxymethyl)-18-[(4R)-4-hydroxy-2,6,6-trimethylcyclohexen-1-yl]3,7,12-trimethyloctadeca-3,5,7,9,11,13,15-heptaen-17-yn-2-one has a significant affinity for α -amylase (−9.1 kcal/mol).Ramachandran plot was performed, revealing that the majority of protein residues were distributed, result, all proteins are within the favoured and allowed regions. The shortlisted compounds exhibited promising oral bioavailability, along with favourable ADME, toxicity profiles, and strong predicted biological activities. Overall, the findings highlight the therapeutic potential of mangrove-derived phytochemicals from *Sonneratia* species as promising lead candidates for the development of novel drugs targeting or global health challenges against diabetes.

Keywords: *Sonneratia*, Phytochemicals, Pharmacokinetic, Drug-Likeness, ADME, Docking, Ramachandran plot

Phytomedicinal Potential of Weed Flora Associated with Lowland Rice Fields of Puri District, Odisha

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An extensive floristic survey was conducted in the lowland rice fields of Puri district, Odisha, India, during the years 2024–2025 to assess the phytomedicinal potential of weed species associated with the rice agro-ecosystem. The study was carried out in four community development blocks, namely Astaranga, Brahmagiri, Nimapara, and Pipili. The survey documented 70 weed species occurring in the lowland rice field ecosystem across these locations. Among the recorded species, 65 weeds were identified as having potential medicinal value, although they also interfere with crop growth and productivity. Several medicinally important weed species were identified, including *Alternanthera philoxeroides*, *Aeschynomene americana*, *Aerva javanica*, *Bidens pilosa*, *Blumea lacera*, *Chrozophora rottleri*, *Corchorus aestuans*, *Croton bonplandianus*, *Eclipta prostrata*, *Emilia sonchifolia*, *Gnaphalium polycaulon*, *Gomphrena celosioides*, *Ludwigia octovalvis*, *Oxalis corniculata*, *Pontederia crassipes*, *Portulaca oleracea*, *Saccharum spontaneum*, *Tribulus terrestris*, and *Xanthium strumarium*. The study further revealed that local farmers, agricultural laborers, and traditional healers (vaidyas) utilize several of these weeds for treating human and animal ailments. Notable ethnomedicinal uses include *Alternanthera philoxeroides* for cough, *Aeschynomene americana* for impotency, *Aerva javanica* for diarrhoea, *Chrozophora rottleri* for hypertension, *Corchorus aestuans* for

dysentery, *Croton bonplandianus* for wound healing, *Eclipta prostrata* as a hair conditioner, *Pontederia crassipes* to enhance lactation in cattle, *Emilia sonchifolia* for common cold and fever, and *Xanthium strumarium* for jaundice. Despite their medicinal significance, these weed species are under constant threat due to anthropogenic activities such as intercultural agricultural practices and indiscriminate use of herbicides. The conservation and sustainable utilization of these lesser-known but valuable medicinal weeds may contribute to the development of pharmaceutically important formulations and provide opportunities for livelihood enhancement and value addition among rural communities.

Keywords: Phytomedicinal potential, Medicinal weeds, Lowland rice fields, Puri district, Odisha

Cannabis sativa Root Extracts as a Source of Novel Anticancer Agents: A comprehensive study

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Abstract

For over a hundred years, *Cannabis sativa* was regarded as a narcotic and is prohibited legally. However, in recent times, there has been a lot of interest in this plant due to its therapeutic possibilities, along with a fascinating chemical makeup, highlighted by a unique group of molecules known as phytocannabinoids. This review aims to outline the traditional applications, chemical structure, and biological functions of various parts of this plant as an anticancer agent. Medications that interact with the endocannabinoid system are gaining attention as pharmacological alternatives to fight cancer and enhance the quality of life for cancer patients. From this viewpoint, cannabinoid compounds have been effectively evaluated as a systemic treatment option in numerous preclinical studies over the last few decades. Consequently, various reported data indicates that the anticancer properties of cannabinoids operate at various stages of tumor development through different signaling pathways. Thus, there is substantial evidence supporting cannabinoid-induced suppression of tumor cell growth, invasion, and metastasis, as well as angiogenesis, chemoresistance, and the promotion of apoptosis and autophagy. Additional research has indicated that cannabinoids may serve as potential partners in combination with established chemotherapeutic drugs or other therapeutic strategies in cancer management. Recent studies have produced several compounds that show promising effects on tumor cells and tissues, in addition to the psychoactive Δ^9 -tetrahydrocannabinol, including the non-psychoactive phytocannabinoid cannabidiol and agents that inhibit endocannabinoid breakdown. This review offers a current perspective on the potential of cannabinoids as inhibitors of tumor growth and dissemination, as evidenced in anticancer treatments.

Keywords: *Cannabis sativa*, phytocannabinoids. Anticancer, endocannabinoid

Efficient quality control measures for improving the efficacy and safety standards of herbal medication products

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Abstract

Herbal medication products usually refer to the medicinal products derived from plants or plant materials containing active compounds, such as alkaloids, flavonoids, terpenes, and phenolic compounds, which contribute to their pharmacological and therapeutic effects. They have gained widespread popularity due to their natural healing power and curative properties. The integration of traditional knowledge and modern scientific approaches for optimal quality control outcomes and adherence to the regulatory standards is highly essential for improving efficacy and safety of these herbal medication products. Traditional indigenous medicinal plants were selected for extracting herbal compounds. The quality control methods included identification and selection of herbs, optimization of extraction methods, and product assessment during processing of herbal compounds. Stringent selection of herbs was done using macroscopic and microscopic examination, thin-layer chromatography, high-pressure liquid chromatography, DNA barcoding, chemical and molecular fingerprinting methods. The plant exudates were extracted from the plants by techniques like ultrasound and microwave-assisted extraction, pressurized liquid extraction, and supercritical fluid extraction methods. Regular monitoring of environmental conditions like temperature, pressure, pH, and moisture content helped in reducing the rate of microbiological contamination. Screening for toxic compounds, heavy metals and biological contaminants were carried out using different techniques. Heavy metals in the herbal compounds were screened using atomic absorption spectroscopy and inductively coupled plasma-mass spectrometry. Contaminant testing was done by high-pressure liquid chromatography, gas chromatography and mass spectrometry. Pesticide residues were detected through gas chromatography, liquid chromatography, mass spectrometry and liquid chromatography coupled with mass spectrometry. Microbiological testing for *Escherichia coli*, *Salmonella species* and *Staphylococcus aureus* was carried out using the plate count method. These methodologies are highly essential to ensure the safety, quality, and efficacy of products, protect public health, and preserve the environment. Hence, enhancing the quality, efficiency, and safety of herbal medication products involved standardization, authentication, contaminant testing, quantification of active compounds, stability testing and adherence to regulations. These key factors provide a specific road map for establishing robust quality control processes for herbal medication products.

Health benefits of *Garcinia*: from traditional medicine to modern application

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Abstract

The genus *Garcinia* L. (Clusiaceae) represents a group of medicinally valuable plants found across the tropical region of the world. In India, a total of 44 species and 5 varieties are known to occur, of which, 38 species have been seen to grow naturally in wild, while the remaining species are under cultivation. It is seen that the *Garcinia* species have been an integral part of traditional practices and cultural heritage in different parts of India including South and North East India where these plants are highly prized for their

edible fruits and medicinal properties. *Garcinia* species are used in culinary traditions, folk medicines, and cultural rituals by some ethnic communities of those regions highlighting their significance as one of the cultural but valuable bioresources of the country. Recent scientific interventions that validated the hepatoprotective and the anti-obesity activities along with some other health benefits due to the presence of varied amount of phyto-constituents, make the fruits of the *Garcinia* as wonder medicinal resources. This paper explores the multifaceted uses and cultural importance of *Garcinia* species, emphasizing their role in sustaining local livelihoods and preserving traditional knowledge along with their potential application in pharmacognosy and pharmacology. By examining the intersection of culture, biodiversity, and utilization, this study also underscores the importance of conserving *Garcinia* species for future generations.

HPTLC profile of rhizome and leaf extracts of *Maranta arundinacea* L. for identification of bioactive compounds

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Abstract

Medicinal plants are the basic of modern pharmaceuticals for drug discovery for centuries. There is a need for an easy and fast technique to check the quality and authenticity of the raw material. The active principles in them are detected by qualitative chemical tests for each category of phytochemicals. Many chromatographic methods help in separation of the complex mixture into individual phytoconstituents. HPTLC Fingerprinting profile is widely accepted by the WHO and pharmacopeia across the globe as an effective analytical method for investigation of secondary metabolites. The aim of this work is to evaluate the various secondary metabolites in the rhizome and leaf extracts of *Maranta arundinacea*. This study was carried out using CAMAG TLC Scanner linomat 5 automatic applicator. The plant extracts were eluted with solvent system Acetone, toluene and formic acid (4.5:4.5:1). Remarkable bands were observed in the ethanolic extract of rhizome than leaf with 15 phytoconstituents as compared to standard gallic acid. The detection and profiling of metabolites provide the justification for therapeutic activity in the medicinal plants.

Keywords: Gallic acid, HPTLC, *Maranta arundinacea*, Medicinal plants, Phytochemicals

Phytochemical Profiling and Antibacterial Activity of *Trichodesma indicum* (L.) R.Br. and *Sonchus asper* (L.) Hill used against Gastrointestinal Disorders in Coastal Odisha

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Abstract

The coastal districts of Odisha possess fertile agricultural land that supports the cultivation of diverse crops across different seasons. Alongside these crops, numerous weed species grow naturally and are traditionally used by local communities, herbal healers, and folk practitioners for the treatment of various ailments. The present study focuses on the phytochemical screening and antibacterial potential of two lesser-known crop weeds, *Trichodesma indicum* (L.) R.Br. and *Sonchus asper* (L.) Hill, traditionally used to treat gastrointestinal diseases in the coastal districts of Odisha, including Balasore, Bhadrak, Kendrapara, Jagatsinghpur, and Puri. Both weed species were collected from groundnut and gram crop fields. Plant extracts were prepared using n-hexane, methanol, and hydro-alcoholic (1:1) solvents with the help of a Soxhlet apparatus. These extracts were screened for the presence of secondary metabolites such as alkaloids, glycosides, polyphenolic compounds, saponins, steroids, and proteins. The n-hexane and methanolic extracts, which showed superior antibacterial activity, were further analyzed using thin-layer chromatography (TLC). *In vitro* antibacterial activity of the extracts was evaluated against selected gastrointestinal pathogenic bacteria using the agar well diffusion method. The test organisms included *Escherichia coli*, *Bacillus circulans*, *Salmonella paratyphi*, *Vibrio cholerae*, *Shigella flexneri*, *Micrococcus luteus*, *Salmonella enterica* serovar Typhi, *Salmonella enterica* serovar Typhimurium, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Streptococcus mitis*, and *Pectobacterium carotovorum*. The n-hexane and methanolic extracts of *Trichodesma indicum* exhibited notable antibacterial activity against *E. coli*, *V. cholerae*, *S. enterica* Typhimurium, and *K. pneumoniae*. Similarly, the methanolic and n-hexane extracts of *Sonchus asper* showed promising activity against *E. coli*, *K. pneumoniae*, and *V. cholerae*. Overall, methanolic and n-hexane extracts demonstrated higher antibacterial efficacy compared to hydro-alcoholic extracts. The extensive use of these plant species by local communities and folk healers for treating gastrointestinal disorders highlights their importance in primary healthcare and supports their potential for further pharmacological investigation.

Keywords: Phytochemical screening, Antibacterial activity, *Trichodesma indicum*, *Sonchus asper*, Gastrointestinal disorders

Innovative Approaches to Antibacterial Soap: The Role of Spirulina in Combatting Bacteria from Medical Wastewater

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Abstract

Hospital and clinical wastewaters are complex wastewaters containing a mixture of organic matter, disinfectants, and pharmaceutical residues that often harbor pathogenic and antibiotic-resistant bacteria. Improper discharge of such wastewater significantly contributes to environmental pollution and facilitates the spread of antimicrobial resistance genes in natural ecosystems. This growing concern has led to increased interest in identifying biodegradable, plant and algae-derived antimicrobial compounds as environmentally-friendly alternatives to synthetic chemicals. *Spirulina platensis*, a filamentous cyanobacterium, is famous for its rich biochemical composition, including high protein content and diverse bioactive molecules such as phycocyanin, chlorophyll, flavonoids, alkaloids and phenolic acids. These compounds exhibit remarkable antioxidant, anti-inflammatory and antimicrobial activities. Incorporation of Spirulina extract into soap formulations has been reported to increase cleaning efficiency while providing additional therapeutic and antimicrobial benefits. This study aimed to develop an ecological antimicrobial soap incorporating *Spirulina platensis* powder and evaluate its effectiveness against bacteria isolated from medical effluents. Wastewater collected from Fakir Mohan Medical, Balasore, exhibited moderate organic contamination (pH 6.67, BOD 16.4 mg/L, DO 2 mg/L, TDS 570 mg/L), favoring microbial growth. Five bacterial isolates (Bac-1 to Bac-5) were obtained and morphologically characterized. The ethanolic and aqueous extracts of spirulina contained tannins, alkaloids, flavonoids and saponins, with the alkaloids being most abundant in the ethanolic extract. A soap formulated with spirulina showed a pH of 8.5, a soft texture and strong antimicrobial activity (inhibition zones of 23 to 27 mm), surpassing commercial soaps (14 to 18 mm). Growth kinetics confirmed >40% inhibition in Bac-3 under ethanolic extract treatment. The results demonstrate the potential of spirulina-derived bioactives for sustainable antimicrobial personal care products.

Keywords: *Spirulina platensis*, antimicrobial soap, medical waste water, phytochemicals.

Medicinal significance and traditional knowledge associated with wetland flora in Ramsar sites of Odisha

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Abstract

Wetlands are valuable ecosystems that support a wide range of plant and animal life. Many wetland plants are used in traditional medicine and play an important role in the health and livelihood of local communities. Odisha, a coastal State in eastern India, has six “Ramsar sites”- Chilika Lake, Ansupa Lake, Bhitarkanika Mangroves, Satkosia Gorge, Hirakud Reservoir, and Tampara Lake. These wetlands differ in their ecosystem, ranging from freshwater to brackish and saline habitats, and support a rich diversity of plant species. The present study focuses on identifying and documenting the medicinal plants found in the wetlands of village areas located adjacent to Ramsar sites and understanding their uses in traditional

healing practices. Field surveys were conducted across Three Ramsar sites-Ansupa Lake, Satkosia Gorge and Hirakud Reservoir. Detailed questionnaire, focused group discussion with local inhabitants, traditional healers and community knowledge holders were conducted to collect information about the plants and their medicinal uses. Secondary data from published sources was referred to validate and evaluate information obtained through field study. Plant specimens were photographed, herbarium collected and identified with the help of regional flora and herbarium references. Data was organized based on plant family and reported medicinal uses. In the current study, more than 90 wetland plant species were recorded, of which 42 species belonging to 21 genus and 23 families possess notable medicinal properties and have been in practice by the locals for a long period of time. The families Fabaceae, Asteraceae, and Commelinaceae were found to be the most dominant. Various plant parts, including leaves, roots, stems, and flowers, are currently being utilized. For instance, *Centella asiatica* was identified as a widely used species for treating digestive disorders such as indigestion, *Bacopa monnieri* is helpful for improving memory and brain function, *Hygrophila auriculata* valued as a blood purifier, and *Acmella paniculata* was found to be commonly used for alleviating toothache and oral discomfort. Most of the aquatic species are herbs and well adapted to moist or waterlogged environments. Many of them used by local villagers and tribal communities for primary healthcare, showing a strong link between biodiversity and traditional knowledge. To protect these natural and valuable resources, there is a need for conservation awareness, community involvement, and sustainable management of wetland resources. Establishing local medicinal plant gardens, promoting eco-friendly harvesting practices, and involving local people in wetland conservation programmes can help preserve these species. Further, scientific studies on the chemical properties and pharmacological value of these plants can also support their wider use in modern medicine.

Keywords: Wetlands, Medicinal plants, Ramsar sites, Sustainable management, Conservation, Wetlands

Genetic variability and associated Polymorphism of *Andrographis paniculata* (Burma f.) Wall ex Nees.

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ABSTRACT

Andrographis paniculata (Burm. f.) Wall. ex Nees is an important medicinal plant commonly known as ‘Chiraita’ in Odia and ‘Kalmegh’ in Hindi, belonging to the family Acanthaceae, valued for its bioactive diterpenoids, particularly andrographolide. Variability within the species plays a crucial role in its adaptability, phytochemical composition, and therapeutic potential. The present study focuses on assessing the extent of morphological and genetic variability among different populations of *A. paniculata* collected from diverse agro-climatic regions. Variations were observed in plant height, branching pattern, leaf morphology, flowering behavior, and biomass production, indicating substantial phenotypic diversity. Genetic variability was further evaluated using molecular markers, which revealed significant polymorphism among accessions, suggesting a broad genetic base. Such variability may arise from environmental influences, natural selection, and genetic recombination. The observed diversity has

important implications for conservation, selection of elite genotypes, and genetic improvement programs aimed at enhancing medicinal quality and yield. Understanding intraspecific variability in *A. paniculata* is essential for sustainable utilization, standardization of herbal formulations, and long-term preservation of its genetic resources.

Keywords: *Andrographis paniculata*, andrographolide, genetic variability, phenotypic diversity

***In vitro* Antimicrobial Activity of Selected Plant Extracts Against Skin-Associated Pathogens**

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Abstract

The emergence of antibiotic resistance and the increasing incidence of adverse side effects associated with synthetic antibiotics have intensified the search for novel antimicrobial agents from natural sources. In this context, the present study evaluated the antimicrobial potential of leaf extracts of *Tectona grandis* L.f. and *Terminalia catappa* L. using petroleum ether, methanol, and aqueous (DMSO) solvents. The antimicrobial activity was assessed against a panel of human pathogenic microorganisms, including bacterial species such as *Escherichia coli*, *Bacillus subtilis*, *Bacillus circulans*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Staphylococcus aureus*, *Salmonella typhi*, *Salmonella paratyphi*, *Streptococcus mitis*, and *Proteus vulgaris*, as well as fungal species including *Aspergillus niger*, *Candida albicans*, *Candida tropicalis*, *Candida krusei*, *Fusarium oxysporum*, and *Trichophyton mentagrophytes*. Among the extracts of *T. grandis*, petroleum ether and methanolic extracts at a concentration of 50 mg/ml exhibited the highest antibacterial activity, particularly against *B. circulans*, producing inhibition zones greater than those of the standard antibiotic ciprofloxacin. Significant activity was also observed against *S. mitis* and *B. subtilis*. All extracts of *T. grandis* demonstrated strong antifungal activity against *C. krusei*, *F. oxysporum*, and *T. mentagrophytes*, with inhibition zones comparable to or exceeding those of clotrimazole. The petroleum ether extract showed notable activity against *A. niger*, equivalent to the standard antifungal agent. In *T. catappa*, the methanolic extract at 50 mg/ml exhibited maximum activity against *S. mitis* and showed comparable efficacy against *B. subtilis*, *K. pneumoniae*, *B. circulans*, and *P. vulgaris*. The petroleum ether extract demonstrated enhanced activity against *S. aureus*, while the aqueous extract showed superior inhibition against *P. vulgaris*. Both methanolic and aqueous extracts of *T. catappa* exhibited strong antifungal activity against *C. krusei*, *F. oxysporum*, and *T. mentagrophytes*, surpassing the standard antifungal drug. MIC studies revealed that several extracts inhibited bacterial and fungal growth at low concentrations (1.56 µg/ml), indicating potent antimicrobial efficacy. The findings suggest that leaf extracts of *Tectona grandis* and *Terminalia catappa* possess significant antimicrobial potential and may serve as promising sources for the development of novel herbal antibiotics to combat bacterial and fungal resistance.

Keywords: Antimicrobial activity, *Tectona grandis*, *Terminalia catappa*, Agar well diffusion method, MIC

Phytochemical characterization and bioassay-guided fractionation of antimicrobial fractions from *Lantana camara* leaves of Rajasthan Aravalli region

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Abstract

Lantana camara L. (Verbenaceae), an invasive weed prevalent in Rajasthan's Aravalli hills, serves as a valuable source of bioactive secondary metabolites with potential antimicrobial applications. This study optimized extraction protocols using hot methanol and cold multi-solvent maceration on shade-dried leaves collected from Todgarh-Raoli Wildlife Sanctuary (25°58'12"N, 73°40'24"E), followed by phytochemical screening, disc diffusion assays against ATCC strains, UV-Vis fingerprinting, and TLC-bioautography for activity-guided fractionation. Cold maceration yielded 6.4% extract (w/w), surpassing hot extraction (2.2%), and both revealed rich profiles of flavonoids, phenolics, terpenoids, steroids, tannins, saponins, alkaloids, and anthraquinones, confirmed via standard qualitative tests. Crude extracts exhibited potent antibacterial activity, particularly against Gram-negative pathogens: cold extracts inhibited *E. coli* (13±1 mm), *K. pneumoniae* (12±1 mm), *P. aeruginosa* (17±1 mm), and *S. aureus* (10±1 mm), while hot extracts were selective for *K. pneumoniae* (17±1 mm) and *P. aeruginosa* (11±0.6 mm). UV-Vis spectra displayed strong phenolic absorption maxima at 225 nm (4.5 AU) and 275 nm (4.59 AU), alongside shoulders at 340-360 nm indicative of flavonoids. n-Hexane partitioning and TLC (n-hexane: petroleum ether: EtOAc: CHCl₃: MeOH: H₂O) pinpointed a low-polarity bioactive band (R_f 0.705) in the bioautogram overlay against *P. aeruginosa*, yielding a clear 6 mm inhibition zone suggestive of terpenoid constituents like lantadenes. These findings highlight chemotype-specific antimicrobial potential in Aravalli *L. camara*, validating bioassay-guided approaches for isolating anti-*Pseudomonas* leads from invasive biomass. Future GC-MS dereplication of the R_f 0.705 fraction will elucidate structure-activity relationships, supporting development of natural antimicrobials amid rising multi-drug resistance.

Ecological Factors Influencing growth of *Azolla* species – A Review

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Abstract

Azolla is a free-floating water fern that floats in water and fixes atmospheric nitrogen because of its association with the nitrogen fixing heterocystous blue-green alga *Anabaena azollae* in its dorsal leaves. *Azolla* occurs in fresh water ecosystems in tropical, sub-tropical and warm temperate regions throughout the world. *Azolla* plant can be used for a variety of applications such as protein-rich feed for livestock and aquaculture, biofertilizer as well as green manure in paddy field, phytoremediation, biocontrol for mosquito repellants, reduce methane emissions and for production of biogas. Under optimum conditions *Azolla* can double its biomass within 2 to 5 days. Due to these high economic potentialities, the present study was undertaken to add more information on the ecological factors that influence *Azolla* growth under natural conditions. *Azolla* requires all the macronutrients (except N) and micronutrients for its growth. Phosphorous is the most important and often limiting nutrient for its growth. Photosynthetic activity, growth and nitrogen fixation of *Azolla* and its symbiont are all affected by light intensity. *Azolla* prefers an environment with a certain degree of shading. When light intensity is high and amount of

nutrients in water is low, *Azolla* turns red. The red coloration is due to the development of anthocyanin pigments. Optimal light intensity for *Azolla* growth is 15- 18 Klux, and its growth and photosynthesis are inhibited at higher intensities. Different *Azolla* species, strains or varieties have different temperature sensitivities. There have been numerous studies about the differences in temperature responses of *Azolla* species. A temperature of 20 to 30^o C can be considered as optimal for growth of *Azolla*. Usually, *Azolla* prefers a medium near to neutrality or to some extent acidic condition for growth. Humidity, salinity, length of the growing season and day length are other ecological factors which regulate production of this aquatic plants. In addition to these biotic factors like various types of animals, insects, bacteria, fungi and viruses affect the growth of *Azolla*. However, out of these insects, snails and fungi have been reported to affect growth of *Azolla* seriously. So, understanding the ecological factors for *Azolla* production is very helpful for its practical applications in different fields.

Key words: *Azolla*, Phytoremediation, Biofertilizer

***In vitro* plant regeneration of tetraploid endangered medicinal plant *Drimia indica* (Roxb) Jessop from Odisha**

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Indian squill, *Drimia indica* (Roxb) Jessop, is a rare and endangered medicinal plant belongs to the family Asparagaceae which is found in India, as well as parts of Africa and the Mediterranean region. It embraces potential photoactive compounds for various human ailments, offering cardiogenic, anticancer, anti-jaundice, anti-dropsy, anti-asthmatic, anti-epileptic and diuretic properties. We report *in vitro* regeneration of tetraploid cytotype of *Drimia indica* (2n=4x=40) collected from Nayagrah, Odisha through shoot meristem multiplication in MS media. High multiplication of direct shoot regeneration was obtained in MS supplemented with 4mg/L of BAP and 1mg/L of NAA. Significant shoot proliferation was noticed in higher concentration of cytokinin followed by elongation of shoots in comparatively low dose of BAP along with adenine subplate. The callus mediated shoot regeneration was also obtained in comparatively low BAP from the callus tissue. Successful root regeneration of regenerated shoots was obtained in 1MS+2mg/L of IAA and 1mg/L BAP. Callus formation takes more time as compared to shoot and root regeneration. 1MS+4mg/L of 2,4-D and 0.5mg/L of NAA gives best result in callus formation. Cytological observation of the callus and *in vitro* generated plant roots confirmed that they are true to type plant without any variations of chromosome number. Thus, the regeneration protocol of this medicinally important plant showed chromosomal stability in *in vitro* grown plant which can be exploited for mass multiplication of polyploid ecotypes of *Drimia indica* for *ex situ* conservation and commercial exploitation of secondary metabolites.

Antimicrobial Evaluation of Leaf-Derived Natural Dyes and Pigments from *Artocarpus heterophyllus* Lam. and *Tectona grandis* L.f.

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In recent years, there has been a renewed interest in enhancing the value of textiles through the application of natural products, particularly natural dyes derived from plant sources. Natural dyes not only provide eco-friendly and biodegradable alternatives to synthetic dyes but are also associated with additional functional properties, including medicinal and antimicrobial benefits. Several plant materials traditionally used for dye extraction are known to possess bioactive compounds with therapeutic potential. Despite these advantages, the indigenous knowledge related to the extraction, processing, and application of natural dyes has declined considerably among the younger generations of ethnic communities. The study focused on the preparation and application of natural dyes extracted from the leaves of *Artocarpus heterophyllus* Lam. (jackfruit) and *Tectona grandis* L.f. (teak), both of which are known for their traditional medicinal properties. The dye extracts were prepared using standardized extraction procedures to obtain maximum color yield. Cotton and silk fabrics were dyed using the extracted coloring materials, and the dyed textiles were subsequently evaluated for wash fastness to assess the durability and stability of the colors under washing conditions. The antimicrobial efficacy of the naturally dyed textiles was tested against selected pathogenic microorganisms, including *Klebsiella pneumoniae*, *Escherichia coli*, *Candida albicans*, and *Aspergillus* species. These microorganisms are commonly associated with skin and textile-related infections, making them relevant targets for antimicrobial textile applications. The results demonstrated that fabrics dyed with *Tectona grandis* leaf extract exhibited significantly higher antimicrobial activity compared to those dyed with *Artocarpus heterophyllus*. Notably, the *Tectona grandis*-dyed fabrics produced the maximum zone of inhibition against all tested microorganisms. Among the tested samples, silk fabrics dyed with *Tectona grandis* showed the highest antimicrobial efficacy, with a maximum inhibition rate of 65% against *Escherichia coli*. The findings of this study highlight the potential of natural plant-based dyes not only as sustainable alternatives for textile coloration but also as functional agents capable of imparting antimicrobial properties to fabrics. Such natural dyes can contribute to value-added textiles while promoting environmentally friendly and culturally significant dyeing practices.

Key words: Natural dyes, Antimicrobial activity, *Artocarpus heterophyllus*, *Tectona grandis*, Colour fastness, Textile applications

EXPLORING EFFICACY OF MEDICINAL HERBS FORMULATIONS TO TREAT PERIODONTAL DISEASES IN PATIENTS WITH AND WITHOUT CO-MORBIDITIES.

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Abstract

Gingival and periodontal diseases are among the most prevalent oral health issues worldwide, with a growing incidence particularly in developing countries and affecting more than 13 billion of adult

population. These conditions are primarily associated with microbial biofilms in dental plaque. In recent years, periodontal diseases have been increasingly associated with a wide range of systemic conditions, including cardiovascular and respiratory diseases, stroke, diabetes mellitus, preterm low birth weight, arthritis, and neurodegenerative disorders such as Alzheimer's disease. Conventional chemotherapeutic agents have shown limited effectiveness in completely eliminating or preventing periodontal disease. The increasing prevalence of these infections, coupled with rising bacterial resistance and the risk of opportunistic pathogens, has intensified the search for alternative and complementary treatment approaches. Ayurveda, the ancient system of medicine, describes numerous herbal plants with proven benefits in managing periodontal infections. Plant-derived phytochemicals are considered safer and more effective alternatives to synthetic agents, offering antimicrobial, anti-inflammatory, astringent, antiseptic, and analgesic properties with minimal side effects. This paper tries to explores the potential of Ayurvedic herbs as different formulations in preventing and treating gingival and periodontal diseases in patients without and with co- morbidities where conventional surgical treatment methods are contraindicated. Integrating modern oral hygiene practices with traditional Ayurvedic remedies may provide safe, affordable, and accessible treatment options, especially for patients from lower socio-economic backgrounds.

Keywords: Herbs, Oral Hygiene, Gingival Disease, Periodontal Disease, Co morbid Conditions.

Metabolomics in Medicinal Plant Research

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Abstract

Medicinal plants have been used for a long time to treat diseases, but their chemical makeup is very complicated and changes depending on many factors. The healing power of plants comes from a group of chemicals working together known as metabolites, not just a single one. These metabolites can change based on the plant's genes, where it grows, how old it is, and the stress conditions it faces. Old ways of studying plants usually look at one metabolite at a time. This approach misses the full picture of the plant's chemistry. Metabolomics is a new method that allows scientists to look at all the small metabolites in plants at once. It uses tools like nuclear magnetic resonance (NMR), gas chromatography-mass spectrometry (GC-MS), and liquid chromatography- mass spectrometry (LC-MS) to create detailed chemical profiles of plants. These profiles help scientists understand how plants make their primary and secondary metabolites and what effects those metabolites have on the body. This helps in finding new medicines and learning how the chemicals in plants work to help health. Metabolomics is also very useful for making sure herbal medicines are safe and of good quality. By comparing the chemical makeup of different plants, scientists can tell if the plant is real, if it's been mixed with other things, and if different batches are similar. This helps in keeping herbal medicines consistent and reliable. Additionally, metabolomics plays an important role in studying plant responses to environmental and biotic stresses, which often trigger the enhanced production of valuable secondary metabolites. The integration of metabolomics with other omics technologies, including genomics and transcriptomics, has further strengthened pathway elucidation and accelerated drug discovery from medicinal plants. Even though there are still challenges in interpreting the data and identifying all the chemicals, new tools and methods are making these problems easier to solve. So, metabolomics is a powerful way to study medicinal plants.

It connects ancient plant knowledge with modern science to create safe and effective herbal medicines and help sustainably use plant-based medicines.

Keywords: Medicinal plants, Metabolomics, Metabolic profiling, Secondary metabolites, Drug discovery, Omics integration

***Ocimum basilicum*-Based Functional Beverage: Antidiabetic Activity Through Enzyme Inhibition and Improved Glycemic Control in Wistar Rats.**

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Abstract

Diabetes mellitus, characterized by impaired glucose metabolism due to reduced insulin levels or sensitivity, causes persistent hyperglycemia and various complications. This study formulated a cereal-based beverage using barley and oats, enriched with eugenol, a phenolic compound extracted from *Ocimum basilicum* (basil) leaves. The goal was to evaluate the beverage's antihyperglycemic properties through in vitro and in vivo assays, highlighting its potential as a functional food for managing hyperglycemia. Eugenol was extracted using ultrasonic-assisted extraction and encapsulated for stability before infusion into the beverage. The beverage's physicochemical properties were analyzed, including soluble solids, sugar content, antioxidant activity, and eugenol concentration. In vitro tests showed significant inhibition of alpha-glucosidase (85%) and alpha-amylase (70%), indicating strong antidiabetic potential. In vivo tests with Wistar rats were divided into four groups: control, high-fat diet, eugenol-rich beverage, and metformin. The eugenol beverage group showed significant improvements in blood glucose, cholesterol and renal function markers compared to the control group. Histopathological analysis confirmed reduced hepatic and renal tissue damage. The study concludes that the eugenol-infused barley-oat beverage has potent antihyperglycemic and lipid-lowering effects, suggesting its potential as a natural alternative for diabetes management.

Keywords: Hyperglycemia, alpha-amylase, alpha-glucosidase, *in-vitro*, histopathological, anti-hyperlipidemia

Nanotechnology in Medicinal Plant-Based Drug Delivery Systems

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Abstract

Medicinal plants are an invaluable source of bioactive phytochemicals with diverse pharmacological activities, forming the foundation of traditional and modern therapeutic systems. However, the effective clinical application of many plant-derived compounds is limited by poor solubility, low bioavailability, rapid degradation, short biological half-life, and lack of target specificity. In recent years, nanotechnology has emerged as a promising interdisciplinary approach to overcome these limitations and enhance the therapeutic potential of medicinal plant-based formulations. Nanocarrier systems such as polymeric nanoparticles, liposomes, nano emulsions, solid lipid nanoparticles, and metal nanoparticles are

extensively explored for the efficient encapsulation, stabilization, and targeted delivery of phytochemicals. These nanoformulations facilitate controlled release, improved pharmacokinetics, enhanced cellular uptake, and reduced systemic toxicity. Of particular interest is the green synthesis of nanoparticles using medicinal plant extracts, which offers an eco-friendly, cost-effective, and biocompatible alternative to conventional chemical and physical synthesis methods. Recent research demonstrates that phyto-nanomedicines, including nano-curcumin, nano-resveratrol, and plant-mediated silver and gold nanoparticles, exhibit significantly enhanced anticancer, antimicrobial, anti-inflammatory, and antioxidant activities compared to their bulk counterparts. Advances in surface functionalization, nanotoxicological assessment, and targeted drug delivery strategies are further accelerating the translational potential of herbal nanomedicine. These abstract highlights recent advances, mechanistic insights, and future prospects of nanotechnology-assisted medicinal plant-based drug delivery systems, emphasizing their role in bridging traditional herbal medicine with contemporary pharmaceutical research and sustainable drug development.

Keywords: Nanotechnology; Medicinal plants; Phyto-nanomedicine; Drug delivery systems; Green synthesis; Bioavailability; Targeted therapy.

Evaluation of the Phytoremediation Efficiency of *Ricinus communis* L. under Hexavalent chromium Stress.

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Abstract

The present study was undertaken to evaluate the phytoremediation potential of *Ricinus communis* L. under hexavalent chromium (Cr^{6+}) stress, with particular emphasis on its effects on germination, growth, physiological responses, and biochemical characteristics. The experiment was carried out at the Department of Botany, Utkal University, Bhubaneswar, India, where plants were exposed to varying concentrations of hexavalent chromium under controlled conditions. Chromium is a highly toxic heavy metal that poses serious environmental and health risks, and understanding plant responses to chromium stress is crucial for developing eco-friendly remediation strategies. The results revealed that increasing concentrations of Cr^{6+} adversely affected seed germination and early seedling growth. A significant reduction in the seedling vigour index and metal tolerance index was observed in 14-day-old plants, indicating enhanced metal-induced stress. In contrast, the percentage of phytotoxicity increased progressively with rising chromium levels. Biochemical parameters such as chlorophyll content, soluble protein, and proline exhibited notable alterations in response to chromium exposure. At higher chromium concentrations, chlorophyll and soluble protein contents showed variable responses, while proline content declined compared to the control after 60 days of treatment, suggesting impairment of osmoprotective mechanisms. The study also demonstrated a clear relationship between chromium accumulation and plant tissues, with higher concentrations of chromium detected in both roots and shoots as external chromium levels increased. Roots accumulated comparatively higher amounts of chromium, indicating their primary role in metal uptake and sequestration. Furthermore, the activities of antioxidative enzymes, including key defense-related enzymes, increased significantly with elevated chromium concentrations. This enhancement in antioxidant activity suggests an adaptive response of *Ricinus communis* to counteract oxidative stress induced by chromium toxicity. Overall, the findings of this study highlight the tolerance mechanisms of *Ricinus communis* L. under hexavalent chromium stress and confirm its ability to

accumulate and withstand high levels of chromium. The enhanced antioxidant defense system and metal accumulation capacity indicate that *Ricinus communis* is a promising candidate for the phytoremediation of chromium-contaminated soils, offering a cost-effective and environmentally sustainable approach for heavy metal pollution management.

Keywords: Hexavalent chromium, phytoremediation potential, *Ricinus communis*, metal toxicity, antioxidant enzymes

Nutraceutical properties of medicinal plants

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Abstract

Medicinal plants have been an integral part of traditional healthcare systems since ancient times and are increasingly recognized in modern science for their nutraceutical potential. Nutraceuticals are bioactive compounds derived from natural sources that provide health benefits beyond basic nutrition, including disease prevention and health promotion. The nutraceutical properties of medicinal plants are largely attributed to their antioxidant, anti-inflammatory, antimicrobial, antidiabetic, cardio protective, immune modulatory, and anticancer activities. Plant-derived antioxidants, particularly phenolic compounds and flavonoids, play a crucial role in scavenging free radicals and reducing oxidative stress, which is a major underlying factor in the pathogenesis of chronic diseases such as cardiovascular disorders, diabetes mellitus, neuro degenerative diseases, and cancer. Additionally, dietary fibers and phytosterols present in medicinal plants contribute to improved gut health, cholesterol regulation, and metabolic balance. Several medicinal plants commonly used in traditional systems like Ayurveda, Unani, and Traditional Chinese Medicine—such as *Curcuma longa* (turmeric), *Ocimum sanctum* (holy basil), *Withania somnifera* (ashwagandha), *Aloe vera*, and *Moringa oleifera*—have been scientifically validated for their nutraceutical efficacy. These plants not only provide essential nutrients but also exert functional effects at the cellular and molecular levels by modulating enzyme activity, gene expression, and signaling pathways involved in inflammation and immunity. Advances in phytochemistry, biotechnology and nutria genomics have opened new avenues for the identification, extraction, and characterization of bioactive compounds from medicinal plants. Modern analytical techniques and clinical studies are essential to establish scientific validation, Efficiency and regulatory approval of plant-derived nutraceuticals. Thus, medicinal plants possess significant nutraceutical properties that bridge the gap between nutrition and pharmacology. Their integration into modern healthcare systems offers a promising, sustainable and cost-effective approach to the prevention and management of lifestyle-related and chronic diseases, highlighting the need for continued research and development in this field.

Keywords: Medicinal plants, Nutraceuticals, Bioactive compounds, Antioxidants, Functional foods, phytochemicals.

Herbal plants and their application in cosmeceuticals

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Abstract

The concept of beauty and cosmetics is as old as human civilization. In Ayurveda the concept of beauty has an age-old origin. According to Ayurveda healthy skin is a result of overall health condition of individuals and prescribes numerous skin care treatment that needs to be pursued at every stage of life. Cosmeceuticals represent an emerging class of products that combine the principles of cosmetics and pharmaceuticals to enhance beauty while simultaneously improving the health of the skin and hair. Medicinal plants have been used for beauty and personal care since ancient times in traditional systems such as Ayurveda, Siddha, Unani, and folk medicine. These plant-based remedies form the foundation of traditional beauty practices and continue to remain relevant in modern cosmeceutical research. Medicinal plants possess a wide range of bioactive compounds such as antioxidants, flavonoids, phenolics, alkaloids, essential oils, vitamins, and minerals. These compounds contribute to various cosmeceutical properties including anti-aging, anti-acne, anti-inflammatory, antimicrobial, skin-lightening, moisturizing, and hair-strengthening effects. Many chemical cosmetics contain parabens, sulfates, artificial fragrances, and preservatives that may cause skin irritation, allergies, hormonal imbalance, premature aging, and long-term toxicity. Continuous use of such products can damage the skin barrier and disrupt natural physiological processes. In contrast, medicinal plants are biodegradable, eco-friendly, and generally safer for prolonged use when applied in traditional or standardized formulations. Traditional beauty practices emphasize holistic care by addressing the root cause of skin and hair problems rather than providing temporary cosmetic effects. Herbal pastes, oils, powders, and decoctions prepared using traditional methods not only enhance external beauty but also nourish the skin and hair from within. These methods are cost-effective, culturally acceptable, and sustainable, especially in developing countries where medicinal plants are locally available. Moreover, traditional knowledge, passed down through generations, offers valuable insights into the safe and effective use of natural resources. Promoting the use of medicinal plants and traditional methods for beauty care not only supports personal health but also conserves biodiversity and preserves indigenous knowledge. Therefore, integrating traditional herbal wisdom with modern scientific validation can lead to safer, more effective, and environmentally friendly cosmeceutical products.

Keywords: Ayurveda, Cosmeceuticals, Medicinal Plants, Traditional Medicine, Bioactive Compounds

Assessment of Antibacterial Potential of Two Selected Pteridophytic Species Using In Vitro Assays

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Abstract

Naturally occurring plants have served as a valuable source of medicinally important bioactive compounds for thousands of years. A remarkable number of therapeutic drugs in use today have been isolated directly from botanical sources, demonstrating the enduring relevance of plant-based compounds in modern medicine. Many of these bioactive molecules, obtained through selective extraction using various solvents, have been systematically tested for a wide range of pharmacological activities, including

anti-bacterial, anti-fungal, anti-viral, anti-helminthic, and anti-cancer properties. The long-standing tradition of plant-based medicine continues to play a vital role in global healthcare, with approximately 80% of the world's population relying predominantly on traditional medicinal practices for their primary healthcare needs. In light of this, the present study was designed to investigate the medicinal potential of two pteridophytic species, *Thelypteris prolifera* (Retz.) C.F. Reed and *Lygodium microphyllum* (Cav.) R.Br., selected based on their widespread traditional use, easy availability, and limited prior scientific documentation. The study aimed to systematically evaluate their antimicrobial properties against a panel of 13 pathogenic bacterial strains, including six Gram-positive and seven Gram-negative species. Among the strains tested were two antibiotic-resistant pathogenic bacteria, *Escherichia coli* Res and *Staphylococcus aureus* Res, to assess the potential efficacy of these plant extracts against resistant microorganisms. Antibacterial activity was assessed using both qualitative and quantitative approaches. The agar well diffusion assay was employed to measure the diameter of the zone of inhibition (ZOI), providing an initial qualitative indication of antibacterial potential. This was further confirmed using the microdilution broth method, which allowed precise determination of the minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC), reflecting the inhibitory and bactericidal efficacy of the extracts. Among the different solvents used, methanol, ethanol, and distilled water, the ethanolic extracts consistently showed the highest inhibitory and bactericidal activity, suggesting the superior solubility and extraction of bioactive compounds in ethanol. These findings highlight the significant antimicrobial potential of *T. prolifera* and *L. microphyllum*, supporting their continued exploration as promising candidates for developing plant-based antimicrobial agents. This study reinforces the importance of traditional medicinal plants as a valuable source of new therapeutic agents in combating both common and drug-resistant bacterial infections.

Keywords: Pteridophytes, Antibacterial activity, *Thelypteris prolifera*, *Lygodium microphyllum*, In vitro assays, Ethanolic extract.

Azolla as a Green Therapeutic Candidate against Scrub Typhus: Study of Phytochemicals, ADMET and Molecular Docking Perspective

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Abstract

Scrub typhus, caused by the obligate intracellular bacterium *Orientia tsutsugamushi*, is a neglected tropical disease with increasing incidence and clinical severity in endemic regions of Asia, including India. Therapeutic management is challenged by delayed diagnosis, emerging antibiotic resistance, and the lack of an effective vaccine, highlighting the need for alternative, safe, and sustainable therapeutic options derived from natural sources. The present study aimed to evaluate Azolla as a potential green therapeutic candidate against Scrub typhus by identifying bioactive phytochemicals and assessing their inhibitory potential against essential, non-host homologous proteins of *Orientia tsutsugamushi* using an integrated in silico approach. Methanolic extracts of Azolla were subjected to qualitative phytochemical screening and GC-MS analysis for compound identification. A subtractive genomics strategy was employed to identify pathogen-specific essential proteins, followed by functional annotation, conserved domain analysis, and protein-protein interaction studies. Two key targets, *holA* (DNA polymerase III δ

subunit) and sdhB (succinate dehydrogenase iron-sulfur subunit), were structurally modeled and validated. Selected phytochemicals were screened for drug-likeness and ADMET properties prior to molecular docking and molecular dynamics simulations. GC-MS profiling identified cis-aconitic anhydride as the major constituent along with several azido and isothiocyanate derivatives. Docking studies revealed strong binding affinities of Butane-2-azido-2,3,3-trimethyl toward sdhB (-8.02 kcal/mol) and [Bromo(cyano)methyl oxoazanlidene] (tert-butyl) amine toward holA (-4.35 kcal/mol). Stable hydrogen bonding and favorable interaction profiles were confirmed through molecular dynamics simulations. This study demonstrates the therapeutic potential of Azolla-derived phytochemicals as inhibitors of essential replication and energy-metabolism pathways in *O. tsutsugamushi*, providing a robust computational foundation for future experimental validation and natural product-based drug development against scrub typhus.

Key Words: Scrub typhus, Azolla, GC-MS, ADMET, Docking.

Mimetic Polymorphism in *Boquila trifoliata*

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Abstract

Mimetic polymorphism in plants is a rare biological phenomenon in which a single plant species exhibits **multiple, distinct morphological forms that mimic the appearance of other plant species**, usually in response to its immediate environment. Mimicry in animals is rather common, whereas documented cases in plants are rare, and the associated benefits are seldom elucidated. *Boquila trifoliata* stands as one of the most striking examples known to science. Native to the temperate forests of southern South America, this woody vine exhibits a remarkable ability to modify its leaf morphology to closely resemble that of the host plants it climbs. However, according to a side-by-side published commentary, the absence of any plausible hypothesis for such a phenomenon makes this report unexplainable and mysterious. They preferred some chemical volatile signals released from the host plants, which would allow the *B. trifoliolata* to mimic leaves of host plants. As an alternative proposal, they also speculated that horizontal gene transfer between host plant and Boquila vine, mediated perhaps via air-borne microbes, might allow this leaf mimicry. These speculations led to a vague idea as to why the plant does what it does and it was later thought that *B. trifoliolata* gains protection against herbivory not merely by climbing and thus avoiding ground herbivores but also by climbing onto trees whose leaves are mimicked. The complexity of this mimicry after many studies sparked up many suspicions and a third hypothesis completely different from the previous two was proposed. The plant ocelli concept was elaborated by Gottlieb Haberlandt in 1905 which consists of the upper epidermis cells have a planoconvex or convex shape acting as lenses, allowing the convergence of light radiation into light-sensitive subepidermal cells. The simplest way to test the vision hypothesis with the plant would be to see if it would mimic a non-living leaf shape from an artificial plant. In this study, *B. trifoliolata* was exposed to the artificial plastic plant with a characteristic leaf shape. The results of this study show that this is indeed the case as leaves of *B. trifoliolata* mimicked leaves of the artificial plant. *Mimicry may also facilitate coexistence with multiple host species, allowing the plant to exploit a broad ecological niche without specializing on a single host type. Beyond its ecological implications, mimetic polymorphism*

in *Boquila trifoliata* raises fundamental questions about the limits of plant perception, cognition, and evolutionary innovation. The ability of a plant to dynamically and reversibly adjust its phenotype in response to neighbouring species blurs the boundary between passive plasticity and active environmental sensing. As such, *B. trifoliata* offers a unique system for re-examining plant adaptive strategies, the evolution of mimicry outside the animal kingdom, and the complex, often underestimated interactions that structure plant communities.

Keywords: Mimicry, Polymorphism, Ocelli, Modification, Co-existence

Phytoremediation as a Nature-Based Solution for Mitigation of Environmental pollutants

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Abstract

Phytoremediation is a scientifically advanced, plant-based remediation technology that employs higher plants, algae, and their associated rhizospheric microorganisms to remove, immobilize, transform, or mineralize organic and inorganic contaminants from polluted environments. It operates through complex physiological, biochemical, and molecular mechanisms involving root uptake, translocation, sequestration, enzymatic degradation, and interactions with soil microbes. Major phytoremediation strategies include phytoextraction of metals into harvestable biomass, phytostabilization through root-mediated immobilization, phytodegradation via plant enzymes such as dehalogenases and peroxidases, rhizofiltration for aqueous contaminants, and phytovolatilization involving metabolic conversion of pollutants into less toxic volatile forms. At the cellular level, metal tolerance and accumulation are regulated by metal transporters, chelating molecules such as phytochelatins and metallothioneins, antioxidant defense systems, and vacuolar sequestration. Hyperaccumulator species, including *Pteris vittata* (arsenic), *Thlaspi caerulescens* (zinc and cadmium), and *Brassica juncea* (lead), *Azolla pinnata* (Chromium), *Salvinia molesta* (nickel), *Spirodela polyrrhiza* (hexavalent chromium) exhibit enhanced uptake efficiency due to specialized transport and detoxification pathways. The efficiency of phytoremediation is influenced by multiple factors, including contaminant bioavailability, soil physicochemical properties, plant species and genotype, root system architecture, and rhizospheric microbial activity. Furthermore, the application of nanoparticles, chelating agents, and bioaugmentation techniques has improved contaminant uptake and tolerance. Despite limitations such as slower remediation rates and shallow treatment depth, phytoremediation remains a promising, low-cost, and eco-friendly strategy. Its low energy requirement, ecological compatibility, and potential for ecosystem restoration make phytoremediation an important component of sustainable environmental management and pollution mitigation strategies.

Key Words: Phytoremediation, Hyperaccumulator plants, Heavy metal detoxification, Rhizosphere interactions, Phytoextraction, Phytostabilization.

**Botanical Perspectives on Medicinal Plant-Derived Nutraceuticals and Cosmeceuticals:
Phytochemical Diversity and Sustainable Utilization**

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Abstract

Nutraceuticals and cosmeceuticals derived from medicinal plants represent a critical convergence of botanical science, nutrition, and healthcare. These products utilize diverse plant organs including leaves, roots, seeds, flowers, and fruits, which contain bioactive phytochemicals such as alkaloids, flavonoids, phenolic compounds, terpenoids, and vitamins. Botanical investigations of medicinal plants encompass essential aspects of plant taxonomy, morphology, and phytochemical profiling that underpin product development. Nutraceuticals serve to enhance nutritional status and promote health maintenance, whereas cosmeceuticals employ plant-derived compounds for dermal protection, cellular rejuvenation, and aesthetic enhancement. The quality and therapeutic efficacy of these formulations depend critically on precise botanical identification, controlled cultivation practices, optimal harvesting protocols, and appropriate post-harvest processing methods. Growing consumer preference for plant-based products has intensified the need for rigorous botanical research and the implementation of sustainable resource management strategies. This review examines the botanical foundations of medicinal plant-derived nutraceuticals and cosmeceuticals, emphasizing the integration of traditional botanical knowledge with contemporary scientific validation.

Keywords: Nutraceuticals, Cosmeceuticals, Bioactive compounds, Phytochemicals, Sustainable utilization

Potential antiviral agents from marine fungi

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Abstract

Biodiversity of the marine world is only partially subjected to detailed scientific scrutiny in comparison to terrestrial life. Life in the marine world depends heavily on marine fungi scavenging the oceans of lifeless plants and animals and entering them into the nutrient cycle by. Approximately 150 to 200 new compounds, including alkaloids, sesquiterpenes, polyketides, and aromatic compounds, are identified from marine fungi annually. Various genera of marine fungi such as *Aspergillus*, *Penicillium*, *Cladosporium* and *Fusarium* were subjected to compound isolation and antiviral studies, which led to an illustration of the strong antiviral activity of a variety of marine fungi-derived compounds. The present review strives to summarize all available knowledge on active compounds isolated from marine fungi with antiviral activity. A growing body of research indicates that these metabolites display inhibitory effects against a wide spectrum of viruses, including influenza, herpesviruses, HIV, hepatitis viruses and various emergent RNA viruses. Mechanistic studies reveal multiple modes of antiviral action, such as blocking viral entry and fusion, interfering with viral genome replication, inhibiting protease or polymerase activity, and modulating host immune pathways. For example, certain marine-derived

polyketides have demonstrated potent inhibition of viral neuraminidase and reverse transcriptase enzymes, highlighting their therapeutic promise. Despite these promising discoveries, the field remains constrained by technical challenges such as low metabolite yield, difficulty in replicating marine environments for cultivation, and insufficient genomic annotation for biosynthetic pathway prediction. However, new strategies including metagenomic mining, genome-guided natural product discovery, epigenetic regulation, and high-throughput screening platforms are accelerating the identification and optimization of antiviral candidates. Advances in synthetic biology and fermentation engineering further support the feasibility of scaling production of valuable metabolites. In summary, marine fungi constitute a largely untapped reservoir of antiviral agents that may contribute to future drug development. Continued integration of microbiology, natural product chemistry, marine biotechnology and antiviral pharmacology will be crucial for harnessing their full potential against emerging and drug-resistant viral diseases.

Keywords: natural products, marine fungi, active compounds, antiviral agents,

Quality control and regulatory steps for herbal products

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Abstract

Herbal products are medicinal formulations derived exclusively from plant materials, including whole herbs, extracts, tinctures, powders, teas, or oils from leaves, roots, bark, seeds, or flowers, used for therapeutic purposes. Herbal products have been used worldwide for centuries as traditional medicines and health supplements. In recent years, their global demand has increased significantly due to the perception that herbal medicines are natural, safe, and effective. Unlike synthetic drugs, herbal products are complex mixtures of phytochemicals, making their standardization challenging. Therefore, stringent quality control measures and regulatory guidelines are essential to ensure their consistency and reliability. Quality control of herbal products begins with the proper identification and authentication of medicinal plant materials. Botanical verification using macroscopic and microscopic examination, along with taxonomical classification, helps prevent adulteration and substitution. Physicochemical parameters such as moisture content, ash values, extractive values, and pH are routinely assessed to evaluate purity and quality. Phytochemical screening and chromatographic techniques such as Thin Layer Chromatography (TLC), High Performance Liquid Chromatography (HPLC), and Gas Chromatography (GC) are employed for the detection, quantification, and standardization of bioactive compounds. Stringent testing for contaminants—including heavy metals (arsenic, lead, mercury), pesticide residues, microbial loads (e.g., *Salmonella*, *E. coli*), and mycotoxins—is mandatory to mitigate health risks. Regulatory Frameworks. Regulating herbal products is complex due to their diverse classifications as "traditional medicines," "dietary supplements," or "phyto-pharmaceuticals" across different jurisdictions. WHO provides comprehensive guidelines on quality control methods for medicinal plants, emphasizing GMP, documentation and post-market surveillance. In India, herbal medicines are regulated under the Drugs and Cosmetics Act, 1940 and administered by the Ministry of AYUSH, which provides pharmacopeial standards, licensing procedures, and quality benchmarks.

Keywords: Herbal products, Medicinal plants, Bioactive compounds, Phytochemicals, Drugs and Cosmetics Act.

Herbal cosmeceutical of natural alternative skin and hair

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Abstract

Herbal cosmeceuticals are emerging as a new class of byproducts, combining health-promoting medicinal plants with cosmetic uses for skin care and hair care. High demand for consumers' knowledge about the negative impacts of man-made compounds has market demand for natural plant origin compound. Herbal cosmeceutical is rich in biologically active substances like vitamins, essential oils, alkaloids, phenolic, and flavonoids. They have antioxidant, antimicrobial, and anti-ageing properties. Plant elements like tulasi, aloe vera, turmeric, calendula, chamomile, and neem for skin and hibiscus, bhringraj, coconut oil, rosemary, and fenugreek are used for hair. They are classically used for supporting the skin and healthy hair. These natural byproducts promote skin hydration, pigmentation balance, healthy hair growth, and scalp health with few negative effects. As well, herbal cosmeceutical encourages a sustainable and nature-friendly way by utilizing reusable materials and classical awareness methods. Despite their benefits, problems such as regularization quality control and official approval stay important. Scientific verification of safety, usefulness and balance is needed to improve customer confidence and global endorsement. Generally, herbal cosmeceuticals give a favourable, secure and maintainable method to skin and hair care, linking traditional knowledge with modern dermatological science.

Keywords: Cosmeceutical, Alkaloids, Flavonoids, Pigmentation, Endorsement, Dermatological

Therapeutic Potential of Plant-derived Flavonoids on Neurodegenerative Diseases

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Abstract

Neurodegenerative diseases are disorders that destroy motor neurons in the brain or nervous system, responsible for deteriorated mobility, memory, coordination, muscle strength, or cognitive issues, such as Alzheimer's (memory), Parkinson's (movement), Amyotrophic lateral sclerosis (muscle control), and Huntington's disease. Neuronal degeneration in neurodegenerative diseases (NDDs) is accompanied by overactivation of glial cells, typically astrocytes and microglia, defining gliosis, which further contributes to neuronal dysfunction and death. At present, no neurodegenerative disease is completely curable; however, the available standard treatments primarily help reduce symptoms and delay the progression of the disease. Significantly, plant-derived secondary metabolite flavonoids are one of the most important and diversified among natural products phenolic groups comprising of biological properties, such as anti-inflammatory, antioxidant, antiviral and anti-tumour activity. Recent *in vitro* studies have investigated flavonoids, which induce controlled activation of astrocytes and microglia protecting neural progenitor cells, neuronal differentiation and neuritogenesis. It was observed the flavonoids are also able to mitigate

biochemical alternations induced by various NDDs through down-regulating the nitric oxide (NO) levels, by reducing inflammatory molecules like TNF- α and excitotoxicity and by inhibiting enzymes such as monoamine oxidase (MAO) and tyrosine kinase (TK). Furthermore, the objective is directed to identify mechanisms involved in the changes in viability, morphology and function of glial cells induced by flavonoids accompanied with challenges; such as, low bioavailability, poor solubility and variable biological activity, which must be addressed for clinical application.

Key words: flavonoids; neurodegenerative diseases; glial cells; down-regulation; TNF- α ; excitotoxicity; clinical application

The use of medicinal plants for the treatment of toothache in India

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Abstract

Scientific investigation of medicinal plants is essential because of their contribution to healthcare. This paper presents a review of relevant medicinal plants used for toothache treatment in India. This finding based on a review of literature published in scientific journals. A total of 107 plants under 82 genera and 33 families are reported in the reviewed literature. The toothache plant includes 91 wild species, 15 species are under cultivation and 1 species as both wild and cultivated. The growth form of toothache plant includes 32 herbs, one species as twiner / climber, and 38 shrubs and 35 tree species which are being potentially exploited by the Indian population for treatment of toothache. In terms of number of species used, Fabaceae and Asteraceae appeared as the most dominant family represented by 11 species, followed by Euphorbiaceae 8 species. mimosaceae and Solanaceae (7 spp.), Moraceae (5 spp.) Rubiaceae, Apocynaceae and Verbenaceae (4 spp) Apiaceae, Malvaceae and Asclepiadaceae (3 spp), Acanthaceae, Amaranthaceae, Rutaceae, Annonaceae, Rhamnaceae, Sapotaceae, Piperaceae, Arecaceae, Lamiaceae and Myrtaceae (2 spp.) The families like Cucurbitaceae, Dipterocarpaceae, Moringaceae, Anacardiaceae, Caricaceae, Meliaceae, Liliaceae, Vitaceae and Araceae each represents one species. Present finding include the predominance of plant parts used are stem (32%) followed by leaves (29%), roots (24%), latexes (11%), whole plants (6%), seeds (6%), fruits (5%) and flowers (4%). This study demonstrate the importance of traditional medicines in the treatment of toothache in India. It is essential for the health of users to phytochemically demonstrate the effect of medicinal plants for their possible therapeutic applications. Hence future phytochemical and pharmaceutical studies should give due consideration on frequently reported medicinal plants in order to produce natural drugs that could be effective in toothache treatment and without side effects.

Keywords: Toothache, Ethno medicine, India, medicinal plants

Phytochemical Standardization and Regulatory Framework: Ensuring Quality in Herbal Product Manufacturing

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Abstract

The global herbal products industry faces critical challenges in quality assurance due to inherent phytochemical variability and inconsistent regulatory frameworks. This review examines contemporary approaches to phytochemical standardization, emphasizing marker-based quantification, chromatographic fingerprinting, and metabolomic profiling as essential tools for ensuring batch-to-batch consistency and therapeutic efficacy. We critically analyze divergent regulatory paradigms across major markets, including the European Medicines Agency's traditional-use registration, the United States Dietary Supplement Health and Education Act framework, and emerging harmonization efforts through international guidelines. The integration of advanced analytical techniques such as HPLC-MS, DNA barcoding, and spectroscopic methods has revolutionized authentication and quality control protocols. However, significant gaps persist in standardizing complex multi-herb formulations and establishing evidence-based specifications for traditional preparations. We propose a unified framework incorporating good manufacturing practices, validated analytical methodologies, and post-market surveillance to bridge regulatory disparities. Enhanced standardization protocols are imperative for safeguarding consumer health, facilitating international trade, and establishing scientific credibility for herbal therapeutics in modern healthcare systems.

Keywords: Phytochemical standardization, Herbal quality control, Regulatory framework, Analytical validation, Good manufacturing practices

Biotechnological application to *Semecarpus anacardium* L., a medicinally important tree Species

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Abstract

Semecarpus anacardium L. f., commonly known as marking nut or Bhilawa, is a deciduous forest tree native to India and valued for its rich phytochemical composition, including alkaloids, flavonoids, biflavonoids, and other bioactive compounds widely used in traditional medicine. The present study focuses on the development of efficient in vitro propagation and transformation protocols, along with the evaluation of secondary metabolite production. In vitro seed germination was achieved with a frequency of 64%. Multiple shoot proliferation from seedling-derived nodal explants was successfully induced on woody plant medium (WPM) supplemented with BAP and kinetin. Axillary meristems exhibited swelling and formation of meristematic masses at higher concentrations of thidiazuron (TDZ), indicating enhanced meristematic cell proliferation; however, TDZ showed an inhibitory effect on shoot differentiation, which was reversed upon transfer to growth regulator-free medium. Pre-culturing explants in TDZ (2.27 µM) followed by repeated subcultures on regulator-free WPM resulted in optimal shoot multiplication. Mature

nodal explants collected during April–June also produced multiple shoots following TDZ pre-treatment. Rooting of in vitro shoots was achieved with 100% efficiency on half-strength liquid WPM supplemented with indole-3-butyric acid (IBA), and regenerated plantlets were successfully hardened and acclimatized. Cotyledonary explants from semi-mature seeds showed caulogenic and embryogenic responses in TDZ-containing media, with histological studies confirming de novo organogenesis and embryo-like structures. *Agrobacterium rhizogenes*-mediated transformation using strain ATCC 15834 resulted in maximum rhizogenesis, with PCR confirmation of rol gene integration. Importantly, amentoflavone, a pharmacologically significant biflavonoid, was detected in both in vitro regenerated leaves and cotyledon-derived callus tissues, highlighting the biotechnological potential of this species.

Keywords: *Semecarpus anacardium*, Micropropagation, TDZ, Caulogenesis, *Agrobacterium rhizogenes*, Amentoflavone

***Acalypha indica* Linn. and its bioactive compounds - pyrrolidine and 1-hexadecanol against non-small cell lung cancer: Synergistic formulation**

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Abstract

Non-small cell lung cancer (NSCLC) is a serious and chronic illness, accounting for almost 80% of lung cancer deaths in 2020. Due to the adverse side effects of pharmacological treatments, innovative herbal remedies are necessary for improved patient survival. This study aims to ascertain the possible anticancer properties of the methanolic leaf extract of often-underestimated traditional herb *Acalypha indica* (AILME) against A549 cancer cells. Two of the identified bioactive compounds- 1-hexadecanol (Hex) and pyrrolidine (Pyr) were selected and evaluated against the lung adenocarcinoma, independently and in combination. The inhibition of A549 cell growth (IC₅₀ 240.1 µg mL⁻¹) at 24 hr, nuclear deformation along with membrane disintegration, arrest of cell cycle progression in the G0/G1 phase and induction of apoptosis at the early phases confirmed the anticancer potency of the phytochemical extract AILME. Higher number of early-stage apoptotic cells were seen in AILME as compared to its control at IC₅₀. AILME-treated cells showed a notable decline in the visibility of live cells and an increase in the number of shrunken cells along with some apoptotic bodies as the drug concentration increased. These results may be attributed to the presence of specific bioactive chemicals, including pyrrolidine, hexadecanoic acid, 1-hexadecanol, 2,3-dihydrofuran, and octadecanoic acid, as detected by GC-MS analysis. The combination of Hex + Pyr, significantly increased cytotoxicity, which confirmed the synergy between the two bioactive compounds in anticancer effectiveness in comparison to their individual anticancer action. The combined treatment also showed decreased DNA count and early apoptosis, providing mechanistic insights into cancer treatment. The downregulation of targeted apoptosis-regulating proteins such as EGFR, COX-2, IκB, and NFκB indicates a potential mechanism for the triggering of apoptosis by the phytocompounds. The results indicated that Hex + Pyr significantly inhibited cancer cell growth by

enhancing apoptosis through the EGFR tyrosine kinase signaling pathway and the NFκB canonical pathway. Furthermore, the combination therapy demonstrated more favorable outcomes than the individual therapies, indicating potential for combinatorial medicines. In addition, the study postulates an interconnection between the receptor-mediated pathway and the canonical pathway.

Keywords: *Acalypha indica* Linn., anticancer, apoptosis, cell cycle arrest, western blot

Standardization and Quality Control of Herbal Products: A Botanical Approach

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Abstract

Herbal products occupy a central position in global healthcare systems, offering therapeutic benefits derived from medicinal plants. Ensuring their quality, safety, and efficacy requires comprehensive standardization protocols rooted in botanical science. Variability in plant species, cultivation conditions, harvesting practices, and processing methods directly influences phytochemical profiles and therapeutic outcomes. Critical quality control measures include taxonomic authentication, macroscopic and microscopic botanical characterization, physicochemical evaluation, chromatographic fingerprinting, and contaminant analysis for microbial pathogens and heavy metals. Regulatory frameworks established by the World Health Organization (WHO), national pharmacopoeias, and agencies such as AYUSH in India provide essential guidelines for Good Agricultural and Collection Practices (GACP) and Good Manufacturing Practices (GMP). Standardization through validated analytical methods ensures batch-to-batch consistency, therapeutic reliability, and consumer safety. Harmonization of international regulatory standards and implementation of robust quality assurance systems are imperative for scientific credibility and global market integration of herbal therapeutics.

Keywords: Herbal standardization, Good Manufacturing Practices, Quality control, Botanical authentication, Phytochemical analysis

Assessing the Impacts of Forest Fires on the Diversity, Abundance and Population Dynamics of Medicinal Plants

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Abstract

Recurrent forest fires have emerged as a major ecological stressor, affecting forest ecosystems worldwide, particularly in fire-prone tropical and subtropical regions and exerting profound impacts on biodiversity, particularly on understorey vegetation and medicinal plant populations in tropical forest ecosystems. Medicinal plants, which play a crucial role in traditional healthcare systems and biodiversity conservation, are highly sensitive to changes in habitat structure and microclimatic conditions caused by fire. The present study evaluated the quantitative effects of recurrent forest fires on the population density of nine important medicinal plant species-*Asparagus racemosus*, *Celastrus paniculatus*, *Cissampelos*

pareira, *Curculigo orchioides*, *Dioscorea bulbifera*, *Hemidesmus indicus*, *Osbeckia stellata*, *Rauvolfia serpentina* and *Rothea serrata*, across the study area over a three-year period (2021-2024). Population data were obtained through quadrat-based sampling and interannual variations were analysed to identify trends in abundance and decline. The findings indicated a consistent decrease in population density across all studied species. Among them, *R. serrata* and *C. paniculatus* were the most fire-sensitive, whereas *D. bulbifera* and *C. orchioides* exhibited relatively greater resilience. The study concludes that repeated forest fire events pose a serious threat to the survival and regeneration of medicinal plants, resulting in long-term depletion of forest genetic resources and weakening traditional healthcare systems reliant on these species. Urgent conservation measures, including effective fire management, assisted regeneration, and community-based monitoring, are therefore essential to safeguard medicinal plant diversity and maintain ecological integrity in fire-prone tropical forests.

Keywords: Biodiversity, Bonai Forest Division, conservation, disturbance ecology, population dynamics

Phytochemical analysis and Pharmacology activities of *Paederia foetida* and Important medicinal plant for *Rheumatoid arthritis*

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Abstract

Odisha is well known for its rich tradition of using plants for healing and health care. From ancient times, people have depended on nature for food, shelter, and medicine. The knowledge of using plants as medicine has been passed down through generations, especially among tribal communities. This knowledge is a part of their culture and daily life. Even today, when modern medicines are available, many people in rural and tribal areas continue to depend on local plants for treating common as well as serious diseases. Rheumatoid arthritis (RA) is a chronic autoimmune inflammatory disorder that primarily affects synovial joints, leading to pain, swelling, and progressive joint damage. Traditional medicinal plants have long been used in India for the management of rheumatoid and arthritic conditions due to their anti-inflammatory and immunomodulatory properties. *Paederia foetida*, commonly known as Prasari, is an important ethnomedicinal plant widely used in folk and Ayurvedic medicine for treating rheumatism and joint disorders. Phytochemical analysis of *Paederia foetida* reveals the presence of bioactive constituents such as flavonoids, alkaloids, tannins, saponins, phenolic compounds, steroids, and terpenoids. These phytoconstituents are responsible for its wide range of pharmacological activities. Experimental studies have demonstrated significant anti-inflammatory, analgesic, antirheumatic, antioxidant, antimicrobial, and immunomodulatory effects of *P. foetida* extracts, supporting its traditional use in rheumatoid arthritis.

Keywords: Rheumatoid arthritis, *Paederia foetida*, Phytochemical, Anti-inflammatory, Ethnomedicine, Traditional.

Phytochemical, Antioxidant and *In-Silico* Insights of *Ixora coccinea* Leaf Extract as a Natural Lead against Leucorrhoea

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Abstract

Medicinal plants have long been integral to both traditional and modern healthcare, providing essential raw materials for medicines. *Ixora coccinea*, an ornamental shrub recognized for its diverse medicinal properties, is traditionally used by the Munda communities of Jajpur district, Odisha, as an important herbal remedy for treating leucorrhoea. This study evaluated the proximate composition, phytochemical content, antioxidant capacity and the pharmacological significance of the *Ixora coccinea* leaf aqueous extract. Initial phytochemical screening of the extract depicts the presence of phenols, flavonoids, alkaloid and terpenoids etc, with terpenoids being the most abundant (12.23±0.69 mg UAE). FTIR analysis confirmed the presence of functional groups such as C–H, O–H and C=O indicating key bioactive constituents. *I. coccinea* leaf aqueous extract showed excellent antioxidant activities verified with IC₅₀ values 6.33 mg/ml (DPPH) and 0.29 mg/ml (ABTS⁺) and a FRAP value of 11.19 mg/ml AAE. LC-HRMS/MS profiling led to the identification of 68 phytocompounds in the positive and negative ionization modes. Among them, Uscharidin exhibited the strongest binding affinity (–8.4 kcal·mol^{–1}) to cysteine protease, a major virulence factor in *Trichomonas vaginalis* and *Candida albicans*, as evidenced by molecular docking studies. The *in-silico* ADME prediction represented pharmacokinetic and drug-likeness properties that are quite favourable. The results shown thus lend credence to the effectiveness of *Ixora coccinea* as a natural source of therapeutics against leucorrhoea-associated pathogens.

Keywords: *Ixora coccinea*, antioxidant, LC-HRMS/MS, molecular docking, leucorrhoea, Odisha

A Comprehensive Review on the Medicinal and Phytochemical Properties of Moraceae Species in Religious Practices

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Abstract

The Moraceae family, encompassing several plant species of ecological, medicinal, and cultural significance, has been integral to traditional healing systems and religious rituals across diverse cultures. This review aims to provide a comprehensive synthesis of the medicinal and phytochemical properties of Moraceae species, particularly those with notable religious significance. Key species, including *Ficus* spp., *Broussonetia papyrifera*, and *Morus* spp., have been utilized not only for their therapeutic benefits but also in spiritual and ritualistic contexts, where their leaves, fruits, and bark often hold symbolic meaning. The review highlights the bioactive compounds identified in these species, such as flavonoids, alkaloids, terpenoids, and tannins, which contribute to their antimicrobial, anti-inflammatory, antioxidant, and adaptogenic properties. Moreover, the ethnopharmacological applications of these plants in managing ailments like gastrointestinal disorders, respiratory issues, and skin conditions are explored in detail. In parallel, the spiritual and symbolic roles these plants play in various religious practices, from Hinduism to

Buddhism and indigenous belief systems, are examined. This review not only underscores the dual role of Moraceae species in both healing and religious contexts but also suggests the potential for further scientific investigation into their phytochemistry and therapeutic applications. The growing interest in ethnobotany and phytomedicine calls for a multidisciplinary approach to fully understand the convergence of medicinal use and religious reverence, offering opportunities for future research and sustainable applications of these valuable species.

Keywords: Medicinal properties, Ethnopharmacology, Religious practices, Sacred plants, Bioactive compounds

Unveiling the therapeutic potential of *Cleistanthus collinus* leaf essential oil: Volatile composition, cytotoxicity, antioxidant capacity and tyrosinase Inhibition

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Abstract

Cleistanthus collinus (Roxb.) Benth. ex Hook. f. (Phyllanthaceae), though considered as a poisonous plant, is an important species in the traditional system of medicine with diverse pharmacological properties. However, the chemical composition and biological potential of its essential oil remain unexplored. The present study, for the first time, reports the chemical profiling and bioactivities of *C. collinus* leaf essential oil. Solvent-free microwave-assisted extraction yielded 0.6% (v/w) essential oil on a dry weight basis. GC-MS analysis identified 23 constituents accounting for 90.58% of the total oil, with oxygenated diterpenes as the dominant class of compounds. Phytol (42.27%) was the major constituent, followed by farnesyl acetone (22.73%), cembrene A (5.06%), α -ionone (2.10%), and methyl linoleate (2.21%). MTT assay revealed selective cytotoxicity against different cell lines; with greater sensitivity towards MCF-7 cells ($IC_{50}=60.02\pm0.21$ μ g/mL) compared to A549 cells ($IC_{50}=123.00\pm0.43$ μ g/mL) and minimal toxicity towards normal HEK293 cells ($IC_{50}>200$ μ g/mL) compared to doxorubicin. Antioxidant activity assays revealed moderate scavenging activity against DPPH ($IC_{50}=18.96\pm0.02$ mg/mL) and ABTS ($IC_{50}=16.74\pm0.04$ mg/mL). Additionally, the oil demonstrated moderate tyrosinase inhibitory potential ($IC_{50}=2.22 \pm 0.31$ mg/mL) in comparison to standard kojic acid (IC_{50} 90.23 μ g/mL). Overall, the study highlights the therapeutic potential of *C. collinus* leaf essential oil, and validates the traditional claims on its prospective application in pharmaceutical and cosmetic industries. However, proper toxicity evaluation and *in vivo* studies are necessary to arrive at a scientific conclusion.

Keywords: Traditional, *in vivo*, Toxicity, Antioxidant, MTT assay

Herbal Derivatives for Tuberculosis Treatment

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Abstract

Tuberculosis (TB) continues to pose a serious threat for human life. The problem is further mounted by Multi Drug Resistant (MDR) and Total Drug Resistant (TDR) cases. The disease is caused by *Mycobacterium tuberculosis* (MTB). Therefore, there is a clarion call to look for novel drugs for the

pathogen. The cell wall of *Mycobacterium tuberculosis* (MTB) is a validated target for present day therapeutics. α -L-rhamnosyl-(1 $\rightarrow$ 3)- α -D-N-acetyl-glucosaminosyl-1-phosphate, the disaccharide linker works like a coupler cementing the mycolyl arabinogalactan layer to the peptidoglycan layer. Hence, it is crucial for very existence of the cell wall and the bacterium in turn. Of these components, the L-rhamnosyl residue is not found in human, thus offering its biosynthetic enzymes as putative drug targets. The biosynthesis of L-rhamnose is carried out by an array of enzymes, viz. RmlA, RmlB, RmlC and RmlD, those work in cascade. In this work, RmlC is preferred as drug target over other for its high substrate specificity. Ethnobotany works hand in gloves with traditional knowledge system and it advocates the use of plant products for development of modern therapeutics. The presented investigation was an attempt to find out plant derivatives as possible drug candidates for tuberculosis. Virtual screening followed by many *in-silico* analyses helped the investigator to forward few NPACT database compounds as possible drugs for Tuberculosis treatment.

Keywords: Tuberculosis, MDR, MTB, NPACT, Ethnobotany

Bioactive Compounds and Skincare

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Abstract

Bioactive compounds play a significant role in the development of skin care cosmeceuticals, these offers various benefits for skin health. These compounds are derived from natural sources such as plants, herbs, and food and are known for their antioxidant, antiinflammatory, and antimicrobial properties. Bioactive compounds help in enhancing moisture, elasticity, and barrier function of the skin, combating oxidative stress, inflammation, hyperpigmentation, and infections. Some of the most studied plants in terms of their cosmeceutical potential include Aloe vera, Curcuma longa (turmeric), Camellia sinensis (green tea), and Centella asiatica (gotu kola). These plants are known for their ability to inhibit collagen synthesis, melanin production, and free radical production, contributing to improved skin health. The latest developments in formulation technology, such as nanoencapsulation and liposomal delivery systems, have enhanced the stability and bioavailability of plant derived ingredients. However, there are concerns regarding variability in plant composition, standardization of extracts, and the potential risk of adverse effects. Future studies should focus on clinical validation, new formulation strategies, and scaling up production to meet the growing consumer demand for natural and sustainable ingredients in cosmeceuticals.

Key words: Bioactive compound, cosmeceuticals



Plant Biotechnology

Tissue Culture: A Sustainable Approach for Medicinal Plant Generation

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ABSTRACT

Hedychium coronarium J. Koenig, commonly known as white ginger lily, is an important medicinal and aromatic plant widely used in traditional medicine for its anti-inflammatory, antimicrobial, antioxidant, and wound-healing properties. The rhizomes, leaves, and flowers of this plant are rich sources of bioactive compounds such as phenolics, flavonoids, terpenoids, and essential oils. However, large-scale utilization of *H. coronarium* is constrained by conventional propagation methods, which are slow, season-dependent, and vulnerable to biotic and abiotic stresses. Plant tissue culture offers a reliable and sustainable alternative for the rapid multiplication and conservation of *H. coronarium*. In vitro propagation is commonly achieved using explants such as rhizome buds, shoot tips, and axillary buds cultured under aseptic conditions. Murashige and Skoog (MS) basal medium is most frequently employed for culture initiation and shoot proliferation, supplemented with appropriate concentrations of cytokinins such as 6-benzylaminopurine (BAP) and kinetin, either alone or in combination with auxins. These media formulations promote efficient shoot induction, multiplication, and elongation. Rooting of regenerated shoots is typically achieved on half-strength MS medium supplemented with auxins such as indole-3-butyric acid (IBA) or naphthalene acetic acid (NAA), resulting in healthy root systems suitable for acclimatization. In addition to micropropagation, callus induction from leaf or rhizome explants using MS medium fortified with auxins like 2,4-dichlorophenoxyacetic acid (2,4-D) plays an important role in in vitro biomass production and secondary metabolite enhancement. Cell suspension cultures and elicitation strategies further contribute to improved yield of medicinally valuable compounds under controlled conditions. The use of optimized culture media and growth regulators ensures genetic uniformity, disease-free planting material, and consistent phytochemical profiles. Overall, tissue culture-based propagation of *Hedychium coronarium* using optimized methods and media provides an efficient approach for large-scale plant production, conservation, and sustainable utilization. These in vitro techniques not only reduce pressure on natural populations but also support the continuous supply of high-quality medicinal raw material for pharmaceutical and herbal industries.

Keywords: bioactive, pharmaceutical, aseptic condition, herbal, application

Plant Tissue culture in conservation of medicinal plants

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ABSTRACT

Medicinal plants are an important part of traditional as well as modern medicine, but many valuable medicinal species are now becoming rare, threatened, or endangered due to over-exploitation from the wild, habitat destruction, and climate change. Important medicinal plants such as *Ginkgo biloba*, *Rauwolfia serpentina*, *Picrorhiza kurroa*, *Swertia chirayita*, *Saussurea lappa*, *Taxus brevifolia*, and *Dactylorhiza hatagirea* are facing serious decline in their natural populations. In many cases, conventional propagation methods like seeds and vegetative cuttings are slow, seasonal or unsuccessful

which makes conservation difficult. Plant tissue culture (PTC) has emerged as an effective method for the conservation and mass propagation of endangered medicinal plants. It allows rapid multiplication of plants under sterile and controlled laboratory conditions, producing disease-free, genetically uniform, and good-quality planting material throughout the year. Micropropagation is usually carried out using explants such as shoot tips, nodes or leaves grown on nutrient media containing plant growth regulators like auxins and cytokinins to induce callus formation, shoot regeneration, or somatic embryogenesis. Advanced techniques such as bioreactors and hairy root culture are also used for large-scale propagation and enhanced production of secondary metabolites. At the global level, plant tissue culture has been successfully applied to medicinal plants like *Taxus brevifolia*, *Panaxginseng*, *Ginkgo biloba*, and *Hypericum perforatum*. In vitro cultures are also used for commercial production of important compounds such as vinblastine, vincristine, and shikonin. Recent studies have shown that the use of LED light combinations (blue and red) can improve secondary metabolite production in endangered species. India, being a biodiversity-rich country, has achieved notable success in medicinal plant tissue culture with support from the Department of Biotechnology (DBT). More than 46 commercial tissue culture units and research institutes like CSIR-IHBT, NBRI, NBPGR, IIIM, KFRI, and TDU Bengaluru have developed protocols for endangered plants such as *Picrorhiza kurroa*, *Saussurea lappa*, *Rauwolfia serpentina*, *Ceropegia* species, and *Aconitum chasmanthum*. Although challenges like contamination, high cost, and field establishment remain, plant tissue culture plays a key role in conserving endangered medicinal plants and ensuring their sustainable use.

Keywords: Plant tissue culture, Endangered medicinal plants, Micropropagation, Secondary metabolites, Conservation

Optimized *In Vitro* Micropropagation Protocol for ‘Winter Dawn’ Strawberry (*Fragaria* × *ananassa*): A Cost-Effective Strategy for Sustainable Commercial Cultivation

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Abstract

The cultivation of strawberries (*Fragaria* × *ananassa*), traditionally reliant on runner propagation, is constrained by several challenges, including disease transmission, limited scalability, and high transportation costs. To address these issues, a comprehensive and efficient in vitro micropropagation protocol was developed for the commercially significant ‘Winter Dawn’ cultivar. This optimized protocol encompasses critical stages of tissue culture sterilization, shoot induction, multiplication, rooting, and hardening to enable rapid and disease-free plant production at a reduced cost. Explants derived from runners were successfully sterilized using a combination of 4% sodium hypochlorite (NaClO) and 0.1% mercuric chloride (HgCl₂), achieving 100% contamination control without compromising tissue viability. For shoot induction, explants cultured on SM3 medium (Murashige and Skoog medium supplemented with 1.0 mg/L benzyl aminopurine (BAP) and 0.1 mg/L kinetin) exhibited a remarkable 87% regeneration rate, producing 6-10 shoots per explant during subsequent subculturing cycles. Rooting was optimized on RM2 medium (MS medium fortified with 1 mg/L indole-3-butyric acid (IBA)), which yielded an exceptional rooting efficiency of 94%. The rooted plantlets developed robust root systems with an

average root length of 12.2 cm within 45 days. The primary phase was bypassed, and plantlets were directly transferred to a soil-vermicompost mixture (HM2), achieving a 100% survival rate under controlled polyhouse conditions. This optimized micropropagation protocol is a significant advancement for commercial strawberry cultivation, offering a reliable and scalable method to produce high-quality, disease-free planting material. By reducing reliance on traditional propagation and minimizing transportation and disease management costs, this protocol paves the way for sustainable strawberry production in India and beyond.

Keywords: *Fragaria* × *ananassa*, Hardening, In vitro propagation, Micropropagation, Winter Dawn.

***In vitro* Propagation of the Threatened Ornamental and Medicinal Orchid *Rhynchosyilis retusa* (L.) Blume.**

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Abstract

Orchids are highly valued as cut flowers and ornamental pot plants because of their remarkable floral beauty. In addition to their ornamental appeal reflected in diverse colours, foliage forms, and fragrances orchids possess notable medicinal importance. Several species are extensively used in traditional medicine systems due to the presence of bioactive phytochemicals with therapeutic potential. *Rhynchosyilis retusa*, a monopodial and epiphytic orchid native to the region, is traditionally used for the treatment of rheumatic disorders, asthma, malarial fever, and blood dysentery. However, increasing commercial demand, slow propagation through conventional methods, and continuous habitat degradation have led to a decline in its natural populations. To overcome these constraints, the present study aimed to develop an efficient in vitro a symbiotic seed germination and seedling development protocol for large-scale propagation and conservation. Mature seed capsules were collected and subjected to sequential surface sterilization before aseptic inoculation on Murashige and Skoog (MS) basal medium under controlled culture conditions. Seed germination was initiated by seed swelling, followed by the formation of protocorm-like bodies (PLBs), which subsequently differentiated into seedlings. Shoot induction and multiplication were successfully achieved on MS medium supplemented with 6-benzylaminopurine (BAP) in combination with α -naphthaleneacetic acid (NAA). Root induction was optimized separately using MS medium fortified with indole-3-acetic acid (IAA) or NAA, with IAA showing superior root elongation and enhanced plantlet vigor. The addition of activated charcoal further improved shoot and root development and overall seedling quality. The optimized protocol supported uniform growth, rapid plantlet development, and successful acclimatization with high survival rates. This reproducible and scalable method provides an effective strategy for ex situ conservation, sustainable utilization, and medicinally important mass propagation of *R. retusa*, contributing to its long-term preservation of this endangered orchid species.

Keywords: Orchid, *In vitro* Propagation, Ex situ conservation, Endangered, Acclimatization

***Agrobacterium rhizogenes*–induced hairy root culture of *Vitex negundo*: molecular confirmation using *rol* and opine genes.**

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Abstract

Vitex negundo L. is an important medicinal plant of the family Lamiaceae. The root of this plant is known for its use in the treatment of different types of ailments including diabetes, asthma, bronchitis, malaria, colic, boils, leprosy, rheumatism, etc. Use of any root by uprooting the plant is never a sustainable approach. Thus, *A. rhizogenes* mediated hairy root culture was established in *V. negundo* for large scale root biomass production with an aim to fulfil the demand in a sustainable manner. Different parameters influencing *A. rhizogenes* mediated hairy root induction and proliferation such as OD, infection time, concentration of acetosyringone and co-cultivation period were optimised. Two *A. rhizogenes* strains (MTCC 532 and MTCC 2364) were used for hairy root induction. Different types of explants i.e., leaves and internode from *in vitro* as well as *in vivo* source were used for hairy root induction. Better hairy root induction was observed in *in vitro* explants (88.8% in leaf and 72.2% in internode) with compared to the *in vivo* explants (27.7% in leaf and 33.3% in internode). The highest transformation efficiency was observed in case of MTCC 2364 with 45 minutes of infection time, 0.8 OD value and 48 hours of co-cultivation period. The *rolB* ORF was detected in hairy root somaclones (rhizoclones) through PCR amplification. The presence of *man2* gene, transferred with T_R-DNA, was also confirmed by PCR amplification in all selected rhizoclones. The developed protocol is a step forward for large scale hairy root production and enhance the bioactive compounds located in root of *V. negundo*.

Keywords: *Agrobacterium rhizogenes*, Rhizoclones, *rolB* and *man2* gene, *Vitex negundo*.

GC-MS Profile of *In Vivo* and *In Vitro* Leaves of *Uvaria hamiltonii* Hook. f. & Thomson

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Abstract

Uvaria hamiltonii Hook. f. & Thomson belongs to the family Annonaceae and is a perennial woody climbing shrub rich in medicinal properties. It is commonly known as ‘Lakankuli’ in Odisha. In India, it has been dispersed in Uttar Pradesh, Bihar, Sikkim, West Bengal, Assam, Meghalaya, Tripura, Odisha and Andhra Pradesh. Traditionally, leaf, stem and root extracts of this plant have been used as an efficient drug. Its potential medicinal properties include treatment and prevention of cancer, diabetes mellitus, malarial fever, bronchitis and bacterial infections. The medicinal value of this plant is due to the presence of different types of secondary metabolites namely alkaloids, steroids, phenolics, saponins, tannins, terpenoids, iridoids and cardiac glycosides. Owing to low seed availability, poor germination efficiency and being placed under the “threatened” category of plants, the conventional propagation of *U. hamiltonii* falls short to cater its commercial demands, particularly for secondary metabolite production. These conventional methods are also not preferred for pest and disease problems. Therefore, there is a great need to look for biotechnological approaches like tissue culture for producing season independent plants on large scale which will provide sufficient raw materials of uniform quality for pharmaceutical purposes.

An efficient *in vitro* axillary shoot proliferation protocol has been developed for *U. hamiltonii*. The mature nodal explants were inoculated on MS medium supplemented with various kinds of concentrations and combinations of plant growth regulators. The rate of multiple shoot induction per explant was a maximum of 6.15 ± 0.13 shoots of average shoot length 6.72 cm on Murashige and Skoog's (MS) medium augmented with 1.0 mg/L 6-benzyladenine (BA) and showed 100% response. A maximum of 70.83% rooting of *in vitro* regenerated shoots was achieved on ½ strength MS augmented with 4.0 mg/L Indole-3-butyric acid (IBA) with an average of 3.27 ± 0.25 roots per shoot. In the present study, the biochemical stability is assessed through the GC-MS analysis. The GC-MS technique demonstrated similar compounds in the leaf essential oil of both mother and micropropagated *U. hamiltonii* derived from nodes. Mainly, compounds like longifolene, gurjunene, caryophyllene, muurolol are found to be present in both samples with no discernible variations in their content. The plant can be further explored and exploited for the benefits of mankind in a rational manner.

Keywords: Caryophyllene, GC-MS, Gurjunene, Longifolene, Murashige and Skoog (MS), *Uvaria hamiltonii*.

Development and molecular validation of F₁ hybrids for introgression of the *DEP1* gene into restorer lines of Ajay and Rajalaxmi through Marker-Assisted Backcross Breeding

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Abstract

The *DEP1* (*DENSE AND ERECT PANICLE 1*) gene is a major regulator of panicle architecture and grain yield in rice. Incorporating favourable allele of *DEP1* into elite restorer lines can improve hybrid seed production efficiency and enhance productivity in commercial rice hybrids. In the present study F₁ generation was developed for the introgression of the *DEP1* allele into popular restorer lines of Ajay and Rajalaxmi, using marker-assisted backcross breeding (MABB). Ajay and Rajalaxmi are important lines widely used in hybrid rice programs as both can benefit from targeted genetic improvement of panicle traits. Marker-assisted backcross breeding (MABB) provides a precise and efficient strategy for introgressing key yield-enhancing genes while preserving the elite background of established lines. In this study the initial focus was on the development and validation of the F₁ generation derived from crosses between a single *DEP1* donor and the restorer line. The F₁ generation plays a crucial role in MABB because it ensures successful transfer of the target allele before beginning systematic backcrossing. Crosses were made between donor parents carrying the favorable *DEP1* allele and the target restorer lines followed by molecular confirmation of hybridity using *DEP1*-linked markers. The F₁ plants exhibiting the heterozygous *DEP1* genotype were identified and selected for subsequent backcrossing. Molecular confirmation was conducted using (**DEP1 INDEL1 and S5**) linked to the *DEP1* locus. This study successfully established true F₁ populations in both genetic backgrounds, ensuring efficient transfer of the target gene and enabling precise selection in further generations. The development and validation of F₁ hybrids provide a foundational step toward creating improved restorer lines with enhanced panicle traits and higher yield potential through marker-assisted breeding. These validated F₁ individuals form the

essential starting material for subsequent backcross cycles aimed at introgressing *DEPI* into restorer lines of the Ajay and Rajalaxmi genomic backgrounds with minimal linkage drag.

Keywords: *DEPI* gene, F1 generation, Marker Assisted Backcross Breeding (MABB), restorer lines, and introgression

Genetic variation in *NRT1.1B* haplotypes enhances yield performance under combined low nitrogen and phosphorus conditions in *Indica* rice

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Abstract

Nitrogen (N) and phosphorus (P) deficiencies commonly coincide in rice-growing soils and severely reduce yield, yet the genetic basis of tolerance to combined N–P stress remains poorly understood. *NRT1.1B*, a key nitrate transporter enhancing nitrogen use efficiency, is well studied under N deficiency but its role under simultaneous N–P deficiency is unknown. This study investigates *NRT1.1B* (*LOC_Os10g0554200*; *chr10:21757771-21762202*) haplotypes in 223 indica accessions to identify superior variants associated yield traits under combined N–P deficiency. A total of 223 indica accessions were evaluated using 36 SNPs for haplotype analysis, and their phenotypic performance was associated with plant height (PH), flag leaf traits (FLL, FLW), panicle traits (NP, PL, NGP, branches, chaffy grains), 1000-grain weight (1000GW), and single plant yield (SPY) respectively. Five major haplotypes emerged, with H05 superior for flag leaf length (FLL; $p=0.046^*$), flag leaf width (FLW; $p=0.046^*$), number of panicles (NP; $p=0.017^*$), panicle length (PL; $p=0.028^*$), number of grains per panicle (NGP; $p=0.027^*$), 1000-grain weight (1000GW; $p=0.0068^{**}$), and single plant yield (SPY; $p=0.03^*$) versus H04. Overall, *NRT1.1B* showed significant associations with all measured traits (z-test $p<0.05$), highlighting its potential role in improving yield under nutrient stress. Correlation analysis showed strong positive relationships among key yield traits. PL was highly correlated with FLW ($r = 0.90^{***}$). SPY showed a strong correlation with NGP ($r = 0.72^{***}$). Similarly, 100GW was strongly correlated with NPB ($r = 0.85^{***}$). Overall, these results indicate that yield improvement is closely linked with panicle architecture and grain number traits. These findings link *NRT1.1B* haplotypes to enhanced yield under N–P stress, extending its known NUE role to sustainable rice breeding. For Future Prospects, the superior haplotype H05 should be functionally validated through precision gene editing technologies such as *CRISPR-Cas9* in elite indica rice lines, tested under varying field conditions with differential nitrogen and phosphorus availability to confirm its contribution to nutrient use efficiency and yield stability.

Key Words: Haplotypes, Marker traits association, Low Nitrogen, Low Phosphorus and Nitrate transporters

Genetic diversity assessment of popular varieties using nitrogen uptake/efficiency associated simple sequence repeat markers in rice

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Abstract

Rice (*Oryza sativa* L.) is a major staple food crop that sustains nearly half of the global population, and its continuous improvement is essential for meeting future food demands. Understanding the genetic diversity and population structure among popular rice varieties is essential to enhance breeding strategies to increase grain yield. Nitrogen is one of the most important nutrients influencing plant growth, productivity, and overall physiological efficiency. However, limited studies have comprehensively characterized genetic variation among the rice varieties for nitrogen uptake or use efficiency related markers. A clearer understanding of the genetic diversity is essential for identifying nitrogen-efficient genotypes and improving nutrient-use efficiency. This study explored the genetic diversity of 25 popular rice varieties during the *kharif* season 2025. Genomic DNA was extracted from these young seedling leaves using a modified CTAB method to ensure good quality DNA suitable for molecular analysis. A total of 18 SSR markers were used to evaluate genetic variation across the genotypes. Gene diversity values were estimated using PowerMarker v3.25, alongside analysis of molecular variance (AMOVA) were performed using GenAlEx V6.5 to elucidate population structure and genetic differentiation. Results revealed that SSR markers showed considerable variation in their ability to detect genetic differences. The average gene diversity across all loci was 0.2305, indicating moderate variability among the varieties. The highest diversity was recorded at marker *RM17* (0.665), which also showed the highest observed heterozygosity ($H_o = 0.24$), suggesting that this marker was particularly informative for distinguishing genetic differences. AMOVA provided further insights into how the genetic variation was distributed. It showed that 17% of the total variation occurred among populations, 74% among individuals, and 9% within individuals. These findings provide important genetic insights for rice breeding program aimed at improving nitrogen use efficiency and yield under diverse agronomic conditions.

Keywords: Genetic diversity, Nitrogen uptake, Simple sequence repeat marker, Molecular variance

Targeted manipulation of auxin response factor 6 (*ARF6*) gene using CRISPR-Cas9 genome editing tool to improve productivity in *indica* rice

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Abstract

Tiller number and tiller angle are two of the most critical agronomic traits that determine overall plant architecture, light interception efficiency, and ultimately grain yield in rice. Among all the genes regulating these traits, the Auxin Response Factor 6 (*ARF6*) gene play a significant role in modulating auxin-mediated signaling pathways that govern axillary bud outgrowth, tillering behavior, and spatial tiller orientation. Given its central regulatory function, *ARF6* represents a promising target for precise genome editing to develop rice varieties with desirable architectural traits. In this study, the CRISPR-Cas9 genome editing system was employed to functionally manipulate *ARF6* in two widely cultivated, high-yielding *indica* rice varieties, IR 64 and MTU 1010 to enhance productive tiller formation. A gene-specific 20 bp target sequence located within the exon region of the *ARF6* gene was identified and selected based on PAM compatibility and minimal predicted off-target activity. The guide RNA (gRNA) targeting this sequence with U3 promoter and assembled within the pRGEB32 binary vector backbone, with Cas9 endonuclease expression cassette. The recombinant CRISPR-Cas9 constructs were introduced into embryogenic calli of IR 64 and MTU 1010 via *Agrobacterium* mediated transformation. Successfully transformed calli were regenerated into T0 plants through standard tissue culture protocols. Molecular screening of these T0 lines using PCR amplification and Sanger sequencing revealed the presence of Cas9-induced edits, with heterozygous peaks at the target site. Subsequent phenotypic evaluation of the edited T0 lines in comparison to their respective wild-type parents demonstrated notable variations in multiple agronomic parameters. These observations support the functional significance of *ARF6* as a conserved genetic determinant of plant architecture in the *indica* rice varieties. Overall, the study successfully validated *ARF6* as a high-confidence, conserved target for structural improvement of rice plant type using CRISPR-Cas9. Future work involving the advancement of these lines to T1 and subsequent generations, along with detailed physiological and yield assessments, will provide further insights into the stability and agronomic value of *ARF6* edited rice for modern breeding programs.

Keywords: *ARF6*, Tiller number, Tiller angle, MTU 1010, IR 64, CRISPR/Cas9, *Agrobacterium*-mediated transformation

Identification of OsCAX1c Haplotypes Associated with Vegetative-Stage Drought Tolerance in Rice

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Abstract

Rice (*Oryza sativa* L.) serves as the primary staple food for more than half of the global population, particularly across Asia. However, rice productivity is increasingly challenged by abiotic stresses, with drought emerging as one of the most critical limitations. Vegetative-stage drought stress severely restricts plant development by affecting tillering, biomass accumulation, plant height, and root architecture. As this stage is highly sensitive to water deficit, drought can lead to irreversible reductions in yield potential even before panicle initiation. Cation/H⁺ exchangers (CAXs) are key regulators of ion homeostasis,

vacuolar sequestration of Ca²⁺, and stress-responsive signalling pathways, supporting plant adaptation under adverse environments. Among them, *OsCAX1c* (LOC_Os02g21009.2), a vacuolar Ca²⁺/H⁺ antiporter, has been implicated in modulating Ca²⁺-mediated signalling cascades associated with drought tolerance. The present study aimed to identify genetic variation and favourable haplotypes of *OsCAX1c* linked to improved seedling performance under vegetative-stage drought stress. A total of 99 genetic variants were detected across 361 diverse rice accessions, and association analysis was conducted for eight seedling traits under drought stress conditions at 30 days after sowing (DAS). Among the four major superior haplotypes identified, significant variation was observed for chlorophyll content index ($p = 0.003^{**}$), leaf rolling ($p = 0.0003^{***}$), and leaf drying ($p = 0.005^{**}$), indicating haplotype-specific drought responsiveness. Leaf rolling plays an important role in identified favourable haplotypes of *OsCAX1c* provide valuable genetic resources for drought-resilient rice improvement. Future research should focus on validating these haplotypes through functional genomics approaches, such as gene editing, expression profiling, and transgenic characterization under field drought conditions.

Key words: Rice, *OsCAX1c*, Drought, Vegetative-stage, Haplotype

Optimized callus induction in *Dalbergia sissoo* Roxb. For biotechnological interventions.

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Abstract

Dalbergia sissoo Roxb., commonly known as Indian rosewood, is a tree species that belongs to the genus *Dalbergia*, under the family *Leguminosae*. The tree produces high-quality timber and is also a good source of secondary metabolites. It is valued for its role in agroforestry and therapeutics, yet research on this tree species remains limited. There are challenges in conventional studies of the tree due to its long life span with an extended growth period; therefore, an *in-vitro* culture system provides an efficient method for controlled analysis and biotechnological exploration. In the present work, callus induction and proliferation were successfully established from cotyledons of 7-day-old axenic seedlings. The combination of NAA and BAP in the Murashige and Skoog media greatly affected the growth and development of callus, with a 100% callus induction result at 10.8 μ M naphthalene-acetic acid (NAA) and 2.2 μ M benzyl adenine (BA). Green and friable calli were frequently subcultured to fresh medium every 2 weeks with the same hormonal combination for proliferation. The establishment of reproducible callus culture in *D. sissoo* can lead to a platform for clonal propagation, conservation of genotype, assessment of biotic and abiotic stress responses, and metabolic profiling for pharmaceutical application.

Keywords: Leguminosae, Rosewood, Metabolites, Proliferation, Propagation

Preliminary Standardization of *In Vitro* Callus Establishment in *Dalbergia latifolia* Roxb.

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Abstract

Indian rosewood, *Dalbergia latifolia* Roxb., an economically important timber yielding tree species belongs to Fabaceae and is native to the tropical monsoon forests of peninsular and southeastern India. Beyond its economic value, *D. latifolia* plays an important role in traditional medicine and is used to treat various ailments due to presence of several bioactive compounds. Non-sustainable exploitation of the species left its natural population dwindling and vulnerable (VU), as per the IUCN record. Therefore, its conservation is imperative for maintaining biodiversity and preserving its economic and medicinal benefits. Micropropagation offers a promising approach for conservation, and successful callus establishment and standardization are the preliminary steps. In the present study, callus induction and proliferation were successfully established by utilizing healthy young leaves (explant) of mature tree. The combination of NAA and BAP in the Murashige and Skoog media is crucial for the growth and development of callus, with efficient callus induction at 2 mg/L naphthalene-acetic acid (NAA) and 0.5 mg/L benzyl adenine (BA). Green calli were sub-cultured to fresh medium in every 2 weeks with the same hormonal combination for proliferation. The standardized *in vitro* callus induction system facilitates efficient mass propagation, ex situ germplasm conservation and production of pathogen-free planting material of *Dalbergia latifolia*. Additionally, it enables bioactive compound production, stress-tolerance screening and future genetic improvement, supporting sustainable conservation and utilization of the species.

Keywords: Rosewood, Vulnerable, Conservation, Sustainable, BAP

Genome-wide characterization and expression of Heavy Metal ATPase (HMA) in Pigeon pea [*Cajanus cajan* (L.) Millsp.]

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Abstract

Pigeon pea [*Cajanus cajan* (L.) Millsp.; Family: Fabaceae; 2n=2x=22] is an important pulse crop across the world, and is also a rich source of dietary protein. Nutrient imbalances in vegetarian diets, in particular micronutrient deficiency, pose a major concern leading to reduced immunity, impaired cognitive development, and various metabolic syndromes. Therefore, biofortifying pigeon pea grains with balanced micronutrients are essential to combat micronutrient malnutrition. Accordingly, elucidating the role of various gene families, including heavy metal ATPases (HMAs), in micronutrient homeostasis in pigeon pea is quite imperative. In this study, a comprehensive analysis of genome assembly of *C. cajan* (ICPL87119 V2.0) resulted in the identification of 13 HMA genes (*CcHMA*) and their corresponding proteins in pigeon pea (*cajcaICPL87119.gnm2*). *CcHMA* proteins were also characterized based on their biomolecular features, conserved domains and motifs arrangement, transmembrane helices, pore-line helices, subcellular location and occurrence of signal peptides. Based on sequence homology, 13 *CcHMAs* were clustered into two major substrate-specific groups: *CcHMA5*, *CcHMA10* and *CcHMA11*

were categorized under the Zn/Co/Cd/Pb ATPase group, whereas the remaining 10 *CcHMA*s belong to the Cu/Ag subgroup. Gene structure analysis and promoter scanning revealed the structural divergence and presence of various stress-responsive *cis*-acting elements, respectively. The expression analysis of *CcHMA* genes in root and leaf tissues, in response to heavy metal (Zn, Cd and Cu) stress, indicates their role in the uptake, transport and sequestration of metal ions. Interestingly, *CcHMA10* showed incremental upregulation in roots in response to all three heavy metal stresses, whereas the *CcHMA5* expression was only upregulated in the root tissues under Zn stress, which indicates its role in root uptake in *C. cajan*. Further studies on yeast complementation analysis will delineate the specific role of these HMAs on uptake and homeostasis of important micronutrients such as zinc, copper etc. during growth and development of pigeon pea.

Moreover, this study provides valuable insights into the functional roles of *CcHMA* genes and will lay a foundation for future genetic improvement in pigeon pea aimed at enhanced heavy metal stress tolerance and micronutrient homeostasis.

Keywords: *Cajanus cajan*, Metal homeostasis, Gene expression, HMA genes, MBD, GRAVY.

Comparative analysis of volatile profiles and antioxidant potency of three underexplored *Vitex* species from Odisha

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Abstract

The genus *Vitex* is the most predominant genus of the family Lamiaceae used traditionally in the treatment of a broad range of diseases, such as female disorders, acne, inflammatory conditions, diarrhoea, dysentery, flatulence, catarrhal fever, asthma, bronchitis, rheumatism, cancer, etc. The current study focuses on 3 underexplored species of this genus namely, *Vitex pinnata*, *Vitex peduncularis*, and *Vitex leucoxylon*, which are spread across the Asian continent. The chemical profiling of leaf essential oil of these 3 species was performed using GC-MS analysis, where the results revealed sesquiterpene hydrocarbons as the major class of phytoconstituents in *V. pinnata* and *V. leucoxylon* essential oil, whereas in *V. peduncularis* leaf essential oil, oxygenated sesquiterpenes were the major class of phytoconstituents. In terms of quantity, allo-aromadendrene (15.44%), phytol (22.80%), and longifolene (35.57 %) were identified as the major compounds of the *V. pinnata*, *V. peduncularis*, and *V. leucoxylon* essential oils, respectively. The antioxidant potential of the leaf essential oil of all these 3 species was evaluated using both DPPH and ABTS assays. The results demonstrated significant variation in antioxidant activity among the species. *V. peduncularis* exhibited the highest radical scavenging activity among the three, followed by *V. pinnata* and *V. leucoxylon*. The difference in antioxidant capacity may be attributed to the variation in phytoconstituents of the essential oils. The findings of the present study provide a valuable insight into variation in chemical constituents of *Vitex* species as well as their bioactive potency that may contribute to their future applications as natural sources of antioxidants in pharmaceutical, nutraceutical, and functional food development.

Keywords: *Vitex pinnata*, *Vitex peduncularis*, *Vitex leucoxylon*, essential oil, GC-MS, Antioxidant activity

Phytochemicals as emerging neurotherapeutics in Alzheimer's disease: Exploring plant-based interventions for complex brain disorders

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Abstract

Alzheimer's disease (AD) is a progressive neurodegenerative disorder and remains the most prevalent cause of dementia, accounting for approximately 60–70% of dementia cases worldwide and contributing substantially to disability and loss of independence in older adults. It is an increasing global health and economic burden. Its multifactorial, interconnected pathophysiology, including the deposition of amyloid- β (A β), hyperphosphorylation of tau, and neurofibrillary tangle (NFT) formation, as well as mitochondrial dysfunction and oxidative stress, makes treatment challenging because drugs targeting a single pathway often fail to cure or reverse the disease's root cause. Conventional pharmaceutical therapies such as cholinesterase inhibitors and N-methyl-D-aspartate receptor antagonists offer only symptomatic relief with significant side effects. Hence, in this context, phytochemicals have emerged as promising neurotherapeutic candidates, due to their multi-target effects and reduced side effects. This review highlights key plant-derived bioactive compounds, including withanolides, curcumin, bacosides, epigallocatechin-3-gallate, resveratrol, rosmarinic acid, limonene, caffeic acid, and lycopene, and their proposed mechanisms relevant to AD prevention and management. Most studies on these bioactive compounds are preclinical. These phytochemicals have the potential to reduce A β plaque formation and tau pathology and to enhance antioxidant defense. Using nanotechnology approaches, their bioavailability can be improved. Therefore, by integrating traditional medicine knowledge with advanced molecular technologies, the phytochemical-based therapy can become a promising treatment for AD.

Keywords: Alzheimer's disease; Phytochemicals; Neuroprotection; Amyloid- β ; Nanomedicine; Oxidative stress

Integrating Ethnobotanical knowledge for Sustainable use of medicinal plants

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Abstract

Indigenous communities around the world have been using medicinal plants for a very long time to treat diseases and stay healthy. This traditional knowledge, called ethnobotanical knowledge, is gained through experience and passed from one generation to another. Today, this valuable knowledge and many medicinal plants are in danger because of modernization, environmental damage, and reduced interest among younger generations. This study focuses on understanding and documenting ethnobotanical knowledge and finding ways to use it sustainably while linking it with modern healthcare systems. The main aim of this study is to record the traditional use of medicinal plants by indigenous communities and highlight their importance in health care and daily life. The study also tries to show how traditional plant knowledge can be combined with modern medical practices for better and long-term health benefits. A qualitative research method was used for this study. Information was collected through interviews with

local healers and community members, direct observation, and discussions about traditional healing practices. These methods helped in understanding the cultural and medicinal value of plants in a respectful and accurate way. The results of the study show that medicinal plants play an important role not only in treating illnesses but also in the social and cultural life of indigenous communities. Many plants are connected with traditional beliefs, rituals, and spiritual practices. The study also identifies major threats such as over-harvesting of plants, loss of natural habitats, and the gradual disappearance of traditional knowledge due to modernization. This research highlights the need for sustainable use and conservation of medicinal plants. It suggests that traditional ethnobotanical knowledge should be integrated with modern healthcare systems to develop safe, affordable, and effective treatments. Such integration can improve healthcare access, especially in rural and tribal areas, and support global health sustainability. At the same time, it is important to protect the rights of indigenous communities and respect their cultural knowledge. The study emphasizes community-based conservation strategies, where local people actively participate in protecting medicinal plants. It also recommends developing policies that recognize traditional medicine within national health systems. Overall, this study supports a balanced approach that combines traditional wisdom with modern science to ensure the sustainable use of medicinal plants and preservation of cultural heritage for future generations.

Key words: Ethnobotany, Medicinal plants, Sustainability, Indigenous knowledge, Cultural heritage

Phytochemical profiling and *Invitro* antiinflammatory potential of *Polyalthia suberosa* (Roxb.)

Thwaites leaf extracts

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Abstract

Polyalthia suberosa (Roxb.) Thwaites is a wild edible plant known for its wide range of ethnomedicinal applications. As a folk medicine, the leaves of the plant are employed for the treatment of ailments like joint pain and rheumatism. The present study was conducted with an aim to detect the active phytoconstituents from leaf extracts prepared using different solvents (methanol, ethanol and aqueous) and to assess the antiinflammatory potential of *P. suberosa* leaf extracts. The presence of bioactive compounds in the leaf extracts of *P. suberosa* were analysed by Gas Chromatography-Mass Spectrometry (GC-MS) using standard protocol. The antiinflammatory property of the leaf extracts were determined by Albumin Denaturation Assay using six varying concentrations of each crude extract, ranging from 31.25 µg/ml to 1000 µg/ml.

Phytochemical profiling of the crude leaf extract of *P. suberosa* through GC-MS spectrum analysis identified 29 compounds in the methanolic extract, 30 compounds in the ethanolic extract, and 14 compounds in the aqueous extract. The major compounds identified in the methanolic leaf extract included Benzoic acid, 4-ethoxy-, ethyl ester (45.87%), Diphenyl sulfone (6.32%), 1-(4-ethoxyphenyl) propan-1-ol (5.87%), and Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl) ethyl ester (5.33%). In the ethanolic leaf extract, the predominant compounds were Benzoic acid, 4-ethoxy-, ethyl ester (50.01%), 13-Docosanamide (Z) (10.54%), and 1-(4-ethoxyphenyl) propan-1-ol (6.46%). The aqueous leaf extract mainly contained 13-Docosanamide (Z) (29.15%), 2, 4-di-tert-butylphenol (16.66%), and tetracosane (10.05%). Since the major compounds identified in the leaves of *P. suberosa* have been reported to possess anti-inflammatory and antioxidant properties, this study was undertaken to validate those

findings. The *invitro* anti-inflammatory assay showed that at a concentration of 1000 µg/ml, the methanolic leaf extract exhibited the highest inhibition of albumin denaturation (96.36%), followed by the ethanolic extract (88.72%) and the aqueous extract (73.13%), indicating the superior anti-inflammatory potential of *P. suberosa* leaves. Based on these findings we conclude that the methanolic leaf extract possess a significant antinflammatory property compared to other tested leaf extracts. Further investigation is under process to validate the anti-inflammatory potential of the identified bioactive compounds using computational approach and to determinethe antioxidant property of the *P. suberosa* leaf extracts.

Keywords: *Invitro* antinflammatory potential, *P. suberosa*, leaf extracts, bioactive compounds, GCMS.

Optimisation of Soxhlet Extraction Followed by RP-HPLC Purification for the Simultaneous Determination of Ursolic Acid Content in the Flower of *Nyctanthes arbor-tristis* L.

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Abstrat

Nyctanthes arbor-tristis is a commonly used plant in traditional Indian medicine treating intermittent fevers, arthritis crude extracts and isolated compounds from the plant were shown to be pharmacologically active against inflammation, malaria, viral infection, leishmaniasis and as an immunostimulant and contains diterpenoids, triterpenoids and various other compounds. Among these components, ursolic acid have gained considerable interest concerning anti-inflammatory, antioxidant and anti-cancer activities. To select the best organic solvent and ideal extraction technique for purification of ursolic acid from the flowers of *N. arbor-tristis* by reversed-phase high-performance liquid chromatography (RP-HPLC) a method has been developed and validated for estimation and purification of ursolic acid. Two different influential extraction procedure (soxhlet and ultrasound assisted extraction), extraction time, solvent type, aqueous ethanol concentration, loading ratio and extraction temperature, were investigated. RP-HPLC operating conditions were also optimised, and the chromatographic separation was performed on a C18-column with methanol–water gradient as the mobile phase. The optimum extraction conditions were 90 % aqueous ethanol solution as solvent, the liquid: material ratio of 20:1 (v/w) and extraction for four hours at 70 °C. Validation of the HPLC technique developed showed that the method has good linearity, sensitivity, precision and accuracy. The combined soxhlet–HPLC method was applied to quantitate the amount of ursolic acid in the plant sample and exhibited good repeatability. The combined soxhlet–HPLC process is a fast, convenient and appropriate method for the quantitative analysis and purification of ursolic acid in *N. arbor-tristis*.

Keywords: Ursolic acid; *Nyctanthes arbor-tristis*; RP-HPLC; Triterpenoids

Genome wide characterization of zinc regulated transporter (ZRT) and iron regulated transporter (IRT) like protein (ZIP) genes in Mung Bean [*Vigna radiata* (L.) R. Wilczek]

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Abstract

Zinc (Zn) is an essential micronutrient in plants. The zinc/iron-regulated transporter-like protein (ZIP) family has a crucial role in maintaining the Zn homeostasis in plants. Although ZIP gene family has been characterized in a variety of plant species, yet remain unexplored in Mung Bean. Genome-wide exploration in Mung Bean identified 21 non-redundant ZIP genes (VrZIP). Further biochemical characterization and motif organization including trans-membrane helix, pore-lining helix, signal peptide and subcellular location of VrZIP proteins were also determined. Protein structure analysis revealed that VrZIP proteins had 6 to 15 transmembrane (TM) domains and most of them were predicted to be located on the plasma membrane. Also, the gene structure, phylogenetic analysis and cis-regulatory elements (CREs) in promoter region were also carried out. In total, 12 conserved motifs, containing 21–50 amino acid residues were predicted among the VrZIP proteins and the prime function of these motifs were annotated to be zinc transporter, iron transporter. Further, the analysis revealed that N-myristoylation signature sequence was predominantly present in all VrZIP proteins as the major post translational modification. The expression analysis of these VrZIP genes under zinc deficient condition reveals that 14 members of the VrZIP (VrZIP-01, -02, -03, -04, -05, -07, -12, -15, -17, -18, -19, -20 and -21) showed ≥ 2.0 fold up regulation in the root tissues of the high zinc content genotype of mung bean, whereas only two members (VrZIP-11 and 14) showed upregulation in the low zinc containing mung bean genotype. This work provides an insight into understanding of the ZIP gene family in Mung bean plant and further these data of genes will be useful in Zn bio-fortification which will further improve the soil Zn acquisition by mung plants and increase Zn transport and accumulation in edible plant parts that will help in combatting micronutrient deficient malnutrition issue across the world.

Keywords: ZIP, CRE, TM

Structure, Composition, and Habitat Heterogeneity of Mangrove and Associated Vegetation in Bhitarkanika National Park, Odisha

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Abstract

Bhitarkanika National Park and its adjoining mangrove ecosystems represent one of the most ecologically significant coastal wetlands of eastern India and constitute the largest and most diverse mangrove assemblage in the state of Odisha. The present study provides a comprehensive assessment of vegetation structure, floristic composition, and habitat heterogeneity of the Bhitarkanika mangrove ecosystem, based

on extensive field surveys, herbarium examination, and critical evaluation of earlier floristic records. Systematic field investigations were conducted across different seasons to document the full spectrum of vegetation types and species composition, supported by taxonomic identification using standard regional floras. Vegetation was classified into distinct ecological formations to elucidate habitat-specific distribution patterns of plant species. The study area exhibits remarkable habitat heterogeneity, encompassing mangrove forest, mangrove scrub, freshwater swamp forest dominated by *Tamarix-Salvadora* scrub, palm swamp, salt marshes, grasslands, sand dune vegetation, and aquatic ecosystems. Mangrove forests form the core vegetation and are characterized by dominant species such as *Heritiera fomes*, *Excoecaria agallocha*, *Avicennia alba*, and *Sonneratia apetala*. These species display distinct zonation patterns governed by tidal inundation, salinity gradients, sediment characteristics, and freshwater influx. Freshwater swamp forests, grasslands, and scrub vegetation significantly enhance overall biodiversity by supporting a wide array of associated tree, shrub, climber, and herbaceous species.

Floristic analysis reveals a high degree of species richness, with more than 370 plant species belonging to over 260 genera and approximately 100 families, predominantly represented by angiosperms. Dicotyledons form the major component of the flora, followed by monocotyledons, while pteridophytes are sparsely represented. Habit-wise analysis indicates a dominance of herbaceous species, followed by trees, climbers, and shrubs, reflecting the dynamic, disturbance-prone nature of the deltaic coastal environment. Among the vegetation types, *Tamarix-Salvadora* scrub supports the highest species richness, followed by freshwater swamp forests and mangrove formations. Species diversity and distribution are strongly influenced by physicochemical parameters such as soil salinity, moisture content, nutrient availability, and tidal regimes. However, increasing anthropogenic pressures, including habitat fragmentation, resource extraction, tourism, and the rising frequency of cyclonic disturbances, pose significant threats to the stability and regeneration of mangrove ecosystems. Despite these pressures, Bhitarkanika continues to function as a vital ecological buffer, providing shoreline protection, carbon sequestration, and critical habitat for diverse faunal assemblages.

The study underscores the importance of Bhitarkanika as a biodiversity hotspot and highlights the need for continuous floristic monitoring, habitat restoration, and science-based conservation strategies. The comprehensive documentation of vegetation structure and floristic diversity presented here provides a robust baseline for sustainable management and long-term conservation of this internationally important mangrove ecosystem.

Assembly and annotation of the chloroplast genome of *Clitoria ternatea* single blue and single white and its comparative analysis within the members of Fabaceae

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Abstract

Clitoria ternatea is a perennial, twining herbaceous plant belonging to the family Fabaceae, widely cultivated in tropical and subtropical regions. The species is well known for its medicinal, ornamental, and nutritional importance, with distinct floral colour variants such as single blue and single white forms. Despite its economic and ethnopharmacological relevance, comprehensive information on the chloroplast genome of these variants and their comparative genomic relationships within Fabaceae remains limited.

In the present study, high-throughput sequencing was performed using the Illumina platform, and the chloroplast genome was assembled using GetOrganelle (v1.7.7.1). Genome annotation was carried out through the CpGAVAS2 and Chlorobox web servers. Repetitive elements, including simple sequence repeats and tandem repeats, were identified using the MISA and REPuter programs, respectively. Comparative sequence divergence analysis was conducted using the mVISTA tool in Shuffle-LAGAN mode. Chloroplast genomes of *C. ternatea* were compared with those of 133 representative species from the family Fabaceae following multiple sequence alignment using MAFFT, and a phylogenetic tree was reconstructed. Boundary variation among quadripartite regions was examined using IRscope. Codon usage patterns and relative synonymous codon usage were computed and visualized using the ggplot package in R.

The assembled chloroplast genome of *C. ternatea* single blue was 151687 bp and *C. ternatea* single white was 151697 bp in length and exhibited the canonical quadripartite organization comprising large single-copy, small single-copy, and two inverted repeat regions. The overall GC content was 34.55% and 34.55% for single blue and single white respectively. A total of 125 genes were annotated, including 59 protein-coding genes, 37 transfer RNAs, and eight ribosomal RNAs. Among these, 18 genes were duplicated and 18 contained introns. Additionally, 83 and 87 simple sequence repeats and 44 and 45 tandem repeats were detected. Phylogenetic analysis indicated a close evolutionary relationship between *C. ternatea* and *Erythrina sandwicensis*. Comparative analyses with related taxa, including *Canavalia gladiata* and *Toxicopueraria peduncularis*, revealed a high degree of plastome sequence conservation. These results provide a valuable genomic resource for future studies on genetic diversity and improvement of *C. ternatea*.

Keywords: *Clitoria ternatea*, Chloroplast Genome, Gene Annotation, Repetitive sequence

Assembly and annotation of the chloroplast genome of *Asteracantha longifolia* (L.) Nees and its comparative analysis within the members of Acanthaceae

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Abstract

Asteracantha longifolia is a thorny, upright and sturdy herb that grows 2-5 feet tall belonging to family Acanthaceae. It is a predominant species distributed throughout tropical and subtropical environments, preferring the warm and humid climate. It holds significant value as a medicinal plant. Despite this, there is a lack of genetic and genomic research.

Illumina and GetOrganelle v. 1.7.7.1 were used for the sequencing of entire cp DNA, and assembly of the organellar genome, respectively. The CpGAVAS2 and Chlorobox webserver were used to annotate the genome. MISA and REPUTOR online programs were employed to identify the repetitive sequences. For sequence divergence analysis, the Vista web server running the mVista function in Shuffle-LAGAN mode was used. Using the MAFFT online server, the chloroplast genomes of *Asteracantha longifolia* were compared with chloroplast genomes of 54 species belong to family Acanthaceae and a phylogenetic tree was established between them. IRScope online tools were used to analyse boundary shifts between

quadripartite chloroplast genomic regions. Codon usage frequency and relative synonymous codon usage values were calculated and plotted using “ggplot” package of R programme.

Assembly, annotation and analysis of the chloroplast genome of *Asteracantha longifolia* as well as its comparison with related species was performed. The assembled chloroplast genome has a length of 145475 bp with a typical quadripartite structure (LSC-IRA-SSC-IRB). The calculated GC content was 38.39%. A total of 131 genes were annotated – 87 protein coding genes, 36 tRNAs and 8 rRNAs. Amongst them, 15 duplicate genes and 21 splitting genes were present. 46 SSRs were identified alongside 25 tandem repeats. The phylogenetic relationship between *Hygrophila ringens* and *Asteracantha longifolia* was the closest. The analysis of sequence divergence between the chloroplast genomes of *Asteracantha longifolia*, *Hygrophila ringens*, *Strobilanthes cusia*, and *Andrographis paniculata* revealed a high degree of similarity.

These findings can be of great potential for further diversity studies and genetic improvement of *A. longifolia*.

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Abstract

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Floristic analysis reveals a high degree of species richness, with more than 370 plant species belonging to over 260 genera and approximately 100 families, predominantly represented by angiosperms. Dicotyledons form the major component of the flora, followed by monocotyledons, while pteridophytes are sparsely represented. Habit-wise analysis indicates a dominance of herbaceous species, followed by

trees, climbers, and shrubs, reflecting the dynamic, disturbance-prone nature of the deltaic coastal environment. Among the vegetation types,

Tamarix–Salvadora scrub supports the highest species richness, followed by freshwater swamp forests and mangrove formations. Species diversity and distribution are strongly influenced by physicochemical parameters such as soil salinity, moisture content, nutrient availability, and tidal regimes. However, increasing anthropogenic pressures, including habitat fragmentation, resource extraction, tourism, and the rising frequency of cyclonic disturbances, pose significant threats to the stability and regeneration of mangrove ecosystems. Despite these pressures, Bhitarkanika continues to function as a vital ecological buffer, providing shoreline protection, carbon sequestration, and critical habitat for diverse faunal assemblages.

The study underscores the importance of Bhitarkanika as a biodiversity hotspot and highlights the need for continuous floristic monitoring, habitat restoration, and science-based conservation strategies. The comprehensive documentation of vegetation structure and floristic diversity presented here provides a robust baseline for sustainable management and long-term conservation of this internationally important mangrove ecosystem.

UPLC-QTOF-MS based metabolic profiling and evaluation of the bioactive potential of *Vanda tessellata*: A promising medicinal orchid

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Abstract

Vanda tessellata (Roxb.) Hook. Ex Don. is a medicinal epiphytic orchid. It has long been appreciated for its therapeutic applications in the management of health conditions such as inflammation, rheumatism, bronchitis, and other nervous disorders. We have done a comprehensive UHPLC-QTOF-MS analysis of *Vanda tessellata* extract (VTE) to elucidate its chemical composition and other bioactivities. Thirty-three metabolites were tentatively identified in VTE with phenolic acids, carboxylic acids, flavonoids, and terpenoids as predominant classes of compounds. VTE was shown to be a strong antioxidant, scavenging DPPH and ABTS radicals with IC₅₀ values of 59.38 ± 0.27 µg/mL and 27.63 ± 0.14 µg/mL, respectively. The high phenolic (95.72 µg GAE/mg of extract) and flavonoid (113.49 µg QE/mg of extract) content was correlated with its high potent antioxidant activity. Moreover, the extract also showed moderate inhibitory activity of tyrosinase with IC₅₀ of 235.36 µg/mL. Selective antiproliferative activity of VTE was determined on Panc-1, HepG2, and PC3 cancer cells with low IC₅₀ values of 31.16, 54.09, and 62.24 µg/mL, respectively whereas the normal cells showed very high IC₅₀ 221.47 µg/mL. Besides this, the extract had a moderate antibacterial effect against *Staphylococcus saprophyticus* and *Enterococcus faecalis* with MIC of 62.5 µg/mL. The variety of metabolites observed in *V. tessellata* was the evidence of its pharmacological potential, offering valuable insights into its utilization as a potential natural source of antioxidant, antimelanogenic, anticancer, and antibacterial agent.

Vanda tessellata; UHPLC-QTOF-MS; phytoconstituents; antioxidant; tyrosinase inhibition; antiproliferative activity; antibacterial

Formulation and evaluation of *Byttneria herbacea* Roxb. root extract-loaded Carbopol hydrogel for enhanced wound healing

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ABSTRACT

Byttneria herbacea Roxb. (Malvaceae), a medicinal plant traditionally used in India and Bangladesh for the management of wounds and skin disorders, was investigated for its wound-healing potential through the development of a Carbopol-based topical hydrogel containing its root extracts. Aqueous (BHA) and ethanolic (BHE) extracts were prepared by Soxhlet extraction and evaluated for antioxidant activity, phytochemical composition, cytocompatibility, and wound healing efficacy. The ethanolic and aqueous extracts showed notable antioxidant activity in DPPH (IC_{50} =123.97 and 132.20 μ g/mL) and FRAP (EC_{50} =52.42 and 77.30 μ g/mL), respectively. UHPLC-QTOF-MS/MS analysis identified 41 phytoconstituents in the ethanolic extract and 26 in the aqueous extract, including alkaloids, phenolic acids, and flavonoids. Both extracts maintained over 80% viability in HaCaT keratinocytes at concentrations below 20 μ g/mL, while the ethanolic extract significantly enhanced cell migration, achieving 91.71% wound closure at 5 μ g/mL within 12h compared to 38.26% in untreated controls. In vivo excision wound studies in rats demonstrated that topical application of 5% extract-loaded hydrogels resulted in significantly greater wound contraction by day 7 and near-complete wound closure by day 14. The hydrogels exhibited suitable physicochemical properties for topical use, and FTIR analysis confirmed successful extract incorporation without chemical interaction. No skin irritation, histopathological changes, or systemic toxicity were observed. Histological and immunohistochemical analyses revealed organized collagen deposition, restoration of skin architecture, and enhanced expression of type I collagen, VEGF-A, FGF-2, and TGF- β 1, indicating accelerated tissue repair and angiogenesis. These findings demonstrate that *Byttneria herbacea* root extract-loaded hydrogels are safe and effective topical formulations that could promote wound healing through antioxidant, anti-inflammatory, and tissue regenerative mechanisms.

Comprehensive GC×GC-TOFMS profiling, in vitro antioxidant and tyrosinase inhibitory activities of *Plumeria alba* flower essential oil

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Abstract

Plumeria alba (Family: Apocynaceae; common name: white frangipani), is an ornamental, tropical plant for its attractive, fragrant flowers. Several parts of this species are traditionally used to treat a variety of diseases. Flower essential oil of *P. alba* possesses different bioactivities like anti-inflammatory, antimicrobial, antibiofilm, and antioxidant activity etc. In this study the chemical composition of *Plumeria alba* flower essential oil (PAFEO) was investigated using time-of-flight mass spectrometry and

two-dimensional gas chromatography (GC×GC-TOFMS) for the first time, along with its antioxidant and tyrosinase inhibitory potential in vitro. GC×GC-TOFMS identified total 121 compounds accounting for 92.84% of the total oil out of which 24 oxygenated hydrocarbons as the major class following 19 esters, 15 unsaturated hydrocarbons, 14 saturated hydrocarbons, 10 oxygenated monoterpenes, 8 monoterpene alcohols, 8 oxygenated sesquiterpenes, 8 sesquiterpene alcohols, 6 ketones, 5 sesquiterpene hydrocarbons, and 4 monoterpene hydrocarbons. The major constituents identified were Nerolidol (18.09%) followed by α -Citral (14.40%), benzyl salicylate (13.40%), geraniol (9.11%), linalool (6.38%), heptacosane (4.50%), benzyl benzoate (3.80%), (e)-Octadec-13-enoate (2.49%), (3E,7E)-4,8,12-Trimethyltrideca-1,3,7,11-tetraene (2.39%) and trans-farnesol (1.83%). Antioxidant assays showed moderate scavenging activity in DPPH (IC_{50} =2.026 mg/ml), ABTS (IC_{50} =216.88 μ g/mL) and FRAP, (IC_{50} =199.29 μ g/mL) assays. Moreover, PAFEO exhibited moderate tyrosinase inhibitory activity (IC_{50} =1.712 mg/mL). Hence, the PAFEO could be utilized as a natural antioxidant and as a raw material in cosmetic formulations.

Keywords: Plumeria alba; Phytochemicals; GC×GC-TOFMS; Antioxidant; Anti-tyrosinase



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