



National Conference on
Exploring Nature's
Pharmacy: Potentials of
Medicinal and Aromatic
Plants for Health,
Livelihoods, Bio-economy
and Conservation

July 16-18, 2026 | Thursday - Saturday

COMPENDIUM OF
ABSTRACTS



2026

Published by

Karnataka Science and Technology Academy
Department of Science and Technology, Govt. of Karnataka

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Shri Srinivasu V K. Senior Scientific Officer, KSTA
Shri Umesh Ghatage. Scientific Officer, KSTA



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Medicinal and Aromatic Plants For Health,
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Publisher
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Department of Science and Technology, Government of Karnataka

ISBN: 978-81-958020-5-0

Publisher: Karnataka Science and Technology Academy [KSTA], Department of Science and Technology, Govt. of Karnataka, Prof. U R Rao Vijnana Bhavan, Major Sandeep Unnikrishnan Road, Vidyarnyapura Post, Bangalore -560097

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About the Conference

India possesses a rich heritage of Medicinal and Aromatic Plants (MAPs) rooted in its biodiversity, traditional knowledge systems, and healthcare practices. With rising global demand for herbal medicines, nutraceuticals, wellness products, and natural ingredients, the MAPs sector presents a significant opportunity to build economically viable and ecologically sustainable green growth business models for growers and rural enterprises.

However, gaps in conservation, scientific validation, quality planting material, sustainable harvesting, value addition, traceability, and market access continue to constrain the sector's full potential. There is a clear need to strengthen integrated systems that connect farmers to quality inputs, standardized production practices, efficient value chains, and reliable domestic and global markets.

This Conference aims to develop practical pathways to make MAPs a scalable, conservation-led bioeconomy. It will focus on aligning traditional knowledge with modern science, quality standards, digital traceability, and market intelligence to ensure better access to quality MAP products for consumers while enhancing farmer incomes. By bringing together researchers, policymakers, industry leaders, growers, and traditional practitioners, the program seeks to position India as a global leader in a sustainable herbal bioeconomy built on health security, farmer prosperity, and ecological stewardship.

About Karnataka Science and Technology Academy [KSTA]

Karnataka Science and Technology Academy is an organization under Department of Science and Technology, Govt. of Karnataka, which was established under the Chairmanship of distinguished Space Scientist Padma Vibhushan Late Prof. U R Rao [2005-2017] Former Chairman, ISRO / Secretary, DOS, Govt. of India. Padma Shree Awardee Dr. S K Shivakumar, Former Director, Prof. U R Rao Satellite Center, Bengaluru led the Academy from 2017 to 2019, followed by Padma Shree awardee Prof. S Ayyappan, Former Director General, ICAR, Govt. of India who served from 2021 to 2023. Presently chaired by Prof. Rajasab A H, Former Vice Chancellor, Tumkur University, Tumakuru.

**National Conference on Exploring Nature's Pharmacy:
Potentials of Medicinal and Aromatic Plants for Health,
Livelihoods, Bio-economy and Conservation**

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Prof. Rajasab A H

Chairman, Karnataka Science and Technology Academy (KSTA)

Patrons:

Dr Manjula N., IAS

Secretary to Government

Department of Electronics, Information Technology, Biotechnology &
Science and Technology, Government of Karnataka

Shri Bharath S., IAS

Director

Department of Science and Technology MD, KSTePS /
Member Secretary, KSTA
Government of Karnataka

Advisory Committee:

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Member, KSTA

Former Vice Chancellor

University of Horticultural Sciences, Bagalkote

Dr Vishnuvardhana

Vice Chancellor

University of Horticultural Sciences, Bagalkote

Prof. Chandrashekhar M Biradar

Member, KSTA

CMD, Global Green Growth

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Former Joint Director, BSI, Dehra Dun & Kolkata

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Senior Principal Scientist

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Karnataka State Medicinal Plants Authority (KaMPA), Bengaluru

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Kerala Forest Research Institute, Peechi

Dr Sreenivasappa

Professor, Department of Horticulture, University of
Agriculture Sciences, Bengaluru

Dr Veerendra Pratap Singh

Associate Professor, College of Horticulture, Bidar

Dr B S Harish

Associate Professor
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Organizing Committee:

Convenor

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Chief Executive Officer, KSTA

Co-ordinators

Shri V K Srinivasu

Senior Scientific Officer, KSTA

Shri Umesh V Ghatage

Scientific Officer, KSTA

Shri Mahadevegowda

Administrative Officer, KSTA



Preface

It gives me immense pleasure to present this Compendium of Abstracts of the National Conference on “Exploring Nature’s Pharmacy: Potentials of Medicinal and Aromatic Plants for Health, Livelihoods, Bio-economy and Conservation,” organized by the Karnataka Science and Technology Academy (KSTA), Department of Science & Technology, Government of Karnataka, during 16–18 July 2026.

India is one of the world’s richest repositories of medicinal and aromatic plants, possessing immense biological diversity and a long-standing tradition of indigenous knowledge systems. These valuable resources have served humanity for centuries through traditional healthcare practices and continue to gain global recognition for their applications in pharmaceuticals, nutraceuticals, cosmetics, wellness products and sustainable agriculture. As the world increasingly seeks nature-based solutions for health and environmental sustainability, there is a growing need to integrate traditional wisdom with modern scientific research, technological innovation, quality assurance, sustainable cultivation practices and market-driven value chains.

The conference has been conceived as a multidisciplinary platform to bring together scientists, academicians, policymakers, industry experts, entrepreneurs, farmers, researchers, traditional practitioners and students to deliberate on the scientific, technological, ecological, and economic dimensions of medicinal and aromatic plants. The technical sessions, keynote lectures, panel discussions, exhibition and stakeholder interactions are designed to facilitate meaningful dialogue, promote collaborative research and generate actionable recommendations for strengthening the medicinal and aromatic plants ecosystem.

This Compendium of Abstracts represents the collective research efforts and innovative ideas contributed by researchers from universities, research institutions, government organizations, industries and other stakeholder groups across the country. The abstracts reflect the breadth of contemporary research encompassing biodiversity conservation, bioprospecting, ethnobotany, scientific validation, quality planting materials, sustainable cultivation, value addition, traceability, entrepreneurship, intellectual property rights, digital technologies and market development. We believe this publication will serve

as a valuable knowledge resource, stimulate interdisciplinary collaborations and inspire future research and innovation in the sector.

On behalf of the Karnataka Science and Technology Academy, I express my sincere gratitude to Hon'ble Chairman, KSTA Prof. Rajasab A. H., KSTA, for his visionary guidance and constant encouragement. I also express my gratitude to Prof. Dandin S., Member, KSTA/Former Vice Chancellor, UHS Bagalkot and Dr. Chandrashekhhar M Biradar, Member, KSTA/ CMD, Global Green Growth for their guidance in suggesting topics and resource experts. I gratefully acknowledge the support extended by our Secretary to Government, Department of Electronics, Information Technology, Biotechnology and Science and Technology, Dr. Manjula N., IAS and Shri Bharath S., IAS, Director, Department of Science and Technology, Government of Karnataka, for their continued encouragement in promoting scientific initiatives. I also extend my heartfelt appreciation to the members of the KSTA Executive Committee, Advisory Committee, Organizing Committee, invited speakers, sponsors, collaborating institutions, authors and participants whose valuable contributions have made this conference possible.

I sincerely hope that the deliberations of this conference and the knowledge shared through this compendium will contribute to developing sustainable strategies for conservation, scientific advancement, entrepreneurship, farmer prosperity and the growth of India's herbal bioeconomy. I wish the conference every success and trust that it will foster enduring collaborations and meaningful outcomes for the advancement of science and society.



Dr. Anand R

Chief Executive Officer,

Karnataka Science and Technology Academy (KSTA) Convener, National Conference

U.T. KHADAR FAREED
Minister for Health and
Family Welfare



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NO: HFMM R/343/226

Date: 13 7.2026



MESSAGE

It gives me great pleasure to learn that the National Conference on Exploring Nature's Pharmacy: Potentials of Medicinal and Aromatic Plants for Health, Livelihoods, Bioeconomy and Conservation" is being organized during 16-18 July 2026 by the Karnataka Science and Technology Academy (KSTA), an autonomous organization under the Department of Science and Technology, Government of Karnataka

India has been the custodian of a rich heritage of medicinal and aromatic plants, supported by centuries of traditional knowledge and remarkable biodiversity. These invaluable natural resources hold immense potential not only to strengthen healthcare and wellness systems but also to generate sustainable livelihoods, promote rural entrepreneurship, drive the bio-economy, and conserve our precious biodiversity. Their scientific validation, conservation, value addition, sustainable cultivation, and commercialization are essential for building a resilient and globally competitive herbal sector.

This conference provides an excellent platform for scientists, researchers, industry leaders, farmers, entrepreneurs, and policymakers to exchange knowledge, deliberate on emerging challenges and opportunities, and identify strategies for the sustainable development of the medicinal and aromatic plants sector. I am confident that the deliberations will generate valuable recommendations for strengthening research, innovation, conservation, and market linkages while ensuring equitable benefits to farming communities and society at large

I congratulate the Karnataka Science and Technology Academy and the Organizing Committee for this timely initiative and extend my best wishes for the grand success of the conference. I am confident that this event will make a meaningful contribution towards advancing the sustainable utilization of medicinal and aromatic plants for improved public health, environmental conservation, and economic prosperity.

A handwritten signature in black ink, appearing to read "U.T. Khadar Fareed".

(U.T. Khadar Fareed)

ಡಾ. ಎನ್. ಮಂಜುಳ, ಭಾ.ಆ.ಸೇ
ಸರ್ಕಾರದ ಕಾರ್ಯದರ್ಶಿ

Dr. N. Manjula, IAS
Secretary to Government



GOVERNMENT OF KARNATAKA

ವಿದ್ಯುನ್ಮಾನ, ಮಾಹಿತಿ ತಂತ್ರಜ್ಞಾನ, ಜೈವಿಕ ತಂತ್ರಜ್ಞಾನ
ಹಾಗೂ ವಿಜ್ಞಾನ ಮತ್ತು ತಂತ್ರಜ್ಞಾನ ಇಲಾಖೆ

Department of Electronics, Information Technology
Biotechnology and Science & Technology



MESSAGE

It gives me immense pleasure to know that the Karnataka Science and Technology Academy (KSTA), under the Department of Electronics, Information Technology, Biotechnology and Science & Technology, Government of Karnataka, is organizing the National Conference on "Exploring Nature's Pharmacy: Potentials of Medicinal and Aromatic Plants for Health, Livelihoods. Bio-economy and Conservation" during 16-18 July 2026 and I appreciate that KSTA bringing out a Compendium of Abstracts containing the research contributions presented during the conference.

India is endowed with an extraordinary wealth of medicinal and aromatic plants, supported by rich biodiversity and centuries of traditional knowledge. These valuable biological resources play a vital role in healthcare, sustainable livelihoods, biodiversity conservation, and the emerging bioeconomy. With increasing global demand for herbal products, nutraceuticals and plant-based therapeutics, there is an urgent need to promote scientific research, sustainable cultivation, value addition, quality assurance and innovation across the entire value chain.

This conference provides an excellent platform for researchers, academicians, policymakers, industry representatives, entrepreneurs, farmers and traditional practitioners to deliberate on contemporary challenges and opportunities in the medicinal and aromatic plants sector. The exchange of scientific knowledge, technological Innovations, and field experiences will contribute significantly towards developing sustainable solutions and strengthening India's leadership in the global herbal bio-economy.

(Dr. Manjula N.)

Secretary to Government

Department of Electronics, Information Technology,
Biotechnology and Science & Technology



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Prof. Rajasab A H

Chairman, KSTA

Former Vice Chancellor, Tumkur University



MESSAGE

Karnataka Science and Technology Academy (KSTA), an autonomous organization under Department of Science and Technology, Government of Karnataka, is committed to strengthening basic science education at all levels, popularizing science among all sections of the society with particular focus on students, teachers and rural population. Through its large canvas of activities, with focus on relevant and contemporary topics it is providing an important platform for students to learn from fellow researchers as well as national experts. Thus, KSTA is focused on achieving vision of its founder Prof U.R. Rao, the former Chairman, ISRO. Its achievements have been recognized at national level.

I am delighted to inform that KSTA with support from the National Medicinal Plant Board (NMPB), Ministry of Ayush, Government of India is organizing a National Conference on Exploring Nature's Pharmacy: Potentials of Medicinal and Aromatic Plants and Their Conservation" from July 16-18, 2026. This conference aims to explore and unlock the vast potential of medicinal and aromatic plants, particularly in the context of the One Health approach, which integrates human, animal, and environmental health for holistic well-being.

As we confront growing global health challenges, it is imperative to harness the therapeutic power of natural resources. India, with its rich and diverse tradition of using medicinal and aromatic plants, offers invaluable insights into preventive healthcare, disease management, and sustainable treatment methods.

India is home to an estimated 7,500 species of medicinal plants, many of which form the foundation of traditional medicine systems such as Ayurveda, Siddha, and Unani. I hope that the discussions and deliberations at the conference will focus on harnessing the potential of medicinal and aromatic plants to promote holistic health and well-being. By exploring their therapeutic properties, we can address the interconnected health of humans, animals, and the environment.

I take this opportunity in welcoming delegates to its deliberations. Among the delegates are students, teachers, institutions and university researchers who would have a unique opportunity to learn from national experts. The interactions among the young researchers would allow them to sharpen their research focus on topics of great relevance.

My greetings and best wishes to you all.

(Raja Sab A.H.)
Chairman, KSTA

AKRAM PASHA, IAS
MISSION DIRECTOR
NATIONAL HEALTH MISSION



MESSAGE

The National Conference on "Exploring Nature's Pharmacy: Potentials of Medicinal and Aromatic Plants for Health, Livelihoods, Bio-economy and Conservation" is a timely initiative of the Karnataka Science and Technology Academy (KSTA) that reflects the growing importance of interdisciplinary research in addressing contemporary societal and environmental challenges.

I am pleased to note that the Conference is supported by National Medicinal Plants Board (NMPB), Ministry of AYUSH, Government of India. I appreciate NMPB for extending financial assistance to this important initiative, which will facilitate meaningful scientific deliberations and strengthen national efforts towards the conservation, sustainable utilization, and value addition of medicinal and aromatic plants.

The Department of Science and Technology, Government of Karnataka, is committed to promoting scientific excellence, innovation, technology development and knowledge-driven growth across the State. Through the Karnataka Science and Technology Promotion Society (KSTEPS) and its continued support to the Karnataka Science and Technology Academy (KSTA), the Department strives to strengthen research ecosystems, encourage scientific collaborations, build human capacity and promote the application of science and technology for societal benefit. Conferences of this nature play a vital role in fostering interdisciplinary dialogue, nurturing innovation, and facilitating partnerships among academia, government, industry and community stakeholders.

Medicinal and aromatic plants represent an important interface between biodiversity, traditional knowledge, modern science, healthcare and the bioeconomy. Advancing research in areas such as scientific validation, sustainable cultivation, value addition, quality assurance, digital traceability and commercialization will create new opportunities for innovation, entrepreneurship, rural livelihoods and conservation.

I am confident that the deliberations of this conference will generate valuable insights and actionable recommendations for strengthening research, technology development, policy support and sustainable utilization of medicinal and aromatic plants. The Compendium of Abstracts will serve as a valuable repository of contemporary scientific research and will inspire future collaborations among researchers, institutions, industries and policymakers.

I congratulate the Karnataka Science and Technology Academy, the Organizing Committee, and all the contributors for this commendable initiative. I extend my best wishes for the grand success of the conference and trust that its outcomes will contribute significantly to advancing science, innovation, sustainable development and the growth of India's herbal bioeconomy.

(Akram Pasha, IAS)

BHARATH S., IAS

Director (1/c)

Department of Science and Technology
Govt. of Karnataka



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Dr. B. R. Ambedkar Veedhi
Bangalore - 560 001, INDIA



MESSAGE

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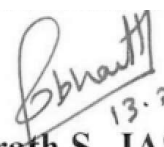
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13.2.20
(Bharath S., IAS)

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Technical Sessions

Time	Session	Topic & Resource Expert
12:00 to 12:30	Keynote Address Harnessing the Potential of Medicinal and Aromatic Plants (MAP): Development of Value Chains	Prof. P G Changappa, Former Vice Chancellor, University of Agricultural Sciences, Bangalore
Session 1 12:40 PM to 01:30 PM	Diversity and Bioprospecting of Medicinal and Aromatic Plants: Conservation and Sustainable Use Strategies	Indian Region as a Major Emporium of Medicinal and Aromatic Plants: Diversity, Conservation and Bioprospecting. Dr R R Rao Senior Scientist / Former Joint Director BSI, Dehra Dun & Kolkata
1:30 - 2:30	Lunch Break	
Session 2 02:30 PM to 03:15 PM	Ethnobotanically Important Medicinal Plants of India: Scientific Validation and Mainstreaming into Healthcare and Wellness Industry	Mainstreaming Medicinal Plants into Human Healthcare and Wellness: Integrating Ancient Wisdom with Modern Science Dr Kumar S K Director, School of Ancient Wisdom, Govt. Ayurveda Medical College, Bengaluru
03:15 03:30	Coffee/Tea Break	
Session 3 03:30 PM to 04:15 PM	Traceability and Marketing of Medicinal and Aromatic Plants: Ensuring Quality, Transparency and Market Credibility and Consumer Confidence	Adulteration, Marketing with Traceability of NTFP of MAPs Dr M J Prabhu Senior Medicinal Plant Consultant Karnataka State Medicinal Plants Authority (KaMPA), Bengaluru
Session 4 04:15 PM to 05:00 PM	Quality Planting Material for Medicinal and Aromatic Plants: Accreditation, Certification and Regulatory Frameworks	Production, Certification and Distribution of QPM of MAPs Dr U M Chandrashekara Project Director, NMPB-RCFC (SR) Kerala Forest Research Institute, Peechi
Session 5 10:30 PM to 11:15 PM	Contract Farming, Collective/Community Farming and Farmer Producer Organizations (FPOs): Inclusive Models for Scaling Medicinal Plant Cultivation	Role of FPO in Contract and Collective/Community Farming of the MAPs in Karnataka Dr G K Sadanand CoE, FPO, College of Horticulture, Bengaluru
11:15 11:30	Coffee/Tea Break	

Time	Session	Topic & Resource Expert
Session 6 11:30 to 12:15	Value Chain Development in Medicinal and Aromatic Plants: Opportunities for Value Addition, Processing, Startups and Entrepreneurship	Value Chain Development Models for MAPs Dr Veerendra Pratap Singh Assistant Professor College of Horticulture, Bidar
Session 7 12:15 PM to 01:00 PM	Geographical Indications for Ecological Sustainability (GIES), IPR and Biopiracy in Medicinal and Aromatic Plants: Safeguarding Resources and Promoting Exports	Role of Taxonomy in Medicinal plants & Research Dr M Sanjappa Former Director Botanical Survey of India, Bengaluru
Session 8 01:00 PM to 01:45 PM	Experience Sharing in Processing, Value Addition and Marketing of MAPs – Industry and Research Perspectives	Mrs Smitha Kamath Founding Director, Praana Poorna Collective Naturals Products
01:45 02:00	Lunch Break	
Panel Discussion: 02:30 - 05:00		
02:30 04:00	Expert Panel Discussion:1 Interactive Meet of Growers, Buyers, Processing Industries, Herbal Practitioners and Consumers on MAP Value Addition and Marketing	Chair and Moderated by Dr S B Dandin, Former VC, HUSB Panel Members: Dr Srivathsa Govindaraju, Nature Inspires India, Bengaluru Dr B S Harish, Professor of MAP, COH Bengaluru Dr Dinesh Nagagowda, CIMAP, Bengaluru Dr M V Prakash Rao Manchale, Medicinal Plant Farmer, Shivamogga
04:00 05:00	Expert Panel Discussion:2 Medicinal and Aromatic Plants for India@2047 – Health Security, Farmer Prosperity and Global Leadership Strategic Vision for Positioning India as a Global Herbal Bioeconomy Leader	Chair and Moderated by Prof. Chandrashekhar M Biradar Panel Members: Mr Basaiah Hiremath Founder and Director, NOFH, Bengaluru Mrs Sumangala K H, Founder and CEO, Samanvaya Trust, Davangere/Bengaluru Dr Vijayakumar Narayanapur Prof of MAP, UHS, Bagalkot Dr. Ashwini Godbole, Professor, TDU, Bengaluru
05:00 05:30	Valedictory	

PROFILES OF RESOURCE EXPERTS

Key Note Address



Prof. P G Changappa

Former Vice Chancellor, University of Agricultural Sciences, Bengaluru

- * Dr Chengappa P G is one of the leading Agricultural Economists of the country. He was awarded PhD in Agricultural Economics from IARI New Delhi and underwent an international course on Agricultural Marketing in Germany.
- * He served as the Vice Chancellor of University of Agricultural Sciences, Bangalore and held the prestigious position of National Professor of ICAR, New Delhi.
- * His professional contributions are in Agri Business, Trade and Policy and agricultural education.
- * He has over three decades of experience in teaching, research, and extension and policy analysis. He has published over 100 research papers in peer reviewed journals.
- * His international work experience include - consultant in International Food Policy Research Institute, Washington, International Plant Genetics Resource Institute, Rome, International Rice Research Institute, Manila, DSE Germany and visiting scholar - Universities of Reading, Wales, Purdue and Iowa State University.
- * President of conference 2012, Indian Society of Agricultural Economics & President, Agricultural Economics Research Association, New Delhi 2013-16.
- * Served as Chairman/Member of many policy making committees of Central and state Governments.
- Member Scientific Committee of Food Safety and Standards Authority of India, new Delhi 2009-2016.
- Member, Indian delegation for COP-MOP 6 to the International convention on Biological Diversity 2012.
- Member- Working Group of Planning Commission on Agricultural Marketing Infrastructure, Secondary Agriculture and Policy, and sub group on Agricultural Education and Research 2011-12.
- Member Biotechnology Task Force, Government of Karnataka 2009-12.
- Member, Committee constituted by the ICAR to develop the Agricultural Educational Policy for India 2011-12.
- Member, Governing Body of Indian Institute of Forest Management, Bhopal, 2010-2012

- Member – Committee constituted by the Ministry of External Affairs, GOI for Extending Agriculture Assistance to Sri Lanka 2009.
 - Member, Judging Committee of ICAR Award for outstanding KVK 2009.
 - Member-UGC Expert Committee for Commonwealth Academic Staff Fellowship and Commonwealth Spilt-site Doctoral Scholarship, 2008.
 - Member, Karnataka Knowledge Commission, 2009-10
 - Chairman- WTO cell, Government of Karnataka, 2009-10
 - Member, Biotechnology Task Force, Government of Karnataka 2008-10.
 - Member, State Watershed Development Policy Committee, 2008-10
 - Member Karnataka State Farmers' Commission, 2008-10
 - Member, Organic Farming Mission, Government of Karnataka, 2008-10.
 - Member, Member, sub group on Industry – Institution Interaction Panel of the Confederation of Indian Industry, Southern Region, Bangalore, 2000-02.
 - Member, High Power Committee on Agricultural Marketing DMI, Govt of India, 1992.
 - Member, Expert Committee on Stagnation of Agricultural Productivity During 1980s in Karnataka Committee on Pricing, Storage, Processing and Marketing. 1992.
 - Member, Sub – group on Agriculture of the State Planning Board, Government of Karnataka.
 - Permanent Invitee to the committee constituted by the Government of Karnataka to study the problem of farmers in Karnataka 1986 1988.
 - Member, Committee to prepare Action Plan for the VIII Five Year Plan, Sub group on Marketing, Processing and Exports of Horticultural Crops, Govt of Karnataka, 1989 90.
- * Served on the Board the Board of following companies:
- Independent Director, Tata Coffee Ltd, Bangalore
 - Independent Director, Tasy Bite Eatables, Ltd
 - Independent Director, Sam Agritech Ltd, Hyderabad and
 - Independent Director, Sam Agri Ventures Limited, Hyderabad.
- * He served on the Board of Horticultural Produce Cooperative Marketing Society Ltd (HOPCOMS) as a Government nominee
- * He served as the member, Board of Governors of ISEC



Raghavendra Rao,

Ph.D., FBS, FLS., FES, FIAAT, FNRS, FKSTA, FNASc, FASc., FNA
Senior Scientist / Former Joint Director BSI, Dehra Dun & Kolkata

Dr. R. Raghavendra Rao, foremost plant taxonomist in India hailing from a very poor family from Shivamogga, Karnataka. He did his early education and completed B.Sc. degree doing all kinds of house hold jobs in other houses and selling newspapers etc. Later joined Manasagangotri, University of Mysore for his post-graduation and Ph.D degrees. For his Ph.D. dissertation, he worked on the Flora of Mysore District, which he presented in a new perspective. Dr. Rao has served in various capacities and at various organizations in the country like Botanist in Botanical Survey of India, Shillong, Deputy Director & Joint Director, Botanical Survey of India at Dehra Dun and Kolkata, Lecturer and Reader in North-East Hill University, Shillong, Meghalaya, Scientist F and later Scientist G at CSIR-National Botanical Research Institute, Lucknow, U.P, Scientist G at CSIR – CIMAP, Bengaluru and as CSIR Emeritus Scientist and INSA Hon. Scientist at CIMAP, Bengaluru. Dr. Rao has 10 years of post- graduate level teaching at NEHU, Shillong and more than 50 years of research and research guiding experience. 14 students have obtained Ph.D degrees under his supervision. He has so far published 15 books and nearly 250 research papers in both national and international journals. Dr. Rao has visited a number of countries in connection with his research programmes, mainly herbarium consultation, lectures and attending conferences. Some such countries are Soviet Russia, Uzbekistan, Ukraine, UK (4 times), USA, UAE, Colombia, Malaysia, Kenya, Poland (3 times), Sri Lanka (2 times), Maldives, Nepal, China (3 times), Thailand (3 times), Singapore, Germany (3 times), France, Bangladesh He is an elected Fellow of many Science Academies like Indian National Science Academy, New Delhi., National Academy of Sciences, India, Allahabad., Indian Academy of Sciences, Bangalore, Indian Association for Angiosperm Taxonomy, Indian Botanical Society, Society of Ethnobotanists., Association for Plant Taxonomy. Dr. Rao is a recipient of several life time achievement awards like Dr. APJ Abdul Kalam Memorial Lifetime Achievement Award by National Academy of Biological Sciences, 2022, Life time Achievement Award by Indian Botanical Society, 2022. Life Achievement Award by Nature Science Foundation, Coimbatore, 2023 Life time achievement award for Research in Plant Taxonomy by the Shivaram Research foundation 2018. He has also received many awards and medals

like Pitambar Pant National Environment Fellowship award of the year 1999 by the Ministry of Environment & Forests, William Harshberger Medal for 1994 by the Society of Ethnobotanists. Prof. B. A. Razi Medal of the Association of Plant Taxonomy, Calcutta, 1999. Prof. Y. D. Tyagi Gold Medal of the Indian Association for Angiosperm Taxonomy, Calicut, 2008. Prof. V. Puri Memorial Medal, and Cash prize, 2013, from the Indian Science Congress Association Calcutta, 2013. and Prof. Birbal Sahni Gold Medal from the Indian Botanical Society, 2013 are only a few to mention Dr. Rao has served in various National committees like DST, DBT, MOEF, etc for several years. He was also the elected President of Society of Ethnobotanists and Indian Botanical Society. Also, he has served as the Chairman, Karnataka State Environmental Appraisal Committee. Rao has also served as member of Research Advisory committee of BSI and TBGRI and other organizations.



Dr Kumar S K

Director, School of Ancient Wisdom, Govt. Ayurveda Medical College, Bengaluru

Dr. Kumar S. K. Mohan is the Director, School of Ancient Wisdom, Government Ayurveda Medical College, Bengaluru. A distinguished Ayurveda physician, academician, and educator, he has dedicated his career to the promotion of Ayurveda through education, research, and the integration of traditional knowledge with contemporary healthcare practices. As Director of the School of Ancient Wisdom, he plays a pivotal role in preserving, documenting, and disseminating India's rich heritage of traditional medical knowledge while fostering interdisciplinary learning and research. His areas of expertise include Ayurvedic principles, classical texts, preventive healthcare, lifestyle management, and the application of traditional wisdom for holistic health and well-being. Dr. Mohan has actively contributed to academic programmes, professional training, public awareness initiatives, and scientific forums that promote evidence-based Ayurveda and the conservation of indigenous medicinal knowledge. Through his leadership and scholarly contributions, he continues to strengthen the role of Ayurveda in addressing contemporary health challenges and advancing the vision of holistic and sustainable healthcare.



Dr M J Prabhu

Senior Medicinal Plant Consultant
Karnataka State Medicinal Plants Authority (KaMPA), Bengaluru

Dr. M.J. Prabhu is a Senior Medicinal Plants Consultant at the Karnataka State Medicinal Plants Authority (KAMPA), Department of Forest, Ecology and Environment, Government of Karnataka, Bengaluru. With over 15 years of professional experience, he has made significant contributions to the promotion, conservation, and sustainable utilization of medicinal and aromatic plants in Karnataka. His expertise encompasses scientific cultivation practices, plant propagation, sustainable harvesting techniques, and the establishment of herbal gardens. Dr. Prabhu has played a pivotal role in developing and promoting packages of practices for medicinal and aromatic plant cultivation and is well known for advocating intercropping models that integrate high-value medicinal plants with traditional crops such as arecanut and coconut, thereby enhancing farmers' income. He has been instrumental in strengthening market linkages by connecting farmers, forest corporations, and Ayurvedic and cosmetic industries to establish sustainable value chains for medicinal plant products. A committed trainer and extension specialist, Dr. Prabhu regularly conducts state-level workshops, farmer field demonstrations, and capacity-building programmes for nursery technicians, farmers, and Ayurvedic practitioners. He is also a sought-after resource person for KAMPA-sponsored training programmes and forestry research initiatives, where he shares his expertise on the identification, conservation, and sustainable harvesting of medicinal plant species, contributing significantly to the advancement of medicinal plant conservation and livelihood development in the state.



Dr U M Chandrashekara

Project Director, NMPB-RCFC (SR)
Kerala Forest Research Institute, Peechi

Dr. U.M. Chandrashekara is a distinguished Forest Ecologist and Agroforestry specialist. Hailing from Uchanggi village in the Hassan District of Karnataka, he earned his Master's Degree in Botany from the University of Mysore and his Ph.D. in Environmental Sciences from Jawaharlal Nehru University, New Delhi. For his doctoral research, he studied the impacts of natural and human disturbances on tree regeneration, soil, and productivity in the evergreen forests of Nelliampathy, Kerala.

In 1992, Dr. Chandrashekara joined the Kerala Forest Research Institute (KFRI) in Peechi as a scientist in the Agroforestry Division. He was subsequently appointed as the Head of the KFRI Sub-Centre at Nilambur in 2001. Throughout his career, his research has focused heavily on biodiversity assessment, disturbance ecology, indigenous ecological knowledge, and traditional practices related to forest conservation and agroforestry systems. A prolific academic, he has published over 85 research papers in national and international journals, authored 48 technical reports, co-authored seven books, and guided four Ph.D. candidates alongside numerous M.Sc. students.

Beyond his research, Dr. Chandrashekara has contributed significantly to international and domestic forestry initiatives. He served as an expert member for the Food and Agriculture Organization (FAO) to strengthen the capacity of the Forest Research Institute (FRI) in Myanmar, where he trained scientists in biodiversity conservation, forest dynamics, climate change, carbon accounting, and agroforestry practices. Back in India, he was instrumental in establishing the Bioresources Nature Park at the KFRI Sub-Centre campus in Nilambur—a unique theme park dedicated to rare and endangered plant species. He also guided the establishment of the State-Level Herbal Garden at Nilambur, which has been recognized as the most successful project funded by the National Medicinal Plants Board (NMPB), Government of India.

Following his retirement as Chief Scientist from KFRI in May 2020, Dr. Chandrashekara continues to advance the field by serving as the Project Manager of the NMPB's Regional cum Facilitation Centre (Southern Region), based at KFRI, Peechi.



Dr. Sadananda G K

Assistant Professor of Postharvest Technology
College of Horticulture, Bengaluru

Dr. Sadananda G. K., is an accomplished academician, researcher, and institution builder serving as Assistant Professor of Postharvest Technology at the College of Horticulture, Bengaluru, University of Horticultural Sciences (UHS), Bagalkot. He is presently the Deputy Director of the Centre of Excellence for Farmer Producer Organisations (CoE-FPO), Bengaluru, where he leads initiatives on capacity building, institutional strengthening, agribusiness promotion, value chain development, and market integration of Farmer Producer Organisations (FPOs). He also holds the additional charge of General Manager (Business Development), HOPCOMS, contributing to strategic business expansion, market development, and strengthening farmer-centric marketing systems.

Dr. Sadananda's foundational academic excellence is highlighted by a B.Sc. in Horticulture from KRCCH, Arabhavi (UAS Dharwad), where he earned six gold medals and the Best Outgoing Student award. He went on to complete an M.Sc. in Vegetable Science from CCS HAU, Hisar, and achieved his Ph.D. in Postharvest Technology from the prestigious Indian Agricultural Research Institute (IARI) in New Delhi. With over a decade of experience in teaching, research, extension, and institutional development, he has made significant contributions to postharvest technology, value addition, food processing, Farmer Producer Organisations (FPOs), and agribusiness development.

Dr. Sadananda has published more than 43 research papers in reputed national and international journals, authored an international book chapter, developed academic manuals, and mentored postgraduate and doctoral scholars. He has coordinated numerous national and international training programmes.

Through his multidisciplinary contributions in academia, research, extension, and agribusiness development, he continues to play a significant role in advancing horticultural value chains, promoting farmer-owned enterprises, and strengthening sustainable agricultural development.



Dr Veerendra Pratap Singh

Assistant Professor
College of Horticulture, Bidar

Dr. Veerendra Pratap Singh is an accomplished horticulturist, academician, and researcher specializing in medicinal and aromatic crops. He is currently serving as Assistant Professor at the College of Horticulture, Bidar, where he teaches undergraduate students, mentors postgraduate and doctoral scholars, and contributes to the institution's academic and developmental activities. With over two decades of professional experience spanning academia, research, industry, and extension, Dr. Singh has made significant contributions to the cultivation, value addition, and promotion of medicinal and aromatic plants.

He obtained his B.Sc. (Agriculture) from Narendra Dev University of Agriculture & Technology, Ayodhya, earned an M.Sc. in Horticulture (Plantation Crops) from the University of Agricultural Sciences, Bengaluru, and completed his Ph.D. in Horticulture from Chaudhary Charan Singh University, Meerut. He has also qualified the ICAR-NET examination and holds postgraduate diplomas in Medicinal and Aromatic Crops and Human Resource Management.

Before joining academia, Dr. Singh served as Chief Scientist and Technical Head at Silpa Agro Farms Pvt. Ltd. and later as Technical Consultant for BiOMAP, where he planned and implemented projects, conducted farmer training programmes, and provided technical guidance for medicinal and aromatic plant cultivation. His research portfolio includes over 40 research papers, 25 conference abstracts, 7 books, 27 technical articles, 10 popular articles, five technologies incorporated into cultivation packages, and leadership of 20 institutional and externally funded research projects.

Dr. Singh has received several prestigious recognitions, including the ICAR Junior Research Fellowship, Young Scientist Award, Best Teacher Award, and international awards for innovative research and scientific presentations. He has represented India at international conferences in China, the United Arab Emirates, and Indonesia, reflecting his commitment to advancing research, education, and sustainable development in medicinal and aromatic crops.



Dr. M. Sanjappa

Former Director
Botanical Survey of India, Bengaluru

Dr. M. Sanjappa, born on January 1, 1951, in Pethandlahalli, Karnataka, stands as a titan in the field of plant taxonomy and conservation. After completing his B.Sc. (Hons.) and M.Sc. at Central College, Bangalore, and earning his Ph.D. from the M. S. University of Baroda, he embarked on a distinguished career. Following a brief tenure at the Central Sericultural Research and Training Institute, he joined the Botanical Survey of India (BSI) in 1979. Over three decades, he rose through the ranks, serving as Head of the Central National Herbarium and ultimately as Director of the BSI until his retirement in 2010.

With over five decades of research experience, Dr. Sanjappa has profoundly shaped our understanding of angiosperms. His expertise spans taxonomic revisions, floristics, and cytotaxonomy, with a specific focus on the Leguminosae family. His authoritative work, *Legumes of India*, remains a widely cited cornerstone of botanical literature. Under his mentorship, his team has described 42 new plant species and documented 25 new additions to the *Flora of India*. A visionary leader, he initiated the annual *Plant Discoveries* publication at the BSI and made significant contributions to international legume databases.

In recognition of his monumental contributions, Dr. Sanjappa has been elected as a Fellow of all major Indian science academies (FNA, FASc, FNASc). His accolades include the prestigious Dr. E.K. Janaki Ammal National Award, the Sir M. Visvesvaraya Senior Scientist's State Award, and the Karnataka Rajyostava Prashisthi. Beyond these honors, his legacy is immortalized in the nomenclature of science, with an endemic legume genus and 28 other species named in his honor. Even in his post-retirement years, as an INSA Honorary Scientist, he continues his vital work on the ex-situ conservation of critically endangered legumes of the Western Ghats, ensuring that his life's work continues to protect India's rich botanical heritage for future generations.



Mrs Smitha Kamath

Founding Director, PraanaPoorna Collective Naturals Products

Sixteen years into a corporate career in polymer engineering and sustainability consulting, her daughter's struggle with acute skin allergies changed the direction of her work entirely. What began as a personal search for safer, chemical-free alternatives for her own family became PraanaPoorna — a company built on the belief that everyday products should heal, not harm. Before PraanaPoorna, she spent her corporate years driving business transformation at Tech Mahindra, leading the Green & Sustainability ICT Solutions Practice at Mahindra Satyam, and heading Organisation Development at Greenpeace. That combination of engineering rigor and sustainability practice shaped how she now build products: minimally processed, ethically sourced from Non-Timber Forest Produce, and lab-tested for real efficacy — not just marketed as 'natural.' Today, PraanaPoorna Collective works with eco-resorts, hospitals, and wellness businesses across India, and has diverted over 1,03,602 kg of plastic from landfills since 2019, while supporting tribal and farmer communities through direct, whole-ingredient sourcing.

Her journey began with her involvement in DevaraKaadu, where she actively worked on sustainable farming, the establishment of sacred groves for biodiversity, and initiatives for groundwater recharge. This experience sparked her interest in ancient wisdom and abundance, leading her to delve into natural farming techniques and the creation of micro-habitats to support biodiversity.

Key Note Address

Keynote Address

Harnessing the Potential of Medicinal and Aromatic Plants (MAP): Development of Value Chains

Chengappa P G

Former Vice Chancellor, UAS Bangalore and National Professor of ICAR, New Delhi

Medicinal and aromatic plants (MAPs) are essential natural resources with applications in pharmaceuticals, food, cosmetics, and pesticides. This sector recorded a CAGR of 9.3% in global level during 2026-30 with the market size reaching \$288 billion in 2025 and expected to grow to \$449.32 billion in 2030. China and India, dominates production due to biodiversity and supportive policies, Europe and North America focus on value-added re-export. MAP market is driven by rising use in pharmaceuticals, cosmetics, and food products, supported by consumer demand for natural ingredients. Challenges in sourcing, quality assurance, and regulatory compliance shape industry strategies for future growth. MAPs are studied across diverse scientific fields: agricultural scientists develop improved cultivars, Ayurveda practitioners assess therapeutic efficacy, and biotechnologists explore molecular compounds for drug discovery. In India, thousands of enterprises rely on these plants for traditional medicine formulations. The increasing domestic and global demand for high-quality, certified herbal products necessitates expanded commercial and scientific cultivation and development of efficient supply/value chains.

The value chain development for MAP can be visualised: 1) Cultivation and sustainable collection involving: contract farming models, Geo-tagging and traceability, agro-forestry, involvement of tribal and forest Communities. 2) Processing, manufacturing and value addition, WHO-GMP Compliance, AYUSH industrial park development 3) Quality, certification and brand building. 4) Market linkage, trade and export promotion. The 1991 WHO guidelines, mandates a thorough evaluation of herbal medicines which includes: rigorous quality assessment of raw plant materials, preparations, and final products and efficacy assessment supported by traditional use documentation and/or animal and human studies. In this context, it is necessary that India should develop global value chains maintaining quality, cost and price competitiveness. For value chain development policy support from the Government is necessary. Recognizing the critical need to conserve medicinal plants and ensure their sustainable utilization, the Government of India established the National Medicinal Plants Board (NMPB) in 2000 under the Ministry of AYUSH. The NMPB serves as a nodal agency for coordinating all matters related to medicinal plants, focusing on conservation, cultivation, trade promotion, and integration into healthcare systems. India has a great potential to emerge as a global leader in MAP through value chain development at regional level and up scaling them to national and international value chains so that all stakeholders along the chain will be benefitted.

Invited Lectures

Invited Lectures

Code	Title	Speaker	P.No.
INV01	Indian Region, a Major Emporium of Medicinal and Aromatic Plants: Diversity, Conservation and Bioprospection-a priority agenda for 21st century	Dr R R Rao Senior Scientist/Former Joint Director BSI, Dehra Dun & Kolkata	
INV02	Mainstreaming Medicinal Plants into Human Healthcare and Wellness: Integrating Ancient Wisdom with Modern Science	Dr Kumar S K Director, School of Ancient Wisdom, Govt. Ayurveda Medical College, Bengaluru	
INV03	Adulteration, Marketing with Traceability of NTFP of MAPs	Dr. M J Prabhu Senior Medicinal Plant Consultant, KaMPA, Bengaluru	
INV04	Production, Certification and Distribution of Quality Planting Materials (QPM) of Medicinal and Aromatic Plants (MAPs)	Dr U M Chandrashekara Project Director, NMPB-RCFC (SR)Kerala Forest Research Institute, Peechi	
INV05	Contract, Collective and Community Farming through Farmer Producer Organizations (FPOs): Inclusive and Workable Models for Scaling Medicinal and Aromatic Plant Cultivation in Karnataka	Dr G K Sadanand CoE, FPO, College of Horticulture, Bengaluru	
INV06	Value Chain Development Models Medicinal and Aromatic Plants (MAP)	Dr.Veerendra Pratap Singh Assistant Professor College of Horticulture, Bidar	
INV07	The Role of Taxonomy in Medicinal Plant Research	Dr M Sanjappa Former Director, Botanical Survey of India, Bengaluru	
INV08	Ethnobotanical Engineering: MAPs as natural hygiene high value products in skincare and Disinfectant cleaners. Antimicrobials replacing petrochemicals. Scaling with Sustainable Circular Bioeconomy - Praanapoorna Case study	Smt. Smitha Kamath Founding Director, Praana Poorna Collective Naturals Products	
EXPERT PANEL DISCUSSION 1	Interactive Meet of Growers, Buyers, Processing Industries, Herbal Practitioners and Consumers on MAP Value Addition and Marketing	Chairperson: Prof. Dr. S.B. Dandin Member, KSTA Former VC, UHS, Bagalkot	
EXPERT PANEL DISCUSSION 2	Medicinal and Aromatic Plants for India@2047. Health Security, Farmer Prosperity and Global Leadership. Strategic Vision for Positioning India as a Global Herbal Bioeconomy Leader	Chairperson: Prof. Dr. Chandrashekhar M. Biradar Member, KSTA CMD, Global Green Growth	

INDIAN REGION, A MAJOR EMPORIUM OF MEDICINAL AND AROMATIC PLANTS: DIVERSITY, CONSERVATION AND BIOPROSPECTION- A PRIORITY AGENDA FOR 21ST CENTURY

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Abstract

The Indian subcontinent is one of the most distinct biogeographic regions of the world with an extremely varied and diverse climate, which support almost all types of habitats for luxuriant growth of ca 8000 species of medicinal and aromatic plants. The use of medicinal plants to alleviate human suffering is as old as the human civilization itself. Mention of medicinal virtues of hundreds of plants in India has been made in the ancient works like *Charaka samhita*, *Susruta samhita*, *Rigveda*, *Yajurveda*, *Astanga Hridaya* and the epic Ramayana and Mahabharata. India also possesses a great heritage of other ancient systems of medicine such as Ayurveda, Siddha, Unani and Homeopathy which mention numerous medicinal and aromatic plants. According to FRLHT's reports in Ayurveda-1689; Folk medical system-4775; Homeopathy-491; Modern medicine-200; Siddha-1563; Tibetan-343 and Unani-843 plants are mentioned. Apart from these systems, there also exists in India a vast knowledge of tribal and folk medicine among the numerous ethnic tribes and all these collectively add to the rich diversity of medicinal and aromatic flora in India. Nearly 550 ethnic tribes dwelling in different forest regions have vast amount of traditional knowledge about plants, particularly medicinal plants. Again, these species are represented by numerous subtypes or populations depending upon the climatic and edaphic conditions. Medicinal plants diversity in India is very high. Although rough estimate of the total number of medicinal plant species in India is reported to be around 8000 species, the infra specific diversity of these species is much higher but least known. It is stressed that Diversity should not be treated as a game of numbers, as often we do, but should consider the total variation within a species such as the various morphotypes, chemotypes, cytotypes, ecotypes, edaphic land races, etc in the range of distribution which is often ignored. Such infra specific diversities are more important particularly in MAPs in assessing the "elite" populations for large scale cultivation and product development. The medicinal and aromatic plants diversity in different biogeographic regions in India is highlighted. It is roughly estimated that West Himalaya harbors 1500 species of medicinal plants, East Himalaya 3000, Western Ghats 3500, Eastern Ghats 1500, Andaman & Nicobar Islands 750 species. Further, it is shown that Karnataka hosts for about 1495 medicinal species, Tamil Nadu 1574, Kerala 1500, Andhra Pradesh 1100 species. Himalaya is shown to be an abode of many high value, life saving medicinal plants like "*Sanjeevani*" mentioned in the epic Ramayana. *Saussurea costus* (kuth root), *Inula racemosa* (poshkar root), *Aconitum heterophyllum* (atees root), *Picrorhiza kurrooa* (kutkai root), *Dactylorhiza hatagirea* (salampanja root), *Valeriana jatamansi* (sugandhabala root), *Ephedra girardiana* (somlata bhuti), *Angelica glauca* (chora root), *Mucuna pruriens* (kaunch beej), *Bergenia ciliata* (pashanbedh), *Rheum emodi* (Revand chindi rhizome), *Dioscorea deltoidea* (singli mungli tibers), *Podophyllum hexandrum* (Mahamedha), *Berberis* spp. (Daruharidra,banfasha) and

many more are reputed medicinal species. Similarly, Western Ghats is shown to be a store house of many reputed medicinal plant species. Medico-botany of a few important medicinal plants like *Butea monosperma* (palash), *Tribulus terrestris* (gokhsura), *Zanthoxylum armatum* (tejbal), *Phyllanthus amarus* (bhumii amla), *Celastrus paniculata* (jyotishmati), *Mallotus philippensis* (kamala), *Adhatoda zeylanica* (vasa, vasaka), *Morinda citrifolia* (noni), *Withania somnifera* (aswagandha), *Aegle marmelos* (Bilva), *Mucuna pruriens* (Kawanch), *Eclipta prostrata* (bringraj, bhangra) and *Martynia annua* (Kakanasa, Tiger claw) is highlighted. Many medicinal plant species such as *Rauvolfia serpentina*, *Gloriosa superba*, *Cassia angustifolia*, *Withania somnifera*, *Chlorophytum* spp., *Catharanthus roseus*, *Andrographis paniculata*, *Pyllanthus amarus*, *Trichopus zeylanicus*, *Janakia arayalpathra*, *Utleria salicifolia*, *Aristolochia tagala*, *Piper barberi*, *Adenia hondala*, *Garcinia* spp., *Thotea siliquosa*, *Caryota urens*, *Adhatoda beddomei*, *Myristica malabarica*, *Coscinium fenestratum* etc. in Western Ghats and *Taxus wallichiana*, *Picrorhiza kurrooa*, *Aconitum* spp, *Saussurea obvallata*, *Berberis* sp., *Ephedra gerardiana*, *Podophyllum hexandrum*, *Rhodiola* sp. (Modern Sanjeevani ?) and a few others in the Himalayas should offer immense prospects for bioprospection of medicinal flora. There is an urgent need for intensive and critical analysis of all claims on medicinal plants and document them for further bioprospection. The author also emphasizes the need to intensify the inventories of medicinal plants for developing a comprehensive, State wise databases on medicinal plants of India. Study of infra specific and genetic diversity in medicinal plans, which is least attempted is also advocated at least for those medicinal and aromatic plants, which are in high demand and needing commercial cultivation.

Diversity in wild aromatic plants, particularly in western ghats is also of a very high order. Aromatic plants are those, which contain odoriferous and volatile substances, which occur as essential oils in one or more parts, viz. roots, wood, barks, foliage, flowers and fruits. Essential oils occur in several plant families but more frequent and abundant in families like Lamiaceae, Rutaceae, Asteraceae, Lauraceae, Zingiberaceae, Oleaceae and Poaceae. Many of these aromatic plants are also powerful germicides and have anti-bacterial properties, but the bulk of the produce finds use in perfumery, and the food-flavouring industries. Some important aromatic species having medicinal properties are listed. The rich diversity of W. Himalaya harbors apart from many medicinal plants, several aromatic species such as *Saussurea costus* roots, *Angelica glauca*, *Valeriana jatamansi*, *Hedychium spicatum*, *Cedrus deodara*, *Carum carvi*, *Zanthoxylum armatum*, *Juniperus* spp., *Cinnamomum tamala*, and *Acorus calamus*. In addition, quite a number of other important aromatic plants are also collected for commercial use. Mentionable among these are *Tagetes minuta*, *Jurinea dolomiaea* and *Skimmia anquetilia*. Similarly, the rich diversity of Western Ghats harbours more than 150 aromatic species in different ecosystems of Western Ghats with an enormous infraspecific diversity, which has not yet been assessed so far. Among these *Cinnamomum caudatum*, *Cinnamomum litseaefolium*, *Cymbopogon gidarba*, *Janakia arayalpathra*, *Moonia heterophylla*, *Pogostemon atropurpureus*, *Pogostemon nilagiricus*, *Pogostemon travancoricus*, and *Micromeria capitellata* have very strong aroma in them and have great potential for further investigations before they can be commercially exploited. Many species like *Cymbopogon flexuosus*, *Ocimum basilicum*, *Plectranthus mollis*, *Hyptis suaveolens*, *Blumea lacera*, *B. hieracifolia*, *B. membranacea*, exhibit remarkable morphological variations in the region. Further, there are nearly 75 endemic aromatic species, which are confined to Western Ghats. Acceptability of some of these species in the trade needs to be evaluated after detailed bioprospection works. Phyto-chemists, Pharmacists, Botanists, Industrialists and Economists should all join together to evaluate the quality and quantity of essential oils in them and develop some of these aromatic species as future essential oil crops.

Discussing the conservation of medicinal and aromatic plants, the author points out that during recent decades, the rich biodiversity of medicinal plants in India is under considerable threat from a variety of human generated factors like habitat loss, fragmentation of species, degradation of special niches, spread of invasive alien species, over exploitation and selective removal of medicinal species from wild, forest clearance for agriculture, expansion of townships and for shifting cultivation. Most of the high value medicinal plants in trade are exclusively collected from wild, critically endangering them in their natural habitats. The efforts towards biological conservation and protection of habitats in the country though laudable, the deterioration of the forests, fragmentation of species and habitats is rather increasing due to the anthropogenic disturbances. Several medicinal species like *Podophyllum hexandrum*, *Aconitum* sp., *Janakia arayalpathra*, *Trichopus zeylanicus*, *Garcinia gummiguta*, *Utleria salicifolia*, *Myristica malabarica*, *Aquilaria malaccensis*, *Dioscorea deltoidea*, *Pterocarpus santalinus*, *Rauvolfia serpentina*, *Saussurea lappa* and *Taxus wallichiana* etc having high economic potential may likely to be lost for ever if we fail to create effective checks and remove the threats facing these species. Several important taxa like *Aconitum* sp., *Aquilaria malaccensis*, *Coptis teeta*, *Coscinium fenastratum*, *Cycas beddomei*, *Dactylorhiza hatagirea*, *Dioscorea deltoidea*, *Euphorbia* sp., *Frerea indica*, *Gnetum* sp., *Gentiana kurroo*, *Kaempferia galanga*, *Nepenthes khasiana*, *Panax pseudo-ginseng*, *Paphiopedilum* spp., *Picrorhiza kurroo*, *Pterocarpus marsupium*, *Rauvolfia serpentina*, *Renanthera imschootiana*, *Swertia chirata*, *Taxus wallichiana*, *Vanda coerulea*, etc., are currently prohibited from collection from wild. Already many medicinal species like *Aconitum heterophyllum*, *Valeriana* spp., *A. falconeri*, *Arnebia benthamii*, *Dactylorhiza hatagirea*, *Gymnadenia orchoides*, *Megacarpaea polyandra*, *Picrorhiza kurroo*, *Nardostachys jatamansi*, *Podophyllum hexandrum* and *Taxus wallichiana* are listed in the schedule 2 of CITES. Sustainable management of these MAPs (conservation) is most important. Numerous threatened species of medicinal and aromatic plants in Himalaya and Deccan region are enumerated. Among the various remedial measures, cultivation of the required medicinal plants, preferably in their native habitats is suggested as a viable option. This would ensure apart from conservation of flora, the efficacy of medicinal plants. Complete inventory of medicinal flora (including infraspecific diversity), development of comprehensive databases that help in framing strategies for conservation and development, identifying the habitats of certain unique species like *Myristica* spp., *Trichopus zeylanicus*, *Utleria salicifolia*, *Janakia arayalpathra*, *Nepenthes khasiana*, *Sapria himalayana*, *Drosera* spp., etc for creating species-oriented conservation sites, attempting reproductive biology studies on those critically endangered medicinal species for locating the “bottlenecks”, if any, in their life cycles to overcome these, establishing gene-banks/seed-banks of all wild medicinal plants for long term preservation, identifying important medicinal plants in trade and initiating large scale cultivation of these for conserving the biodiversity and enhancing the regional economy, lastly and most importantly, training and generation of devoted field botanists and taxonomists for close interaction with biotechnologists for successful bioprospection programmes are certain priority actions suggested.

Biodiversity prospecting of medicinal and aromatic plants for product development and for converting the bio wealth into economic wealth is emphasized as the priority agenda for 21st century. The significance of some of the enigmatic species like soma, Sanjeevini, Bala, Kalpavriksha, etc for fixing the correct botanical identity and bioprospection is stressed. Scanning all known medicinal plants and ethnic leads for short listing of priority species for all ailments through cross cultural ethnobotanical studies is highly necessary for taking up further focused research aimed at product development. Cross-cultural ethnobotanical studies in the country are shown to be very few and must be taken up on priority basis. Conversion of traditional knowledge/leads into a commercialized

product making use of modern science is said to be biodiversity prospecting at species level. Bioprospection of medicinally important tree flora, particularly of Western Ghats, where important antitumor plants like *Aphanamixis polystachya*, *Nothopodytes nimmoniana*, *Mesua nagassarium*, *Semecarpus anacardium* etc exist, would be rewarding. *Nothopodytes foetida* is shown to contain 0.1% camptothecine, an antitumor/anticancer drug.

While the opportunities for bioprospection are limitless, constraints are also shown to be too many. Lack of trained manpower (field botanists and taxonomists), enormous diversity in vast number of species, lack of basic knowledge of medicinal plants, lack of much needed co-operation between field botanists and biotechnologists are some such major constraints. Complete inventories and development of comprehensive databases on medicinal plant wealth of our country, study of Intraspecific diversity in reputed medicinal plants, relocation of such taxa which are considered extinct or extremely rare, safeguarding or “fencing” our wild gene pool against biopiracy, intensifying the efforts towards conservation and sustainable utilisation of medicinal plants, ‘harvesting’ the bio-wealth for human welfare - wedding of Biodiversity and Biotechnology for Bioprospection, safeguarding the interests of indigenous forest people and their associated cultures and lastly Capacity building in Traditional Botany are some tasks suggested for future. The author feels that serious and meaningful efforts should be initiated to overcome these constraints so that the medicinal and aromatic plant wealth of the country is properly and profitably utilized at least in the 21st century.

MAINSTREAMING MEDICINAL PLANTS INTO HUMAN HEALTHCARE AND WELLNESS: INTEGRATING ANCIENT WISDOM WITH MODERN SCIENCE

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Abstract

Medicinal plants have formed the backbone of traditional healthcare systems for millennia and continue to play a vital role in global health. Systems such as Ayurveda emphasize the therapeutic potential of plant-based medicines for maintaining physiological balance, preventing disease, and promoting longevity. Classical Ayurvedic texts like the Charaka Samhita and Sushruta Samhita describe extensive pharmacopeias of medicinal plants and their applications in preventive and curative medicine. In recent decades, there has been a renewed global interest in medicinal plants due to the increasing burden of chronic diseases, antimicrobial resistance, and the limitations of purely synthetic pharmacological approaches.

According to the World Health Organization, nearly 80% of the global population relies on traditional medicine, particularly plant-based therapies, for primary healthcare. Several medicinal plants widely described in Ayurveda, such as *Withania somnifera* (Ashwagandha), *Tinospora cordifolia* (Guduchi), *Curcuma longa* (Turmeric), and *Bacopa monnieri* (Brahmi), have been increasingly validated through modern research in fields like Phytochemistry, Pharmacology, and clinical medicine. These studies demonstrate their antioxidant, anti-inflammatory, immunomodulatory, neuroprotective, and adaptogenic properties.

Mainstreaming medicinal plants refers to the systematic integration of plant-based medicines and traditional herbal knowledge into modern healthcare systems, public health programs, and wellness practices. It means moving medicinal plants from traditional or complementary use into recognized, evidence-based healthcare frameworks where they contribute to disease prevention, treatment, and health promotion.

Mainstreaming medicinal plants into contemporary healthcare requires a multidisciplinary approach that integrates traditional knowledge with scientific validation, quality control, and evidence-based clinical research. Standardization of herbal formulations, identification of bioactive compounds, and rigorous clinical trials are essential for ensuring safety, efficacy, and reproducibility. In addition, sustainable cultivation and conservation of medicinal plant biodiversity remain critical for long-term healthcare resilience.

Integrating medicinal plant-based therapies within modern healthcare frameworks supports preventive medicine, holistic wellness, and the emerging One Health perspective that links human, animal, and environmental health. Strengthening collaboration between traditional medical practitioners, biomedical researchers, and policy institutions such as the Ministry of AYUSH can facilitate the responsible integration of medicinal plants into mainstream healthcare systems. This integrative approach holds significant promise for developing sustainable, accessible, and culturally relevant healthcare solutions for the future.

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INV03

ADULTERATION, MARKETING AND TRACEABILITY OF MEDICINAL PLANTS IN KARNATAKA

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Abstract

Medicinal plants play a vital role in healthcare, traditional medicine, and the pharmaceutical industry. Karnataka is one of India's biodiversity-rich states and is home to numerous medicinal plant species that support local livelihoods and the herbal / AYUSH industries. However, the increasing demand for medicinal plants has led to challenges such as adulteration, lack of primary processing facilities, inefficient marketing systems, and inadequate traceability across the supply chain. Adulteration, whether intentional or accidental, reduces the quality, safety, and therapeutic efficacy of herbal products, posing risks to consumers and damaging market confidence. Marketing of medicinal plants in Karnataka involves collectors, cultivators, traders, processors, and pharmaceutical companies, but issues such as price fluctuations, lack of organized markets, limited value addition, and insufficient quality assurance often affect producer incomes and product competitiveness. Traceability has emerged as an essential tool for ensuring authenticity, quality control, regulatory compliance, and sustainable harvesting practices. The adoption of digital technologies, including barcoding, QR codes, blockchain, and Geographic Information Systems (GIS), can improve transparency and enable stakeholders to track medicinal plant materials from cultivation or collection to the final consumer. Strengthening certification systems, promoting Good Agricultural and Collection Practices (GACP), improving farmer awareness, and implementing robust traceability mechanisms can significantly reduce adulteration and enhance market access. This presentation highlights the current status, challenges, and opportunities related to adulteration, marketing, and traceability of medicinal plants in Karnataka and emphasizes the need for coordinated efforts among researchers, policymakers, industry, and local communities to ensure the sustainable development of the medicinal plant sector while safeguarding the interest of all the stakeholders including consumer health and conservation of biodiversity.

PRODUCTION, CERTIFICATION AND DISTRIBUTION OF QUALITY PLANTING MATERIALS (QPM) OF MEDICINAL AND AROMATIC PLANTS (MAPS)

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Abstract

The cultivation of Medicinal and Aromatic Plants (MAPs) is evolving from a traditional hobby into a precision-driven industry. To succeed in the global market, growers must shift their mindset from simply “growing plants” to managing “biological factories.” In this modern landscape, profit is no longer driven by sheer biomass, but by the concentration of bioactive compounds and the ability to provide a traceable, high-quality product.

The foundation of this industrial shift is Quality Planting Material (QPM). By prioritizing genetic purity and standardized propagation, farmers ensure that every plant meets the rigorous chemical standards required by the pharmaceutical and nutraceutical sectors. Essentially, QPM turns a simple crop into a reliable, high-value raw material.

Medicinal plants are unique because their value lies in specific chemical constituents—alkaloids, glycosides, or essential oils—which can be significantly influenced by how the plant is started. Propagation methods are generally divided into four categories:

Generative (Seeds): Ideal for large-scale field sowing. Species like *Andrographis paniculata* (Kalmegh), *Senna alexandrina* (Indian Senna), and *Catharanthus roseus* (Periwinkle) are typically grown from seeds. However, for high-value perennials like *Santalum album* (Sandalwood), seeds must be grown into saplings and paired with a host plant (like *Cajanus cajan*) to ensure survival.

Vegetative (Soft/Stem Cuttings): Used primarily to ensure the offspring is a genetic clone of the high-yielding mother plant. *Pogostemon cablin* (Patchouli), *Pelargonium graveolens* (Geranium), and *Coleus barbatus* (Coleus) rely on terminal cuttings to maintain their specific essential oil profiles.

Vegetative (Hard/Suckers & Slips): Aromatic grasses such as *Cymbopogon flexuosus* (Lemongrass), *Cymbopogon nardus* (Citronella), and *Chrysopogon zizanioides* (Vetiver) use “slips” (split tillers), which allow for rapid establishment and excellent soil binding.

Storage Organs: Some plants require specialized handling of underground parts. For instance, the *Gloriosa superba* (Gloriosa Lily) is propagated via tuber halves, a delicate process essential for maintaining its colchicine content.

In the past, farmers relied on local seeds or wild-collected cuttings. While inexpensive, these “conventional” materials often suffered from low germination, pest vulnerability, and, most importantly,

variable chemical content. A plant might look healthy but lack the necessary medicinal potency required by pharmaceutical companies.

QPM represents a paradigm shift. It refers to genetically pure, disease-free, and “certified” planting material. QPM ensures Higher Potency (standardized active ingredients), Disease Resistance (reducing the need for chemical pesticides), and Uniform Growth (allowing for synchronized harvesting and efficient processing). Today, modern QPM utilizes advanced technology like DNA barcoding for genetic traceability and tissue culture to ensure phytochemical consistency.

For a grower, knowing the “Key Quality Markers” is essential for fetching a premium price. Industry standards dictate specific requirements for different crops:

Root/Seed Crops: *Withania somnifera* (Ashwagandha) requires certified seeds (like Jawahar-20) with a germination rate above 70% and a Withanolide content exceeding 0.30%. *Mucuna pruriens* (Kapikacchu) is valued for seeds with an L-Dopa content higher than 4%.

Leaf/Shoot Crops: *Ocimum tenuifolium* (Tulsi) is evaluated based on its Eugenol content, while *Bacopa monnieri* (Brahmi) must show vigorous green growth and specific Bacoside levels. *Centella asiatica* (Gotu Kola) should ideally contain more than 2.5% Asiaticoside.

High-Value Perennials: *Santalum album* (Sandalwood) saplings must be 25-30 cm high with a “lignified” (brown) stem, indicating readiness for field survival. For *Embolia officinalis* (Nelli), grafted plants like the NA-7 variety are mandatory to ensure high Vitamin C and consistent fruit size.

Successful cultivation of Medicinal and Aromatic Plants (MAPs) relies heavily on matching specific species to their ideal Agro-Ecological Zones (AEZ) to maximize secondary metabolite production. In South India, for instance, in the Humid Tropical regions of the Western Ghats, crops like *Rauvolfia serpentina* (Sarpagandha), *Piper longam* (Long Pepper), and *Pogostemon cablin* (Patchouli) thrive in deep, humus-rich forest loams that mimic their natural understory habitats. Conversely, the High-Altitude zones of the Nilgiris provide the unique porous soils and mild temperatures necessary for *Pelargonium graveolens* (Geranium). For the Semi-Arid regions of the Deccan Plateau, drought-tolerant species such as *Aloe Vera*, *Senna alexandrina*, and *Santalum album* are preferred, as they are well-adapted to sandy or red/black loamy soils with limited water availability.

In the Tropical and Sub-tropical Plains, which include coastal and interior regions, well-drained laterite or red loamy soils support a diverse range of high-value crops like *Andrographis paniculata* (Kalmegh), *Asparagus racemosus* (Shatavari), *Stevia rebaudiana* (Stevia), and *Gloriosa superba* (Gloriosa Lily). Beyond these specialized zones, certain resilient aromatic grasses like *Cymbopogon flexuosus* (Lemongrass) and *Chrysopogon zizanioides* (Vetiver) exhibit remarkable adaptability, thriving across all zones even in poor, barren, or clayey soils. This strategic placement ensures that each plant functions as an efficient “biological factory,” meeting the rigorous chemical standards required for global pharmaceutical and nutraceutical markets while optimizing land use for regional farmers. Thus, to maximize the potential of QPM, growers must align species selection with their local environment. In South India, MAPs are categorized by Agro-Ecological Zones (AEZ):

For a farmer to access international markets, the produce must meet standards like WHO-GACP (Good Agricultural and Collection Practices). In India, the National Medicinal Plants Board (NMPB) and the Quality Council of India (QCI) oversee the Voluntary Certification Scheme for Medicinal Plant Produce (VCSMPP). Third-party auditors, such as Aditi Organic Certifications in Bengaluru,

play a vital role. They provide the necessary audits to verify that a farm's practices meet national and international standards. Growers can apply for this certification using specific documentation (Form F-3.1.2.6.1), which acts as a "botanical passport." This traceability ensures that the raw material is ethically sourced, free from adulteration, and safe for human consumption.

The Regional Centre of the National Medicinal Plants Board (RCFC-Southern Region) situated in the Kerala Forest Research Institute, Peechi, Thrissur has adopted a dual strategy to support the herbal industry. First, they produce high-quality QPM at the Kerala Forest Research Institute (KFRI) Central Nursery. Second, they promote decentralized production through partner agencies to make QPM accessible to local farmers. The Seed Centre Facility at KFRI serves as a critical resource for the farming community by: a) supplying source-identified and certified QPMs, b) providing storage facilities for farmers to keep their seed materials under controlled conditions, and c) facilitating seed grading and distribution to ensure only the best material reaches the soil.

The integration of technology, certification, and scientific propagation is transforming the MAP sector. By moving toward precision agriculture and utilizing DNA profiling and QR codes for traceability, farmers are no longer just cultivators—they are partners in the global healthcare supply chain. Ensuring every plant is a "Quality" plant is the only way to meet the rigorous demands of the modern pharmaceutical and nutraceutical industries, ensuring both consumer safety and farmer profitability.

CONTRACT, COLLECTIVE AND COMMUNITY FARMING THROUGH FARMER PRODUCER ORGANIZATIONS (FPOS): INCLUSIVE AND WORKABLE MODELS FOR SCALING MEDICINAL AND AROMATIC PLANT CULTIVATION IN KARNATAKA

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Abstract

Medicinal and Aromatic Plants (MAPs) constitute a strategically important component of India's bio-economy, supporting the rapidly expanding AYUSH, pharmaceutical, nutraceutical and natural products industries while simultaneously contributing to biodiversity conservation and rural livelihoods. Despite India's rich repository of over 7,500 documented medicinal plant species, the sector continues to be constrained by fragmented production systems, heavy dependence on unsustainable wild harvesting, inconsistent quality standards, weak traceability mechanisms and limited market integration. Nearly 80% of medicinal plant raw material is still sourced from forests, underscoring the need to transition towards organized cultivation systems capable of meeting domestic and international quality, sustainability and regulatory requirements. The critical bottleneck is therefore institutional rather than technological, necessitating scalable models that effectively integrate dispersed smallholders into resilient and market-responsive value chains.

Farmer Producer Organizations (FPOs) provide a robust institutional architecture for operationalizing contract farming, collective farming and community-based production systems in the medicinal and aromatic plant sector. By aggregating geographically dispersed producers, FPOs facilitate economies of scale, standardized adoption of Good Agricultural and Collection Practices (GACP), group certification, traceability, quality assurance, aggregation of marketable volumes and collective price negotiation. Contract farming frameworks supported through tripartite arrangements among FPOs, financial institutions and industrial buyers enhance market security, input access, technical advisory services and risk-sharing mechanisms. Simultaneously, collective and community farming models enable efficient utilization of common production infrastructure, including nurseries, primary processing facilities, drying units, steam distillation plants and custom hiring centres, thereby improving operational efficiency and value addition while reducing transaction costs.

Inclusive institutional models assume particular significance in tribal and forest-dependent regions, where community-based producer enterprises can facilitate sustainable commercialization without compromising ecological integrity. Existing institutional platforms such as Van Dhan Vikas Kendras and their transformation into Van Dhan Producer Enterprises under PM JANMAN offer significant opportunities for integrating tribal communities into formal value chains through decentralized processing, community ownership and local value addition. Convergence among technical, research, conservation, financial and market institutions, including Centre of Excellence for Farmer Producer Organizations (COEFPO), Karnataka Medicinal and Aromatic Plants Authority (KAMPA), CSIR-

CIMAP, ICAR-DMAPR, Central Ayurveda Research Institute (CARI), FRLHT, Karnataka Biodiversity Board, State Horticulture Department and private industry partners, creates an enabling ecosystem for technology dissemination, capacity building, quality assurance, biodiversity governance and sustainable market development. Furthermore, Access and Benefit Sharing (ABS) mechanisms and Biodiversity Management Committee (BMC) certification can strengthen conservation-linked value chains while generating additional revenue streams for local communities.

The long-term competitiveness of the sector will increasingly depend upon the integration of digital agriculture and Industry 4.0 technologies, including AgriStack enabled geo-spatial crop registration, blockchain based end-to-end traceability, artificial intelligence driven multilingual advisory systems, IoT enabled process monitoring, digital market platforms and rapid quality-at-source testing. Such technological interventions, combined with institutional convergence and FPO-led governance, have the potential to establish transparent, certified and globally competitive medicinal plant supply chains. An integrated ecosystem based on collective entrepreneurship, sustainable resource management, technological innovation and community participation offers a viable pathway for transforming Karnataka into a national model for inclusive, climate-resilient and market-oriented medicinal and aromatic plant cultivation.

Keywords: Farmer Producer Organizations (FPOs); Medicinal and Aromatic Plants (MAPs); Contract Farming; Collective Farming; Community Farming; Tribal Producer Enterprises; Van Dhan Vikas Kendras; PM JANMAN; Good Agricultural and Collection Practices (GACP); Institutional Convergence; Digital Traceability; Biodiversity Conservation; Karnataka.

VALUE CHAIN DEVELOPMENT MODELS FOR MEDICINAL AND AROMATIC PLANTS(MAP)

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Abstract

India is recognized as a global leader in biodiversity and a cradle of traditional medicine, with over 7,000 documented species of medicinal and aromatic plants (MAPs). The country is one of the world's 12 leading biodiversity centres, featuring 16 agro-climatic zones that support a massive, diverse industry. Medicinal and Aromatic Plants (MAPs) are vital to India's economy, driven by surging global demand for natural products and a robust domestic AYUSH industry, boosting income for small-scale farmers and generating substantial rural employment. These crops provide significant livelihood opportunities for small and marginal farmers, particularly in semi-arid and marginal lands. The major crops include Ashwagandha, Tulsi, Safed Musali, Kalmegh, Stevia, Lemongrass, Palmarosa, Sandalwood, Rosemary, Patchouli and Davana. They are considered as low-volume, high-value commodities. Growing demand for natural products has increased their commercialization potential, particularly in countries with high biodiversity like India. Value Chain Development (VCD) of medicinal and aromatic plants is the process of improving coordination, productivity and value addition among stakeholders to bring a product from its initial production stage to the final consumer. These activities include production, processing, transportation, marketing and distribution. The challenges faced in VCD of medicinal and aromatic crops are mainly lack of quality planting material, limited technical knowledge, inadequate processing infrastructure, poor post-harvest management, weak market linkages, price fluctuations, lack of quality standards and certification, limited access to credit and finance.

Certain strategies can be adopted for the improvement of VCD models in the field of medicinal and aromatic crops like strengthening input supply systems, capacity building and farmer training, development of processing infrastructure, improved post-harvest management, strengthening market linkages, formation of Farmer Producer Organizations (FPOs), quality certification and standardization, institutional and policy support. Digital platforms like 'e-CHARAK' and the formation of Farmer Producer Organizations (FPOs) serve as critical institutional anchors that mitigate price fluctuations and provide the necessary market intelligence for rural producers. An effective value chain development requires integrated efforts across production, processing and marketing stages. By addressing key challenges and implementing appropriate improvement strategies, medicinal and aromatic crops value chains can become more efficient, profitable and sustainable, benefiting farmers and the herbal industry locally as well as globally.

Keywords: Medicinal and Aromatic Plants (MAPs), Value Chain Development (VCD), AYUSH Industry, Small-scale Farmers and Rural producers.

THE ROLE OF TAXONOMY IN MEDICINAL PLANT RESEARCH

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Abstract

This presentation discusses in brief the development of indigenous system of medicine in India and how that knowledge was transferred to the modern literature on Indian medicinal plants without proper evaluation. It emphasizes the need for closer interaction between actual practitioners of such a system and plant taxonomists in their effort. The important role played by taxonomists in medicinal plant research is often not properly understood and the system of nomenclature the taxonomists professes is also often looked down with annoyance. Some cases of Indian medicinal plants are discussed illustrating why name changes are inevitable and also highlights the importance of standard/universal international means of referring a plant correctly

The story of man's quest for plants healers is as old as human civilization. The primitive man, led by dire necessity, used as therapeutic agents, plants as well as many other things which he could procure more easily from nature. The experience and observation, handed down by the tradition of over thousands of years, helped them to arrive at many valuable conclusions about the qualities of plants growing around them.

The earliest records of such medicinal plants all over the world are found in the classic works of ancient scholars in all the civilizations. Rigveda and Atharvaveda of the 2nd millennium BC are two such foremost Sanskrit classics of ancient India where medicinal virtues of some 2000 plants are depicted. Over the centuries, the Vegetable Materia Medica of India became more and more richer by the contribution of the Sanskrit scholars, through knowledge gained from countries with which it had developed trade in ancient times, and also from of healing art which the Greek and the Mughal invaders brought with them to India.

During colonial era, European missionaries, army officers and surgeons in the service of colonial rulers started exploring our plant wealth in search of newer spices and condiments, food and beverages, medicines, vegetable dyes, tannins, etc. The scientific system of plant nomenclature soon got acceptance as an international means of referring a plant. It was about this time there began a serious systematic study of Indian flora.

Indian plants were first systematically enumerated by their scientific Latin names and were also provided with their vernacular and Sanskrit names, good botanical descriptions, illustrations, uses, etc. (W. Roxburgh: *Plants of the Coromandel Coast*- 1785–1799; *Flora Indica* – posthumously published -1820, 1832). Garcia de Orta's *coloquies dos simples e Drogas* (1563) and van Rhee's *Hortus Malabaricus* (1678–1693) are first two such accounts of Indian plants in European languages where medicinal virtues of plants were enumerated using their vernacular names.

Though modern botany originated in Europe in the 16th Century AD, the science of taxonomy got newer dimension with the publication of *Species Plantarum* by Carl Linnaeus in 1753. During the

20th century there appeared a number of treatises on Indian medicinal plants where scientific Latin names were adopted. they are primarily compilation of information often from published records without interaction with actual users of such plants and the taxonomists.

Mostly, identity of the plants was ascertained by their Sanskrit and vernacular names. The plants were then provided with a good botanical description and illustration (where available) from a standard flora, and to these were added medicinal virtues also from published records. Primarily in this way, it is presumed, the knowledge gathered by the indigenous people about medicinal plants were disseminated to the international community. It is true vernacular names often facilitate identification, but it should not be the sole criteria for identification of a plant. It is well known that local names vary from area to area within the same language, as well as from one language to another language, and sometimes even the same name is applied to two or more plants. On the other hand, scientific names of plants always remain attached to their *Types* (usually a specimen preserved in a herbarium based on which a species is described as new to science). In case of any ambiguity about the application of a name the *Type* material to which the name is attached, decides its application. Since *Type* governs the correct application of a name, the International Code of Nomenclature for algae, fungi & plants (ICN), now prescribes greater precision in designating a *Type*. Retroactive typification in some such cases many cause abrupt change in established use of a name. There are also other reasons for name changes. These may be either taxonomic or nomenclatural, or both. Taxonomic changes stem from the taxonomic judgment of a scientist about the conspecificity or distinctiveness of two or more taxa (e.g. Species, genus, etc.). And also, their taxonomic decisions may result in nomenclature changes too (for e.g., when two genera are combined, the species belonging to that genus which has been relegated to synonymy have to be transferred to the accepted genus affecting new nomenclatural combinations. Nomenclatural changes may also be caused by the discovery of an earlier homonym and the like. It is also true that instability in scientific names of plants is annoying to plant users, researchers in other fields, and there is now provision in the ‘Code’ for conservation of names even at species level in some cases (e.g., economic species and those names which are widely and persistently misapplied). Yet there is bound to be more nomenclature changes in future when our knowledge about the plant and their interrelationship improves (which will help plant breeders and the like). Therefore, taxonomic stability cannot be achieved by arbitrary fixation of names. It has to be achieved by serious taxonomic study including exhaustive and critical analysis of all literature, materials and *Types* of names.

Correct identification of medicinal plants is a major problem, often very valuable research findings go under incorrectly identified plant names. There are innumerable cases of wrong identification of the plants, these could be cases of mistaking a plant similar to another reported from other part of the world or identification mistakes or cases of conspecificity – two names given for the same species and such other cases. A few such selected cases are given below:

PUNARNOVA–*Trianthema portulacastrum* L. (Aizoaceae) and *Boerhavia diffusa* L. (Nyctaginaceae).

The Sanskrit and other vernacular name ‘Punarnova’ applies equally to entirely different plants in Indian Floras and both of them are equally valued as medicinal herbs.

Trianthema portulacastrum L. (Aizoaceae) and *Boerhavia diffusa* L. (Nyctaginaceae).

BRAHMI–*Centella asiatica* (L.) Urb. (Apiaceae) and *Bacopa monnieri* (L.) Wettst. (Plantaginaceae)

The Sanskrit name 'BRAHMI' applies to *Centella asiatica* (L.) Urb. (Apiaceae) in some parts of India, while in other parts this name applies to *Bacopa monnieri* (L.) Wettst. (Plantaginaceae). *Centella asiatica* has proven anti-protozoa properties, while *Bacopa monnieri* is an important ingredient of well-known herbal nerve tonic. The nomenclature of the two plants are as follows:

Centella asiatica (L.) Urb. In Mart., Fl. Brass. 11 (1): 287, t.78E.1. 1879.

Hydrocotyle asiatica L., Sp. Pl. I: 234.1753.

Bacopa monnieri (L.) Wettst. in H.G.A.Engler & K.A.E.Prantl, Nat. Pflanzenfam.4 (3b): 77. 1891.

Gratiola monnieri (L.) L., Syst. Nat. ed. 10. 851. 1759 'monniera'

Herpestis monniera (L.) Kunth in F.W.H.von Humboldt, A.J.A. Bonpland & C.S.Kunth, Nov. Gen. Sp. 2: 367.1818.

Bacopa monnieri (L.) Pennell, Proc. Acad. Nat. Sci. Phil. 98: 94. 1946.

BHUMI AMLA/BHUMI NELLI / KHIZA NELLI–*Phyllanthus niruri* L.?

Phyllanthus niruri L. (Phyllanthaceae) is a considerably misunderstood species complex in Indian herbaria and floras (starting from Flora of British India in 1887), till R.L. Mitra & Jain (1985) have clearly resolved the complex. Their study revealed that 'Phyllanthus niruri' in F'ora of British India is a mixture of four distinct species, viz., *P. amarus* Schum. & Thonn., *P. fraternus* Webster and *P. debilis* Klein ex Willd. and *Phyllanthus airy-shawii* J.F.Brunel & Jacq.Roux, the true *P. niruri* L. being endemic to Central, & South America and West Indies. In all treatises on Indian medicinal plants it was reported as an effective anti-jaundice plant and tremendous amount of literature has accumulated on *Phyllanthus niruri* L. in India (which is an incorrect name for plants occurring in India), it is necessary to connect the taxonomic history of the species as given below:

Phyllanthus amarus Schum., Schumach. & Thonn., Beskr. Guin. Pl.: 421.1827; Webster, J. Arnold Arb. 37:13. 1956 & 38: 313, t.19 f, I-K. 1957; R. L. Mitra & Jain, Bull. Bot. Surv. India 27(1-4): 164, fig.1.1985; Chaudhury & Rao, Phytotaxonomy 2: 148.2002.

Phyllanthus niruri auct. non L. 1753; Muell.-Arg. in DC. Prodr. 15(2): 406.1886 '*P. niruri* [var.] *genuinus*'; Hook.f. Fl. Brit. India 5: 298. 1887; pro parte maj. quoad syn. *P. urinaria* Hook.f.

Distribution: Central & South America and West Indies; introduced elsewhere.

Phyllanthus debilis J.G.Klein ex Willd., Sp. Pl., ed. 4. 4: 582.1805; Webster in J. Arnold

Arb. 38: 307. t. 19. f. C & D. 1957, excl. syn. *P. debilis* Herb. Ham. ex Hook. f., Fl. Brit. India 5: 299. 1887. *P. niruri* [var.] *a. javanicus* Muell.-Arg., Linnaea 32 : 43. 1853 & in DC., Prodr. 15(2): 407. 1866. *P. niruri* [var.] *8 debilis* (Willd.) Muell.-Arg.; R. L. Mitra & Jain, Bull. Bot. Surv. India 27(1-4): 164, fig.2.1985

P. niruri auct. non L.1753: Hook. f., Fl. Brit. India 5: 298. 1887, pro parte quoad syn. *P. polyphyllus* Herb. Wight ex Wall., Numer. no. 7895D, 1847, nomen.

P. mukerjeeanus Mitra & Bennet, Bull. Bot. Soc. Bengal 19: 145. t.1., f.1. 1966,

Diasperus debilis (J.G.Klein ex Willd.) Kuntze, Revis. Gen. Pl. 2: 601.1891.

Moeroris debilis (J.G.Klein ex Willd.) R.W.Bouman in Phytotaxa 540: 26. 2022.

Phyllanthus niruri var. *debilis* (J.G.Klein ex Willd.) Müll.Arg. in A.P.de Candolle, Prodr. 15(2): 407.1866.

Distribution: India (including Andaman & Nicobar Islands), Indonesia Malaysia, Maldives, Sri Lanka; introduced elsewhere

Phyllanthus fraternus G.L.Webster, Contr. Gray Herb. 176: 53.1955 & J. Arnold Arb. 38: 309. t. 19. Fig. G & H. 1957; R. L. Mitra & Jain, Bull. Bot. Surv. India 27(1-4): 172, fig.3.1985. *P. niruri* Auct. non L. 1753: Hook. f. Fl. Brit.India 5: 298. 1887, pro parte

Moeroris fraterna (G.L.Webster) R.W.Bouman, Phytotaxa 540: 30. 2022.

Distribution: India (including Lakshadweep Islands), Nepal, Pakistan; introduced elsewhere.

AMLA/NELLI KAYI (Indian gooseberry)–*Phyllanthus emblica* L. (1753) & *Phyllanthus indofischeri* Bennet (1983).

The fruits of both the species are used as food and medicine. *P. emblica* (Bettada nelli kayi/Nai nelli kayi) is widely distributed and cultivated (India, Bangladesh, Cambodia, China, Laos, Malaysia, Myanmar, Pakistan, Sri Lanka, Taiwan, Thailand, Vietnam), whereas *P. indofischeri* (Ittu nelli) is endemic to peninsular India. This was originally described as *Emblia fischeri* Gamble (1918). However, based on a critical study of specimens of *Phyllanthus* and *Emblia* by Webster (1957) reduced *Emblia* as a synonym of *Phyllanthus* and all species of *Emblia* were transferred to *Phyllanthus*. *Emblia fischeri* should have been renamed as *Phyllanthus fischeri*, since the name *Phyllanthus fischeri* Pax (1894) already existed for altogether different African species of *Phyllanthus*, the Indian species was renamed as *Phyllanthus indofischeri* Bennet (1983) as per the nomenclatural rules. Both the species can be distinguished based on size and grove markings on the fruit, style branches length and nature, length of limited growth branches, number and arrangement of leaves, shape of bark flakes, and slash/blaze colour and habitat. *P.emblica* is found in dry deciduous forests, fruit diameter 2–2.5 cm, obscurely developed grooves, style branches 5–7 mm long, recurved, puberulous; branchlets 40 cm long, alternate and superposed with about 100 linear leaves; branches and branchlets slender and drooping; leaves greenish glaucous beneath and *P. indofischeri* in scrub forests, fruit diameter 2.5–4 cm with well-developed grooves, style branches 2–3 mm long, straight, glabrous; branchlets 25 cm long, alternate and spiral with about 50 oblong leaves, branches and branchlets stout and erect; leaves greyish glaucous beneath.

GOKHRU/GOKSHURA–*Tribulus terrestris* L. (1753) and *Tribulus rajasthanensis* Bhandari & V.S.Sharma (1977)

The genus *Tribulus* (Zygophyllaceae) has two closely resembling medicinally important species which are often identified as as *T.terrestris* but can be easily segregated based on very distinct spines on fruits. In *T. terrestris* the fruit mericarps are dorsally tuberculate with 4 major spines, while in *T. rajasthanensis*, the fruit mericarps are with 2 major divergent spines and 20-30 minor spines.

DARU HARIDRA (Indian Barbary/Asiatic Barbary)–*Berberis aristata* DC. (1821) and *Berberis asiatica* Roxb. ex DC, (1821)

Most of the species of *Berberis* in the Himalaya are morphologically similar, often confused and difficult to distinguish the species. The above two species can be separated from each other based on

glossy green, not glaucous beneath leaves; flowers in simple or paniculate racemes with entire petals in *B. aristate*, while in *B. asiatica* the leaves are pale green and glaucous beneath; flowers in corymbose or umbellate racemes with emarginate petals.

KUTKI–*Picrorhiza kurrooa* Royle (1835) & *Neopicrorhiza scrophulariiflora* (Pennell) D.Y.Hong (1984)

Picrorhiza kurrooa (Plantaginaceae) which is distributed Western Himalaya is often confused with *Neopicrorhiza scrophulariiflora* distributed in Himalaya and SC China. In the vegetative condition, both of them more or less look alike. but has *P. kurrooa* comparatively bigger habit, densely many-flowered inflorescence; weekly zygomorphic or subactinomorphic corolla with equal lobes, included within calyx; stamens equal, long exerted. On the otherhand *Neopicrorhiza scrophulariiflora* has smaller habit; moderately dense, few-flowered inflorescence; zygomorphic, bilabiate, exerted corolla with 4 unequal lobes; upper lip 3-lobed, lower lip much smaller and unlobed; stamens slightly exceeding corolla, upper part of stamens unequal, included.

The impact of modernization had also its adverse effect on the indigenous systems of medicines. Most of the institutions are now located in urban areas where mostly neither the teachers nor the students have any firsthand knowledge about plants, or the products which they prescribe.

They have to depend on the preparations of pharmaceutical companies which deal with herbal medicines, or else on the crude drug dealers for supply of raw materials where possibility of rampant adulteration cannot be excluded.

It is well known that in parts of Kerala State in India there are still some Ayurvedic Institutions who have their own herbal gardens and trained plant collectors, and practice the system in traditional way. It is, therefore, felt that for any meaningful study in medicinal plants, there should be a close interaction between the plant users and the taxonomists. The material should be properly identified and when required the description should be derived from actual specimens and not from any secondary source.

In all case of plant related studies, a voucher specimen must be preserved in any herbarium of for designated National Repository future reference. The national repositories are designated by National Biodiversity Authority under Biodiversity Act 2002 and Rules 2004. The list of these designated repositories can be found in website of the National Biodiversity Authority (www.nbaindia.org). It is heartening to note that a number of reputed journals have made this clause mandatory for accepting the research results for publication.

**ETHNOBOTANICAL ENGINEERING: MAPS AS NATURAL HYGIENE
HIGH VALUE PRODUCTS IN SKINCARE AND DISINFECTANT
CLEANERS. ANTIMICROBIALS REPLACING PETROCHEMICALS.
SCALING WITH SUSTAINABLE CIRCULAR BIOECONOMY -
PRAANAPOORNA CASE STUDY**

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Abstract

This paper presents the “Praanapoorna” model, a paradigm shift in the Medicinal and Aromatic Plants (MAPs) sector that transitions indigenous knowledge into high-value, circular industrial applications. By leveraging Ethnobotanical Engineering, the study demonstrates how Non-Timber Forest Produce (NTFPs)—MAPS derived Essential oils, including soapnuts, citrus peels, and tree resins like Sambrani and Edible Camphor—can be transformed into potent, 100% bio-based antimicrobial solutions.

Contrary to the “petrochemical sterile fallacy” that creates a microbial vacuum and triggers antimicrobial resistance (AMR), the Praanapoorna process utilizes natural fermentation products bio-enzymes and saponins to produce Natural Disinfectant cleaners and Food-grade Antibacterial detergents. This patent-pending formulation achieves 99.99%+ efficacy against bacteria, viruses, and fungi in external lab tests, providing hospital-grade sanitation without toxicity or environmental frothing.

The framework for Ethnobotanical Engineering and scaling this bioeconomy focuses on five strategic pillars:

1. Raw Origin Integrity: Utilizing locally sourced, high-vitality NTFPs to eliminate supply chain contamination and ensure traceability.
2. Functional Substitution: Replacing synthetic fragrances with MAP-derived resins and oils that physically alter atmospheric microbial loads.
3. Evidence-Based Validation: Utilizing minimal-heat fermentation to preserve volatile actives, backed by reverse mutagenicity and non-toxicity data.
4. Market Intelligence: Bridging the gap between traditional efficacy and modern regulatory hurdles (ISO, GEM, AYUSH) while shifting the narrative from “surface cleaning” to “ecosystem restoration.”
5. Distributed Bioeconomy: Scaling via Section 8 SPVs and CFC frameworks (SFURTI/ ASPIRE) to transition from wild-collection to Good Agricultural Practices (GAP).

By decentralizing production through women-led collectives, the Praanapoorna model offers a science-backed pathway for strengthening innate immunity, securing rural livelihoods, and advancing

environmental conservation through a sustainable circular bioeconomy. PraanaPoorna Natural Product Range developed includes more than eighty formulations: B2C - Natural certified, Lab-tested restorative detox rituals and chakra-balancing oils, resins for Safe skin application, Air and water., Includes Baby Care, Skin Care and PET care products, Cleaners, Skin butters and oils. Natural Aroma Sprays can be used as air freshners and deodorants.

B2B - Natural certified, Lab-tested Industrial solutions include Disinfectants cleaners, food-grade antibacterial detergents, odor control solutions, mosquito repellents, (replace fumigation), eco-friendly fertilizers/pest repellents for agriculture, Livestock and poultry disinfectant sprays/washes

EXPERT PANEL DISCUSSION 1

Interactive Meet of Growers, Buyers, Processing Industries, Herbal Practitioners and Consumers on MAP Value Addition and Marketing

Chairperson:

Prof. Dr. S.B. Dandin

Member, KSTA/Former Vice Chancellor, UHS, Bagalkot

Panel Members:

Dr Srivathsa Govindaraju, Nature Inspires India, Bengaluru

Dr B S Harish, Professor of MAP, COH, Bengaluru

Dr Dinesh Nagagowda, CIMAP, Bengaluru

Dr M V Prakash Rao Manchale, Medicinal Plant Farmer, Shivamogga

Expected points for panel discussion

According to WHO estimates, nearly 80 percent of the world's population depends on herbal medicine for primary healthcare. India, with immense biodiversity wealth, possessing nearly 7,500 medicinal plant species out of 17,000 flowering plants has emerged as a global leader in herbal medicine and natural product trade. Yet, despite this potential, commercialization of MAPs in India has not fully delivered equitable income distribution, biodiversity conservation, or sustainable growth. Instead, the sector faces a complex set of ecological, institutional and economic challenges that must be addressed to unlock its full potential. The MAPs industry in India has immense scope due to its richest biodiversity, traditional knowledge base and rising global demand for herbal products. On the economic front, India's MAP exports have grown steadily, increasing from \$347 million in 2020 to \$535 million in 2024, with an annual growth rate of 11.42 percent, and the United States remains the largest importer. The global MAP market, valued at US\$ 35.2 billion in 2026, is projected to reach US\$ 56 billion by 2033, growing at a CAGR of 6.8 percent, positioning India as a key supplier. Moreover, the MAP industry in India has the potential to become a cornerstone of rural development, healthcare innovation and export led growth. By integrating traditional knowledge with modern science, strengthening farmer cooperatives and meeting international certification standards, India can establish itself as a global leader in medicinal and aromatic plants sector. The scope extends beyond economic gains, it also contributes to biodiversity conservation, ecosystem services, sustainable agriculture and the promotion of holistic health care systems worldwide.

Challenges

One of the most pressing challenges is the heavy dependence on natural resources in wild and unscientific harvesting. Nearly 80-90 percent of raw materials used in India's medicinal plant industry are sourced directly from forests. This reliance has led to overexploitation, habitat degradation and

natural wealth of biodiversity loss, threatening the very existence of several high-value species. Unsustainable destructive harvesting practices, combined with poor awareness of cultivation techniques creates the ecological strain. Climate change further complicates the scenario by habitat loss, lack of quality planting material supply, poor commercial cultivation of MAP, destabilizing yields and affecting the secondary metabolite content of plants, which directly influences their medicinal quality besides the supporting policy ambience and also poor regulations especially with respect to large scale adulteration and poor traceability. The ecological sustainability of the sector is therefore under severe stress, requiring urgent interventions to shift from wild collection to organized cultivation.

The economic structure of the MAP value chain also reveals deep imbalances. Producers and collectors, often poor rural or tribal communities, receive minimal returns for their labour, while intermediaries and processing industries capture the majority of profits. India's export pattern reflects this imbalance, nearly 60 percent of exports are in crude raw form, 30 percent are semi-processed and only 10 percent are finished products. This indicates limited domestic value addition and significant untapped opportunities in processing and product development. Such structural inefficiencies reduce India's competitiveness in global regulated markets, where quality assurance, certification and traceability are increasingly demanded. Moreover, adulteration, lack of standardization and weak quality control systems further undermine the credibility of Indian herbal products abroad. Declining traditional knowledge, long gestation periods, low price/income realization and market uncertainty discourage farmers. Inadequate information of GAP/GPP for large number of commercially important map out of the list of 55 plants as prioritized by NMPB (Table 1), poor irrigation facilities, weak stakeholder linkages and dependence on middlemen further reduce profitability. Communication gaps between researchers, extension agencies and farmers hinder technology dissemination.

EXPERT PANEL DISCUSSION 2
Medicinal and Aromatic Plants for India@2047
Health Security, Farmer Prosperity and Global Leadership
Strategic Vision for Positioning India as a Global Herbal Bioeconomy Leader

Chairperson:

Prof. Dr. Chandrashekhar M. Biradar

Member, KSTA/Earth System Scientist & Lead – Global Green Growth, Founder & CMD, Global Green Growth CoP
(GGGC.CO)

Panel Members:

Mr Basaiah Hiremath, Founder and Director, NOFH, Bengaluru

Mrs. Sumangala K H, Founder and CEO, Samanvaya Trust, Davangere/Bengaluru

Dr Vijayakumar Narayanapur, Prof of MAP, UHS, Bagalkot

Dr. Ashwini Godbole, Professor, TDU, Bengaluru

Context and Rationale

Medicinal and Aromatic Plants (MAPs) represent one of India's most valuable living knowledge systems, linking biodiversity, traditional healthcare, rural livelihoods and emerging green industries. India's civilizational heritage, diverse agro-ecologies and long-standing traditions of Ayurveda, Siddha, Unani, folk healing and household wellness provide a unique foundation for building a future-ready herbal bioeconomy.

The global demand for herbal medicines, nutraceuticals, wellness products, natural cosmetics, plant-based therapeutics and functional ingredients is steadily increasing. This creates a major opportunity for India to move beyond raw material supply and build integrated, quality-assured and ecologically responsible value chains. The central challenge is to ensure that MAP development becomes both economically viable for growers and ecologically sound for landscapes, while delivering safe, authentic and high-quality products to consumers.

The Expert Panel Discussion on 'Medicinal and Aromatic Plants for India@2047 – Health Security, Farmer Prosperity and Global Leadership' led by Prof Chandrashekhar M Biradar, CMD and Green Growth Architect along with Panel of Experts, is therefore designed as a strategic dialogue to identify practical pathways for positioning India as a global leader in the herbal bioeconomy. The session will bring together field-experienced scientists, policy leaders, industry experts, farmer organizations, traditional knowledge holders and market actors to discuss what must be done now to make the MAP sector globally competitive by 2047.

Core Proposition: MAPs can become a conservation-led green economic engine that improves health security, raises farmer incomes, strengthens rural enterprises and positions India as a trusted global source of quality herbal products.

Purpose of the Expert Panel

The panel will focus on actionable, field-tested and scalable pathways to transform MAPs into ecologically viable and economically sustainable business models. The discussion will address the following strategic priorities:

- Develop Agro-Ecological Zone (AEZ)-wise recommended lists of suitable, climate-resilient and commercially viable MAPs.
- Standardize and promote Good Agricultural Practices (GAP) and Good Processing Practices (GPP) for priority species.
- Strengthen certified sources and supply systems of Quality Planting Material (QPM).
- Improve sustainable production, ethical collection, traceability, adulteration prevention and regulatory compliance.
- Generate market intelligence on commercial and high-demand MAPs for growers, FPOs, processors and entrepreneurs.
- Assess export potential and align Indian MAP value chains with international trade, quality and safety regulations.

Strategic Discussion Areas

1. **Health Security and One Health:** The panel will explore how scientifically validated MAPs can contribute to preventive healthcare, wellness, nutrition, community health and One Health approaches that connect human wellbeing with ecosystem health.
2. **Farmer Prosperity and Green Business Models:** A key focus will be on profitable cultivation models, FPO-led aggregation, contract and collective farming, buy-back arrangements, risk-sharing mechanisms and value addition models that improve income security for growers.
3. **Ecological Sustainability and Conservation:** The discussion will emphasize conservation-linked cultivation, responsible wild collection, habitat restoration, biodiversity-friendly production, benefit-sharing and prevention of overharvesting from natural ecosystems.
4. **Quality, Traceability and Consumer Confidence:** Panelists will examine how QPM, GAP/GPP, certification, laboratory testing, digital traceability, anti-adulteration systems and regulatory clarity can build trust across the value chain.
5. **Bioeconomy, IPR and Global Leadership:** The session will address opportunities for bioprospecting, IPR protection, biopiracy safeguards, export readiness, branding and positioning India as a global hub for authentic herbal products and knowledge-based bioenterprise.

Expected Outputs from the Panel

- A practical India@2047 roadmap for strengthening the MAP sector from growers to consumers.
- Priority actions for AEZ-wise species planning, QPM systems, GAP/GPP adoption and value chain strengthening.
- Recommendations for market intelligence, export promotion, traceability, certification and regulatory convergence.
- Guidance for building farmer-centric, ecologically sound and economically sustainable MAP enterprise models.
- Inputs for policy, research, industry partnerships and institutional coordination to advance India's herbal bioeconomy.

Suggested Guiding Questions

- Which MAP species should be prioritized across India's agro-ecological zones based on ecology, market demand and conservation needs?
- How can certified QPM, GAP/GPP and traceability become accessible to smallholders, FPOs and rural entrepreneurs?
- What business models can ensure fair returns to growers while meeting industry quality requirements?
- How can India reduce adulteration, strengthen consumer confidence and meet international standards?
- What policy, research and institutional changes are needed to make India a global herbal bioeconomy leader by 2047?

Conclusion

The Expert Panel Discussion will provide a future-oriented platform to connect ancient wisdom with modern science, conservation with commerce, and farmer prosperity with consumer wellbeing. By aligning ecological sustainability, quality assurance, market access and global standards, the MAP sector can become a flagship pathway for India's green economic growth. The India@2047 vision for medicinal and aromatic plants must therefore be built on trusted knowledge, resilient landscapes, empowered growers, responsible industries and high-quality products that serve both people and the planet.

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ENP01

INSECTICIDAL POTENTIAL OF SELECTED MEDICINAL AND AROMATIC PLANTS FOR ECO-FRIENDLY MANAGEMENT OF DIAMONDBACK MOTH, *Plutella xylostella* (L.) IN CABBAGE

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Abstract

The diamondback moth (*Plutella xylostella* L.) is one of the most destructive pests of cruciferous vegetables, causing up to 90 per cent loss in the marketable yield of cabbage. Its rapid development of resistance to synthetic insecticides necessitates the search for eco-friendly alternatives. In this context, the present investigation was undertaken to evaluate the insecticidal potential of selected medicinal and aromatic plants against *P. xylostella* under laboratory and field conditions. Laboratory screening studies were conducted using aqueous and methanol extracts of twenty selected medicinal and aromatic plants through the leaf-dip bioassay method against early third instar larvae of *P. xylostella*. Among the aqueous extracts, neem seed kernel extract (NSKE) at 2.5 per cent recorded the highest larval mortality (93.33%) after 120 hours of treatment, followed by pongamia (90.00%), turmeric (86.67%), bael and hebbavu (83.33%), datura (80.00%) and calotropis (76.67%). Methanol extracts showed comparatively higher efficacy, with NSKE recording the maximum larval mortality (96.67%), followed by pongamia (93.33%) and datura (86.67%). Overall, the screening study revealed several promising botanical insecticides, with NSKE at 2.5 per cent being the most effective treatment, followed by pongamia, datura, calotropis, bael, hebbavu and nagadali. Promising botanicals identified through laboratory screening were further evaluated under field conditions on cabbage in a randomized block design. The results of the field trial clearly indicated that, 5 per cent NSKE was the most effective treatment in reducing DBM infestation and recorded the highest cabbage yield with a benefit-cost ratio of 2.48. Plant extracts such as datura, bael, tulasi, nagadali, hebbavu and pongamia also showed moderate effectiveness. Further, the plots treated with plant extracts showed higher activity of natural enemies such as *Cotesia plutellae* and spiders compared to chemical insecticide treated plots. The findings indicate that medicinal and aromatic plants, particularly NSKE, can serve as effective and eco-friendly alternatives for sustainable management of diamondback moth in cabbage.

Keywords : *Plutella xylostella*, Botanical Insecticides, Medicinal and Aromatic Plants, Cabbage Pest Management.

ENP02

TEXTILE TO TREATMENT: THE SURPRISING HEALTH BENEFITS OF JUTE LEAVES

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Abstract

Jute (*Corchorus* species, primarily *C. capsularis* and *C. olitorius*), globally recognized as the “golden fibre” for its industrial textile applications, is emerging as a highly potent medicinal plant in ethnopharmacology and modern therapeutics. Historically utilized in folk medicine across tropical Asia and Africa, various parts of the plant—particularly the leaves and seeds—have been administered to treat ailments including dysentery, chronic constipation, fever, ascites, and localized inflammation. Phytochemical investigations have revealed that the jute plant is a rich reservoir of secondary metabolites, with more than 80 bioactive compounds isolated to date. The primary pharmacological constituents include cardiac glycosides (such as corchorin, corchoroside A and B, and helveticoside), triterpenes, ionones, phenolics, phytosterols, and flavonoids. Concurrently, the green leafy vegetable portions possess exceptional nutraceutical value, delivering significant yields of vitamins A, C, and E, alongside vital minerals like iron, potassium, and calcium. Modern in-vitro and in vivo scientific studies have validated these traditional claims, demonstrating that jute extracts possess notable antioxidant, anti-inflammatory, antidiabetic, gastroprotective, antihyperlipidemic, and cytotoxic (antitumor) activities. Furthermore, recent advancements highlight the application of jute leaf polysaccharides as novel, bioactive tablet binders in pharmaceutical formulations. This abstract synthesizes the dual-purpose profile of jute as a nutrient-dense functional food and a therapeutic agent, highlighting its immense potential as a sustainable raw material for bio-directed drug development and natural health products.

Keywords: *Corchorus olitorius*, *Corchorus capsularis*, Phytochemicals, Cardiac Glycosides, Antioxidant, Pharmacological Profile, Functional Food.

ENP03

INFLUENCE OF STAGES OF LEAF REMOVAL ON THE TURMERIC (*Curcuma Longa* L.) LEAF ESSENTIAL OIL AND RHIZOME YIELD AND QUALITY

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Abstract

Curcuma longa L. widely acclaimed as the “Golden Spice of India” is a perennial rhizomatous herb of the family Zingiberaceae (order Scitaminae) and is triploid in nature, valued for its significant medicinal, nutritional and economic importance. India continues to dominate the global turmeric sector, accounting for a major share of world production, with the crop cultivated on approximately 2.97 lakh hectares and producing about 10.42 lakh metric tonnes during 2023-24. While turmeric rhizomes constitute the principal economic product used in food, medicine and traditional healthcare systems, substantial quantities of above-ground biomass, particularly leaves, are often discarded as agricultural residues. Such underutilization not only contributes to agro-waste accumulation but also represents a missed opportunity for sustainable bioresource utilization. Recent studies indicate that turmeric leaves contain volatile essential oils rich in bioactive phytochemicals possessing antioxidant, antimicrobial, antifungal and anti-inflammatory properties. These essential oils exhibit a mild spicy aroma and hold promising applications in perfumery, cosmetics, aromatherapy and natural product industries, thereby offering potential avenues for value addition and rural bio-economy development. However, limited scientific information exists regarding the appropriate stage of leaf harvesting for essential oil extraction and its potential influence on rhizome yield and quality. To address this research gap, a field experiment was conducted during 2022-23 at the Kittur Rani Channamma College of Horticulture, Arabhavi. The study evaluated six treatments involving leaf removal at 165, 180, 195, 210, 225 and 240 days after sowing (DAS) in a Randomized Block Design with four replications. Leaf removal at 240 DAS significantly improved yield attributes, recording higher number (3.05 plant⁻¹) and weight (149.63 g plant⁻¹) of mother rhizomes, greater total fresh rhizome yield (1188.53 g plant⁻¹), superior dry recovery (21.30%) and higher dry finger rhizome yield (8.15 t ha⁻¹). The results demonstrate that strategic harvesting of turmeric leaves for essential oil extraction can enhance crop value without adversely affecting rhizome productivity, thereby contributing to sustainable resource utilization, farmer income enhancement and the emerging bio-economy of medicinal and aromatic plants.

Keywords : *Curcuma longa*, Essential Oil, Leaf Harvesting, Rhizome Yield.

ENP04

***Coriandrum sativum* L.: ETHNOPHARMACOLOGY, PHYTOCHEMISTRY AND CARDIOVASCULAR BENEFITS**

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Abstract

Coriandrum sativum L., commonly known as coriander, is an important medicinal and aromatic plant belonging to the Apiaceae family with significant nutraceutical, therapeutic and economic value. Widely cultivated and utilized in culinary systems worldwide, coriander also holds a long-standing

position in traditional medicine across Asia and the Middle East. Phytochemical investigations reveal the presence of diverse bioactive constituents in its roots, leaves, fruits, and seeds, including polyphenols, flavonoids, phenolic acids, phytosterols and terpenes. Among these, linalool the principal volatile terpene alcohol contributes substantially to its neuroprotective, anxiolytic, anticonvulsant and analgesic properties. Emerging evidence highlights the cardiometabolic potential of coriander, particularly in the prevention and management of cardiovascular diseases (CVDs), which remain the leading cause of global mortality as reported by the World Health Organization. Experimental studies, predominantly in vivo, demonstrate that coriander exhibits antihypertensive, anti-atherogenic, antiarrhythmic, and hypolipidemic effects. These activities are attributed to its antioxidant capacity, angiotensin-converting enzyme (ACE) inhibitory action, lipid-lowering potential and modulation of cardiometabolic risk factors. Traditional knowledge systems document its use in managing gastrointestinal, respiratory and urinary disorders, while modern pharmacological studies substantiate its anti-inflammatory, anticancer and cardioprotective properties. Bioactive compounds such as gallic acid, thymol and bornyl acetate further enhance its therapeutic spectrum.

Keywords : Coriandrum Sativum, Phytochemistry, Cardiovascular Health, Ethnopharmacology

ENP05

JASMONIC ACID: A VERSATILE PHYTOHORMONE FOR BOOSTING SECONDARY METABOLITES IN MEDICINAL PLANTS

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Abstract

Medicinal and aromatic plants (MAPs) form the backbone of nature's pharmacy and play a pivotal role in India's traditional healthcare systems, phytopharmaceutical industries and rural bio-economy. Enhancing the production of high-value secondary metabolites in MAPs is critical for strengthening health security, increasing farmer income and promoting sustainable value chains. Jasmonic acid (JA) and its derivative methyl jasmonate (MeJA) have emerged as powerful signaling molecules capable of activating plant defense pathways and redirecting primary metabolism toward enhanced biosynthesis of pharmacologically important compounds. This study synthesizes experimental evidence demonstrating jasmonate-mediated metabolic reprogramming in key medicinal crops including *Bacopa monnieri*, *Centella asiatica*, *Gymnema sylvestre*, *Catharanthus roseus*, peppermint (*Mentha × piperita*) and *Thymus* species. Optimized JA/MeJA elicitation significantly upregulated key biosynthetic genes (e.g., SQS, FPS, STR, TDC), resulting in multi-fold increases in bacosides, triterpenoid saponins, gymnemic acids, indole alkaloids, thymol, carvacrol and essential oils within short exposure periods. Such precision elicitation strategies offer a sustainable alternative to expanding cultivation area, thereby conserving biodiversity while improving phytochemical yield and quality. At the national level, initiatives led by the Council of Scientific and Industrial Research, particularly through CSIR-CIMAP and flagship programs such as the CSIR Aroma Mission, are actively promoting scientific cultivation, value addition and commercialization of MAPs to double farmers income and

strengthen India's herbal economy. Integrating jasmonate-based elicitation technologies with such national programs can enhance crop quality, increase export competitiveness and contribute to the vision of an Atmanirbhar (self-reliant) bio-economy.

Keywords : Jasmonic Acid , Secondary Metabolites, Medicinal and Aromatic Plants, Metabolic Elicitation

ENP06

DEVELOPMENT AND CHARACTERIZATION OF BIODEGRADABLE FILM DERIVED FROM PECTIN OF BANANA PSEUDO-STEM WASTE

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Abstract

Banana pseudostem, an abundant agro-waste byproduct containing significant pectin reserves, represents an underutilized raw material for sustainable packaging applications. This study investigated the extraction of pectin from banana pseudostem waste using optimized MAE extraction methodology. The extracted pectin was subsequently processed into biodegradable films through solution casting with glycerol as a plasticizer at optimized concentrations. Comprehensive characterization was performed using FTIR spectroscopy, X-ray diffraction (XRD), scanning electron microscopy (SEM), thermal gravimetric analysis (TGA), and mechanical property testing. FTIR analysis confirmed the successful extraction and incorporation of pectin, with characteristic absorption bands at $1,740\text{ cm}^{-1}$ (carboxyl C=O stretch), $1,230\text{ cm}^{-1}$ (C-O stretch), and $3,200\text{--}3,400\text{ cm}^{-1}$ (hydroxyl O-H stretch). XRD analysis revealed semi-crystalline structure with moderate crystallinity, balancing mechanical strength with biodegradability. The resultant films exhibited tensile strength values of 4.99–6.91 MPa, elongation at break ranging from 15–25%, and water vapor permeability suitable for short-term food packaging. Soil burial degradation studies demonstrated approximately 50% mass loss within 30 days and complete biodegradation within 90 days, significantly outpacing conventional plastic degradation rates. SEM images revealed a smooth, homogeneous surface structure with excellent interfacial adhesion and uniform plasticizer distribution. These findings demonstrate the technical and environmental viability of banana pseudo-stem pectin-based films for sustainable food packaging applications while addressing agricultural waste valorization objectives.

Keywords : Banana Pseudostem, Pectin, Biodegradable Film, Sustainable Food Packaging

CULTIVATING THE FUTURE WITH NUTRITIONAL POWERHOUSES (POTENTIAL CROPS) FOR A CHANGING CLIMATE

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Potential crops are plant species that are used traditionally for their food, fibre, fodder oil or medicinal properties, but have yet to be adopted by large scale agriculturists. Potential crops , in general , constitute those plants species that occur as life support species in extreme environmental conditions and threatened habitats, having genetic tolerance to survive under harsh conditions and possess qualities of nutritional and industrial importance for a variety of purposes. Once they are adopted and properly utilized, they may help to contribute in food security , nutrition, health, income generation and environmental services when properly utilized. In India there are many underutilized potential crops and majority of which are not well documented . Among these many of which are being utilized in the development of value added products . At AICRN on Potential crops, UAS,GKVK, Bengaluru about 2500 accessions of grain amaranth have been documented The seed protein content varies from 8.86 to 19.6 per cent. Leaves are an excellent source carotene , grains have high protein with high lysine and good balance of other amino acids. The presence of a higher amount of folic acid can help in increasing blood haemoglobin. Apart from grain amaranth , the popularity of *Chenopodium quinoa* , protein rich and gluten free rice (helpful for diabetic patients) is increasing drastically .Quinoa is discovered as a health food by North Americans and Europeans . It contains natural antioxidants like alph-tocopherol. Around 200 accessions of quinoa are being evaluated at the centre. Similarly an edible seed *Salvia hispanica* commonly referred to as Chia has a great potential in the development of food products as thickener, emulsifier and stabilizer. The small seeds are rich source of Omega -3 fatty acid. Currently research on jobstea (adlay ragi) commonly called japamale is being carried out at the centre. Adlay ragi a multi purpose millet is one of the potential crops grown widely in north eastern regions of India. It is rich in protein and used for grain purpose. It is also used as an excellent fodder crop with medicinal value. Likewise research on various other nutritionally rich potential crops like winged bean , Bambara groundnut and rice bean has led to the development of various varieties . The demand and expectations of modern supply chain lead farmers to concentrate on fewer crops which has resulted in a steady loss of agrobiodiversity. This loss if not corrected , will lead to irretrievable loss of strategic potential crop resources necessary for the well being of millions of people. These crops in addition to their adaptation to diverse ecological niches ,are said to be highly nutritious and in many cases to have medicinal properties. Thus speaks the role they have historically played in rural community.

Keywords : Potential Crops, Nutritional Security, Climate Resilience, Agrobiodiversity

ENP08

A RAPID SCREENING APPROACH: USING TLC BIOAUTOGRAPHY TO MAP THE ANTIMICROBIAL AND ANTIOXIDANT PROPERTIES OF *Schouwia purpurea*

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Abstract

Schouwia purpurea (Forssk.) Schweinf. is a xerophytic plant native to arid regions of Asia and Africa, noted for its diverse pharmacological potential. This study investigated the antibacterial and antioxidant properties of the methanolic root extract of *S. purpurea* using a bio-guided approach. The extract was screened against four human pathogens (*Enterococcus faecium*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa*) and evaluated for free-radical scavenging using Thin-Layer Chromatography-Direct Bioautography (TLC-DB). Active compounds were localized across various solvent systems and characterized via Gas Chromatography-Mass Spectrometry (GC-MS). TLC-DB revealed multiple bioactive zones, with antimicrobial activity spanning values 0.15 to 0.94 and antioxidant activity from 0.55 to 0.78. The most prominent antimicrobial zone (0.67) contained n-hexadecanoic acid, cis-9-octadecenoic acid, and octadecanoic acid. The strongest antioxidant zone (0.78) was characterized by the phytosterols-sitosterol, campesterol, and stigmasterol. These findings identify *S. purpurea* roots as a rich source of fatty acids and sterols with significant therapeutic potential, supporting further investigation into their specific pharmacological mechanisms.

Keywords : *Schouwia purpurea*, TLC Bioautography, Antimicrobial Activity, Antioxidant Activity.

ENP09

INVENTORY OF TRADITIONAL MEDICINAL PLANT KNOWLEDGE OF HASSAN DISTRICT, KARNATAKA

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Abstract

Global healthcare has long benefited from traditional medical systems. Within Hassan district, the enduring use of these systems is likely linked to the region's rich plant diversity, as the district is located in the Western Ghats, and the accumulated knowledge of its resident ethnic groups, who have long utilized these natural resources for traditional healing. This study provides detailed documentation of medicinal plants and their uses in Hassan district, Karnataka, based on information obtained from 172 traditional practitioners. Quantitative assessed the popularity and significance of each plant. A total of 220 species in 205 genera and under 93 families were reported for potential ethnomedicinal purpose with larger portion of them being herbs (74 species) followed by trees (60 species). Wild

plants being the major source of herbal remedy with 181 species. Fabaceae and Apocynaceae are the major plant families with 24 and 14 species respectively. Leaves (41%) were the most used plant part in ethnomedicinal formulations, followed by fruits (14%), root (12%) and bark (09%). Highest Fidelity Level of 96.3% by *Rauvolfia serpentine* for snakebite and 96% by *Aloe vera* for dermatological diseases was recorded. A total of 56 species were identified within the IUCN Red List evaluation. These findings hold significant potential, offering valuable insights for future phytochemical and pharmacological investigations, as well as informing strategies for medicinal plant conservation and sustainable utilization.

Keywords: Hassan, Healers, Medicinal plants, Traditional medicine, ethnobotany.

ENP10

SUSTAINABLE SOLAR-POWERED AEROPONIC SYSTEM FOR HIGH-YIELD CULTIVATION OF TURMERIC (*Curcuma longa*): A STRATEGY FOR ENHANCED PRODUCTIVITY AND LAND USE EFFICIENCY

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Abstract

Conventional soil-based cultivation of turmeric is increasingly challenged by soil-borne diseases, nematodes, and high water consumption and vulnerability to climate variability. This study investigates the feasibility of an innovative, sustainable, and high-yield approach through aeroponic farming of turmeric powered by Solar Photovoltaic (SPV) panels. A mini-model solar operated aeroponic system designed and evaluated, featuring a 120 W SPV module, DC pump, and automated misting system for nutrient delivery. Turmeric plants were grown in a controlled environment, with roots suspended in a nutrient mist. Results indicate that the aeroponic system significantly enhanced vegetative growth compared to conventional soil methods. As turmeric is a high-value tropical crop that thrives in partial shade, making it an ideal candidate for agrivoltaics-the dual use of land for both solar energy and agriculture. The partial shade provided by solar panels reduces heat stress and improve moisture retention, which can lead to increased crop resilience and higher yields compared to full sun exposure. This study shows that solar-powered constructed aeroponics provides a viable, eco-friendly solution for high-value, residue-free rhizome production throughout the year, offering a 45-75% potential increase in yield.

Keywords: Aeroponics, Rhizome, Turmeric, Solar Photovoltaic, Soilless culture, Precising Farming

ENP11

BEYOND ORIGIN LABELS: GEOGRAPHICAL INDICATIONS AND SUSTAINABILITY-RELATED GOVERNANCE IN INDIA'S MEDICINAL AND AROMATIC PLANT SECTOR

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Abstract

Geographical indications (GIs) are increasingly discussed not only as tools of origin-based protection but also as possible mechanisms for improving governance in medicinal and aromatic plant value chains, which in India continue to face problems of adulteration, weak traceability, uneven quality assurance, and broader production-system vulnerabilities. This paper evaluates the conditions under which GI may contribute to sustainability-related governance outcomes in this sector. Using a qualitative policy-analytical approach, it examines three illustrative cases—Kashmir Saffron, Lakadong Turmeric, and Ganjam Kewda Flower through five criteria: place-specific distinctiveness, medicinal or aromatic relevance, authenticity risk, traceability need, and GI suitability as a governance mechanism. The analysis shows that GI is strongest where it supports origin recognition and territorial market differentiation, but its contribution to authenticity remains partial unless backed by traceability, testing, and enforcement. It is still less effective where wider governance gaps dominate, including weak processing support, fragile livelihoods, and institutional fragmentation. The paper argues that GI should therefore be understood not as a standalone sustainability label, but as one component of a wider governance architecture.

Keywords: Geographical Indications, Medicinal and Aromatic Plants, Traceability, Sustainability

ENP12

FORMULATION AND EVALUATION OF A NOVEL POLYHERBAL ANTHELMINTIC GUMMY DOSAGE FORM

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Abstract

This study aimed to formulate and evaluate polyherbal anthelmintic gummies using ethanol extracts of *Carica papaya* and *Cucurbita maxima* seeds. The extracts underwent phytochemical screening and were tested for anthelmintic activity using *Pheretima posthuma*. *Carica papaya* extract was tested at 1, 2.5, and 5 mg/mL, and *Cucurbita maxima* extract at 25, 50, and 100 mg/mL. Albendazole (10 mg/mL) served as the standard, and 0.9 % saline as the control. Polyherbal gummies were prepared by molding and evaluated for pH, weight variation, thickness, moisture content, and stability. Among

the nine extract combinations, the formulation containing a 5:100 ratio of *Carica papaya* extract (CPE) to *Cucurbita maxima* Extract (CME) showed anthelmintic activity comparable to that of the standard drug albendazole. All gummy formulations (F1–F9) exhibited satisfactory results in physical and stability parameters. The presence of alkaloids, saponins, glycosides, phenols, tannins, and fixed oils in the extracts supports their anthelmintic potential, indicating their promise as natural alternatives for worm infestations.

Keywords: *Carica papaya*, *Cucurbita maxima*, ethanol extracts, Anthelmintic, *Pheretima posthuma* and gummies

ENP13

ELICITOR-MEDIATED ENHANCEMENT OF WITHANOLIDE A PRODUCTION IN *Withania somnifera* (L.) DUNAL USING *Agrobacterium* INDUCED HAIRY ROOT CULTURE

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Abstract

Withania somnifera (Ashwagandha) is an important medicinal plant widely valued for its bioactive withanolides, particularly withanolide A, which exhibits diverse pharmacological activities. The increasing global demand for ashwagandha-derived phytochemicals necessitates the development of alternative and sustainable production strategies beyond conventional cultivation. The present investigation aimed to establish an efficient hairy root culture system and evaluate elicitor-mediated enhancement of withanolide A production in *Withania somnifera*. *In vitro* regeneration was standardized using cotyledon explants cultured on Murashige and Skoog (MS) medium. Maximum shoot induction (86.7%), highest shoot proliferation (6.14 shoots per explant), and greater shoot length (3.92 cm) were obtained on MS medium supplemented with 2.0 mg L⁻¹ BAP. Root induction was most effective on MS medium containing 0.4 mg L⁻¹ IBA, producing the highest number of roots (6.80 roots per explant) with maximum root length (16.30 cm). Hairy root cultures were induced from leaf and cotyledon explants using *Agrobacterium rhizogenes* strain MTCC 532. Rapid hairy root initiation was observed within 12 hours of co-cultivation in leaf explant. Molecular confirmation through PCR amplification detected the presence of the *rolC* gene (~545 bp), validating successful genetic transformation. Quantitative estimation using High-Performance Liquid Chromatography (HPLC) revealed significantly higher withanolide A accumulation in hairy roots (0.880 μ g mg⁻¹ DW) compared to *in vitro* roots (0.162 μ g mg⁻¹ DW), representing approximately a 5.4-fold increase. Further enhancement of metabolite production was achieved through elicitor treatment, where salicylic acid (5 mg L⁻¹) recorded the highest withanolide A content (2.05 μ g mg⁻¹ DW) in hairy roots. The findings

demonstrate that hairy root culture combined with elicitation provides a powerful biotechnological approach for enhanced and sustainable production of valuable secondary metabolites in *Withania somnifera*, supporting the development of medicinal plant-based bioeconomy.

Keywords: Ashwagandha, Hairy root culture, Withanolide A, Elicitation, Plant biotechnology

ENP14

EXPLORING THE ELEMENTAL AND PHYTOCHEMICAL POTENTIAL OF ANTI-DIABETIC PLANTS VIA ATR-FTIR AND EDXRF

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Abstract

Plants are important sources of medicine and plays a vital role in traditional healthcare system. They contain a wide variety of bioactive compounds that help in the prevention and treatment of many diseases. Due to their therapeutic properties and minimal side effects, medicinal plants are gaining increasing attention in modern scientific research. In this regard the study was conducted on selected 23 medicinal plants which are widely used in traditional medicine system for the management of various diseases, including diabetes mellitus. Specific parts of each plant, including roots, stems, leaves, seeds, bark, and fruit peels, were dried, powdered and combined in equal proportions. A Attenuated Total Reflectance (ATR)-Fourier Transform Infrared Spectroscopy (FTIR) was employed to identify the functional groups and to confirm the presence of various phytochemical constituents responsible for antidiabetic activities. In addition to that Energy Dispersive X-ray Fluorescence (EDXRF) analysis was conducted to determine major, minor and trace elements such as Calcium, Potassium, Iron, Magnesium, Phosphorus, Sulfur, Zinc, Chromium and Copper etc are identified and that plays significant role in glucose metabolism. The obtained results indicates that these medicinal plants contains biologically active compounds and essential elements that may contribute to their anti-diabetic properties. Hence the present study supports the scientific validation of traditional medicinal plants & their parts are potential as natural therapeutic agents in managing diabetic & can be utilized in the formulation of new pharmacological drugs.

Keywords: Medicinal Plants, Phytochemical, ATR-FTIR, EDXRF

PHYTOREMEDIATION POTENTIAL AND BIO-MEDICINAL PROFILING OF *Gliricidia sepium* L. FROM TUMATTI HILLS, BALLARI, KARNATAKA, INDIA.

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Abstract

As global demand for sustainable ecological restoration grows, identifying native plants with dual roles in environmental cleanup and bio-resource production is vital. This study investigates *Gliricidia sepium* L., a nitrogen-fixing legume, for its ability to accumulate heavy metals in the mining-impacted regions of Tumatti Hills, Ballari. Analytical assessments using Atomic Absorption Spectroscopy (AAS) revealed significant accumulation of Iron (Fe), Nickel (Ni), and Lead (Pb). Notably, *Gliricidia sepium* L. exhibited high translocation efficiency for Iron, with a Leaf/Root Translocation Factor (TF) of 13.66 and a Leaf Bioconcentration Factor (BCF) of 7.37. The Metal Accumulation Index (MAI) was highest in the stem (3199.68), followed by the root (575.17), suggesting strong phytostabilization and phytoextraction potential.

Crucially, the study characterized the plant's rhizospheric environment, identifying a diverse community of heavy-metal-tolerant microorganisms. Biochemical profiling of these isolates confirmed the presence of bacteria capable of citrate utilization, catalase production, and sugar fermentation. These rhizobacteria likely play a synergistic role in enhancing the plant's stress tolerance and metal bioavailability in the contaminated soil.

Parallel to its remedial properties, *Gliricidia sepium* L. serves as a "natural pharmacy." Phytochemical screening of leaf and stem extracts confirmed the presence of phenols, flavonoids, steroids, and saponins, which are essential for antioxidant and ethnomedicinal applications. Biochemical analysis further identified the presence of proteins and carbohydrates in aqueous leaf extracts. These findings support a circular bio-economy model, utilizing *Gliricidia sepium* L. for land reclamation and microbial-assisted remediation while exploring its bioactive compounds for sustainable livelihoods and environmental health.

Keywords: *Gliricidia sepium* L., Phytoremediation, Rhizobacteria, Heavy Metal, Natural pharmacy, Bio-economy.

ENDOPHYTE-MEDIATED SILVER NANOPARTICLES FROM THE ETHNOMEDICINAL PLANT CURCUMA LONGA: SCIENTIFIC VALIDATION OF ANTIBACTERIAL ACTIVITY AGAINST DRUG-RESISTANT *Staphylococcus aureus* AND ANTICANCER POTENTIAL

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Abstract

The emergence of multidrug-resistant (MDR) bacterial infections and cancer represents a major global health challenge due to increasing morbidity, mortality, and limited therapeutic options. The reduced effectiveness of conventional antibiotics and chemotherapeutic drugs highlights the urgent need for novel, sustainable therapeutic agents derived from natural sources. The present study investigates the potential of endophytic fungi isolated from the ethnomedicinal plant *Curcuma longa* (turmeric) for the green synthesis of silver nanoparticles (AgNPs) and evaluates their antibacterial and anticancer activities. Endophytic fungi were isolated from healthy tissues of *Curcuma longa* and identified based on morphological and molecular characteristics. The fungal isolates were screened for their ability to synthesize AgNPs, and isolate NP-3 was identified as the most efficient producer, confirmed by visual color change and UV-Visible spectrophotometric analysis. Characterization using EDS, FTIR, and SEM revealed the formation of spherical AgNPs with an average size of approximately 20 nm and a characteristic absorption peak at 420 nm corresponding to the surface plasmon resonance of AgNPs. The synthesized AgNPs demonstrated significant antibacterial activity against MDR *Staphylococcus aureus*, producing a zone of inhibition of 16 mm. Furthermore, the anticancer potential of the nanoparticles was evaluated against A549 cancer cell lines using in vitro cytotoxicity assays. The AgNPs exhibited dose-dependent cytotoxicity with an IC₅₀ value of 65.10 µg/ml, indicating notable Antiproliferative activity comparable to standard chemotherapeutic agents. These findings provide scientific validation for the Ethnomedicinal significance of *Curcuma longa* and highlight the role of endophytic fungi in the eco-friendly synthesis of bioactive nanoparticles. Endophyte-mediated AgNPs show promising potential as antimicrobial and anticancer agents, offering a sustainable strategy to combat drug-resistant infections and cancer. Further investigations involving mechanism of action, toxicity profiling, and in vivo studies are required to support their potential biomedical applications.

Keywords: *Curcuma longa*, Endophytic fungi, Silver nanoparticles (AgNPs), A549 cell line, Cytotoxicity

SILENT STRANGERS: THE UNSEEN BATTLE AGAINST INVASIVE WEEDS IN KARNATAKA

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Abstract

Invasive alien species (IAS) represent the second most significant global threat to biodiversity, surpassed only by habitat destruction. In India, anthropogenic disturbances including rapid urbanization, habitat fragmentation, and land degradation have created an ecological vacuum increasingly filled by aggressive alien weeds. These invaders pose a severe menace to agricultural productivity and forestry operations across the country. A comprehensive understanding of these species is essential for initiating eradication programs and managing regional biodiversity sinks. This study, "**Aggressive Weeds of Karnataka**," provides a systematic documentation of major invasive plants to facilitate effective environmental management. Each species profile includes detailed taxonomic and vernacular identification, physical descriptions, and spatio-temporal data regarding their distribution in Karnataka and historical introduction to India. Furthermore, the work details critical biological and ecological traits, including reproduction mechanisms, seed dispersal, and phenological cycles. A primary focus is placed on actionable intelligence, offering evidence-based management practices and identifying potential uses for specific species where applicable. By addressing the factors influencing the rapid establishment of alien plants such as India's diverse climatic conditions and frequent human-mediated transport of propagules, this work serves as a critical resource for conservation biologists, agricultural scientists, foresters, and educators. The findings provide a foundational framework for protecting native flora and developing sustainable weed control protocols applicable across the Indian subcontinent.

Keywords: Invasive Alien Species, Alien Weeds, Biodiversity Conservation, Weed Management

PHYTOCHEMICAL CHARACTERIZATION, GC-MS PROFILING, AND *in vitro* CYTOTOXIC EVALUATION OF SOLVENT EXTRACTS OF *Sargassum thunbergii* AGAINST HUMAN CANCER CELL LINES

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Abstract

Marine macroalgae are rich sources of bioactive metabolites with potential therapeutic applications. The present study investigated the phytochemical composition, chemical constituents, and anticancer potential of methanol, chloroform, and hexane extracts of *Sargassum thunbergii* using phytochemical screening, gas chromatography–mass spectrometry (GC–MS), and *in vitro* cytotoxicity assessment in human cancer cell lines.

Dried algal powder was sequentially extracted using methanol, chloroform, and hexane. Preliminary phytochemical screening was performed using standard qualitative methods to identify the major secondary metabolites. The hexane extract was subjected to GC–MS analysis, and the compounds were identified by comparison with the NIST spectral library. The cytotoxic activity of the extracts was evaluated against human lung adenocarcinoma (A549), breast adenocarcinoma (MCF-7), and hepatocellular carcinoma (HepG2) cell lines using the MTT assay. Morphological changes induced by the extracts were examined microscopically and compared with untreated controls and standard doxorubicin-treated cells.

The findings demonstrate that *Sargassum thunbergii* contains diverse phytochemicals and bioactive fatty acid derivatives with significant *in vitro* anticancer potential. The methanol extract, in particular, showed a broad spectrum of phytoconstituents and notable cytotoxic effects against A549, MCF-7, and HepG2 cancer cell lines. These results support further investigation of *Sargassum thunbergii* as a promising source of natural anticancer compounds and warrant detailed studies involving IC₅₀ determination, apoptosis analysis, and molecular mechanism elucidation.

Keywords: *Sargassum thunbergii*; Marine macroalgae; GC–MS; Phytochemical screening; Cytotoxicity; MTT assay; A549; MCF-7; HepG2; Anticancer activity.

ENP19

ISOLATION, STRUCTURAL CHARACTERIZATION, AND PHARMACOLOGICAL EVALUATION OF VITEXIN FROM THE AQUEOUS BARK EXTRACT OF *Glycosmis Pentaphylla* Retz.

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Abstract

Glycosmis pentaphylla Retz., is a medicinal plant widely recognized for its diverse therapeutic properties and rich phytochemical profile. The present study aimed to isolate and identify the bioactive flavonoid vitexin from the aqueous bark extract of *Glycosmis pentaphylla* and to evaluate its pharmacological activities. The bark extract was prepared using aqueous solvent extraction, followed by purification and isolation through chromatographic techniques. The isolated biomolecule was

characterized using advanced analytical techniques including Nuclear Magnetic Resonance (NMR), High-Performance Liquid Chromatography (HPLC), Gas Chromatography–Mass Spectrometry (GC–MS), and Liquid Chromatography–Mass Spectrometry (LC–MS), which confirmed the structural identity of vitexin. The biological potential of the isolated compound was evaluated through various in vitro pharmacological assays. Antioxidant activity was assessed using DPPH, ABTS, and hydrogen peroxide (H₂O₂) radical scavenging assays, which demonstrated significant free radical scavenging activity in a concentration-dependent manner. The anticancer activity of vitexin was investigated against human cancer cell lines including breast cancer (MDA-MB-231), lung cancer (A549), and oral cancer (KB-3-1), showing considerable inhibition of cancer cell proliferation. In addition, wound healing activity was evaluated using an in vitro scratch assay, where vitexin significantly enhanced cell migration and wound closure compared with control groups. The findings of this study suggest that vitexin isolated from *Glycosmis pentaphylla* bark possesses promising antioxidant, anticancer, and wound healing properties, highlighting its potential as a natural bioactive compound for therapeutic and pharmaceutical applications.

Keywords: Vitexin; *Glycosmis pentaphylla*; Antioxidant activity; Anticancer activity; Wound healing.

ENP20

PHYSICOCHEMICAL AND PHYTOCHEMICAL ANALYSIS OF *Helianthus annuus* L. MICROGREENS AS NUTRIENT-DENSE FUNCTIONAL FOOD INGREDIENT

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Abstract

Microgreens have gained significant attention as nutrient-dense functional foods owing to their abundant phytochemical content and potential health promoting properties. The present study aims to comprehensively evaluate the morphological, physicochemical, and phytochemical characteristics of sunflower (*Helianthus annuus*) microgreens. Morphological parameters including plant leaf size and plant height were noted down during the growth period. Physicochemical properties such as fresh weight, dry weight, pH, moisture content, water holding capacity, extractive value, foaming capacity, and foaming stability were determined. Preliminary phytochemical analysis was performed using aqueous and hydroalcoholic extract. Various plant pigments such as chlorophylls, carotenoids, and anthocyanins were estimated, besides their total flavonoid and total phenolic content. Sunflower seeds were procured from the local market and authenticated at the Foundation for Revitalisation of Local Health Traditions, Transdisciplinary University, Bangalore. The seeds were propagated in a tray size of 38 x 28 cm with seed density of around 40 g using cocopeat as growth medium. The microgreens were harvested on day 8, washed with water and the roots were removed. The plant height was 5.06 ± 0.64 cm on day 4, while it reached up to 12.91 ± 1.28 cm on day 8. Fresh and dry weight were found to be 50.05 g and 3.54 g respectively. The pH of the microgreen was found to be 6.37, with water

holding capacity of 1.505 %. The foaming capacity and foaming stability were $11.3 \pm 0.67\%$ and $2.67 \pm 0.67\%$, respectively. Extractive values were found to be $8.8 \pm 0.28\%$ w/w in water and $3.84 \pm 0.58\%$ w/w in 70% alcohol. Moisture content was recorded as 95.59 ± 0.71 w/w (fresh weight) and $5.33 \pm 0.33\%$ w/w (dry weight). The microgreen extracts were found to contain carbohydrates, lipids, proteins, flavonoids and phenolic compounds. The pigments profile analysis indicated the presence of chlorophylls, carotenoids, and anthocyanins at 0.943 ± 0.03 mg/g, 72.4 ± 0.16 μ g/g, and 0.824 ± 0.22 mg/g, respectively. Further, the total flavonoid content was found to be 1661.071 ± 31.93 μ g/g and 7.516 ± 1.29 μ g/g in hydroalcoholic and aqueous extract, respectively. The total phenolic content was found to be 82.132 ± 2.11 μ g/g and 16.27 ± 9.2 μ g/g in hydroalcoholic and aqueous extract, respectively. These findings emphasize the potential sunflower microgreens as a nutrient-dense functional food component with promising health benefits. Future studies are warranted on advanced metabolite profiling and biological activity evaluation to further explore their nutraceutical and therapeutic potential.

Keywords: Invasive Alien Species, Alien Weeds, Biodiversity Conservation, Weed Management

ENP21

COMBINED *IN VITRO*–*IN SILICO* ASSESSMENT OF *Lablab purpureus* AND *Clinacanthus nutans* ANTICANCER PHYTOCHEMICALS

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Abstract

Lablab purpureus (LP) and *Clinacanthus nutans* (CN) are extensively cultivated across South and Southeast Asia, with the former serving as a dietary crop and the latter valued in traditional medicine. This study examines their ethnobotanical relevance and evaluates their anticancer potential against breast and lung cancers using integrated in vitro and computational approaches.

Methanolic extracts of LP and CN were assessed for antiproliferative activity against MCF-7 (breast) and A549 (lung) cancer cell lines. Cell-cycle arrest and apoptosis were evaluated using flow cytometry and cytochemical staining assays. Bioactive fractions isolated by column chromatography were characterized through HR-LCMS analysis. Differentially expressed genes (DEGs) were identified in silico, and molecular docking followed by dynamics simulations was conducted to examine interactions between the phytochemicals and cancer-associated protein targets.

Phytochemicals from both LP and CN exhibited dose- and time-dependent inhibition of cancer cell proliferation, comparable to cisplatin, while showing reduced cytotoxicity toward normal mouse fibroblasts (L929). Flow cytometric analysis confirmed the induction of cell-cycle arrest and apoptosis. Complementary computational studies indicated strong binding interactions between the

phytochemicals and key upregulated proteins implicated in cancer progression.

Phytochemicals from LP and CN exhibit significant anticancer activity against breast and lung cancer cells. These findings underscore their promise as therapeutic candidates and warrant further in vivo investigations to elucidate the underlying mechanisms.

Keywords: Lablab purpureus, Clinacanthus nutans, Anticancer Activity, Molecular Docking

ENP22

GREEN SYNTHESIS OF MAGNETIC IRON OXIDE NANOPARTICLES USING *Moringa oleifera* LEAF EXTRACT FOR OIL SPILL REMEDIATION

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Abstract

Green synthesis of nanoparticles has garnered significant attention due to its reliance on environmentally friendly, cost-effective, non-toxic, and biologically safe reagents, thereby reducing environmental impact and offering a more sustainable alternative to conventional chemical methods.

In this study, Iron oxide nanoparticles were successfully synthesized using *Moringa oleifera* leaf extract as a natural reducing and stabilizing agent. Phytochemicals such as flavonoids, phenolics, terpenoids, and antioxidants are present in it. Ferric chloride and ferric oxide were employed as iron precursors, and treatment with sodium hydroxide facilitated the formation of magnetic iron oxide nanoparticles.

A comprehensive characterisation of the synthesised iron oxide nanoparticles was performed using UV-spectroscopy, XRD, SEM, HR-TEM, and FTIR, which confirmed their surface functionalization, crystallinity, nanoscale dimensions, and predominantly spherical morphology. Exploiting the magnetic properties of the nanoparticles enabled the formulation of a ferrofluid, which effectively facilitates oil-water separation under an external magnetic field.

Enhanced oil-water separation was observed with higher ferrofluid concentrations, emphasizing the potential of *Moringa oleifera* -mediated magnetic iron oxide nanoparticles as an eco-friendly and sustainable approach for oil spill remediation.

Keywords: Flavonoids, *Moringa oleifera*, antioxidants, characterization, Ferrofluid

DEVELOPMENT, CHARACTERIZATION AND ANTIMICROBIAL EVALUATION OF HERBAL CREAM FORMULATION CONTAINING LEAF EXTRACT OF *Rhynchosia beddomei* BAKER

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Abstract

The use of plants for their medicinal and therapeutic properties has been used in India since time immortal. The Ayurvedic system of medicine is as old as time and is significantly dependent on the use of plants. The most important part of the plant is its extract which is isolated and extensively used for therapeutic benefits such as treating skin diseases and building immunity. Skin diseases are primarily caused by microbes and it is imperative to have an effective antimicrobial agent to inhibit their action. The aim of this study is to develop a topical cream formulation of *Rhynchosia beddomei* Baker leaves extract rich in phytoconstituents to treat fungal and bacterial infections invading the skin.

The leaves of the plant were collected from the Tirumala hills, Andhra Pradesh, dried and crushed into coarse powder. The extract was prepared using Soxhlet apparatus with 70% Ethanol. The phytochemical screening of the extract was performed by standard chemical tests. The extract was formulated into a cream and further evaluated. Antifungal and antibacterial evaluation of the extract and formulation was carried out by the Agar well diffusion method against *Candida albicans*, *Staphylococcus aureus* and *Escherichia coli* respectively.

Phytochemical screening of the extract revealed the presence of alkaloids, carbohydrates, glycosides, phytosterols, fixed oils and fats, phenolic compounds and tannins, saponins, flavonoids, proteins and amino acids, gums and mucilage and volatile oils. The extract exhibited activity against the three selected organisms and of the nine formulations prepared, the formulation F4 showed best results in terms of evaluation parameters and antimicrobial studies.

Hence, it can be inferred that the leaf extract of *Rhynchosia beddomei* Baker could be used as a potential drug for antibacterial and antifungal infections. Further, it can be applied in the form of a topical cream.

Keywords: *Rhynchosia beddomei*, Herbal Cream, Antimicrobial Activity, Topical Formulation

ENP24

ETHNO MEDICINAL PLANTS OF THE NORTH-CENTRAL WESTERN GHATS: DOCUMENTATION, SCIENTIFIC VALIDATION, AND PROSPECTS FOR SUSTAINABLE UTILIZATION

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Abstract

The North-Central Western Ghats of Karnataka, encompassing Uttara Kannada and Belagavi districts, constitute a biologically rich landscape with a long tradition of medicinal plant use. Indigenous and local communities in this region continue to depend on ethno medicinal resources for primary healthcare and related livelihood practices. The present study aims to document important medicinal plants, assess their ethno botanical relevance, and identify species with potential for scientific validation and sustainable development. Information was generated through field surveys, semi-structured interviews, and interactions with traditional healers and knowledgeable local informants. Plant specimens were collected, authenticated, and preserved for herbarium reference. The study recorded a diverse range of medicinal species used to manage common ailments and culturally significant health conditions. Particular attention was given to taxa showing high informant consensus and repeated traditional use, as these are more likely to yield promising leads for phytochemical and pharmacological investigation. The findings highlight the continued importance of traditional knowledge systems in the Western Ghats and underscore the need to integrate ethno botanical documentation with modern scientific evaluation. At the same time, increasing habitat disturbance and unsustainable harvesting practices threaten the persistence of several valuable species. Therefore, the study advocates conservation-oriented strategies, community participation, and cultivation-based approaches to support ethical mainstreaming of validated medicinal plants. Such integration can contribute to biodiversity conservation, health security, and livelihood enhancement in the region.

Keywords: Ethno Botany; Medicinal Plants; Scientific Validation; Western Ghats.

ENP25

WHITEFLIES (HEMIPTERA: ALEYRODIDAE) ON MEDICINAL AND AROMATIC PLANTS: A CONSERVATION PERSPECTIVE

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Abstract

Invasive and expanding populations of whiteflies (Hemiptera: Aleyrodidae) continue to pose a serious threat to a wide range of plant species, including medicinal and aromatic plants (MAPs),

which are vital for healthcare systems, rural livelihoods, and the bio-economy. Surveys and published studies reveal that MAPs host a rich assemblage of whitefly species belonging to genera such as Aleurodicus, Aleurolobus, Aleurocanthus, Aleurotrachelus, Bemisia, Crescentaleyrodes, Paraleyrodes and Trialeurodes, with Bemisia tabaci being the most widespread and economically significant pest. The recent report of the exotic African whitefly Aleurolobus graminicola Bink-Moenen on vetiver (Vetiveria zizanioides (L.) Nash), an important medicinal and aromatic grass, from India represents a new and emerging phytosanitary concern, as whitefly infestations are known to adversely affect plant growth, biomass accumulation, essential oil yield, and the qualitative composition of bioactive secondary metabolites, thereby compromising the medicinal value and market acceptability of MAP produce. Species diversity and population dynamics of whiteflies on MAPs are strongly influenced by host plant chemistry, agro-ecological conditions, and cropping practices. Despite the chemical richness of MAPs, which includes terpenoids, flavonoids, and phenolics, certain whitefly species exhibit remarkable adaptability, emphasizing the need for species-specific and ecology-based management strategies. Conventional chemical control options are limited in MAP systems due to concerns over pesticide residues, resistance development, and negative impacts on beneficial insects. Understanding whitefly diversity and host associations is therefore critical for designing sustainable management approaches. Integrating biodiversity-based strategies such as augmentation and conservation of potential natural enemies, use of MAP-derived botanicals, and habitat management offers environmentally safe alternatives that align with conservation goals. This synthesis highlights the importance of whitefly diversity studies in medicinal and aromatic plants as a foundation for sustainable pest management, biodiversity conservation, and resilient MAP-based agro-ecosystems.

Keywords: Whiteflies, natural enemies, conservation, medicinal plants

ENP26

MIC STUDY OF ANTIMICROBIAL AND ANTIFUNGAL ACTIVITY IN INTERBREED OF *Dolichos Lablab* (HYACINTH) AND FENUGREEK (MENTHE)

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Abstract

The interbreed concept has an history of the good production of crop and the increase in the concept of different constituents in the plant. The selected plant of interbreed is variety 1 is Dolichos lablab (Arka prasiddhi) and menthe (AGf2), arjuna) Sample was grown at the particular mixture of soil, biofertiliser and Consortium. The plant has shown very good response from root to flower and fruiting. The sample was powdered leaf, stem, root extract was subjected to methanol extract and further antimicrobial activity that is antibacterial and antifungal activity was conducted with the sample. Antibacterial activity: The test sample show antibacterial activity against the test bacterial strains Bacillus subtilis (MTCC441), Escherichia coli (MTCC443) and Pseudomonas aeruginosa (MTCC111),

Azotobacter chroococcum (MTCC25045), Rhizobium leguminosarum (ATCC14479) and Staphylococcus aureus (MTCC96) which is evident from zone of inhibition. Ciprofloxacin was used as control. In the methanol root interbreed extract sample has shown MIC at the range of 15 mm at 30mg concentration for the microorganism Bacillus subtilis and 10mm at 30mg concentration for the microorganism E.coli. The test sample did not show any antifungal activity against Aspergillus niger (MTTC 404) and Aspergillus flavus (MTCC277) which is evident from zone of inhibition. Whereas, Clotrimazole (positive control) showed activity for all the sample no response was seen in the extract. Particular organism which are used are not showing antimicrobial activity and further work is on.

Keywords: Interbreed, Antimicrobial activity, Antifungal activity, Dolichos lallab, Menthe

ENP27

HARNESSING SOLIERIA CHORDALIS SEAWEED BIOSTIMULANT FOR SUSTAINABLE ENHANCEMENT OF GROWTH, YIELD AND ESSENTIAL OIL PRODUCTION IN FRENCH BASIL (*Ocimum basilicum L.*)

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Abstract

Medicinal and aromatic plants (MAPs) are integral to healthcare, rural livelihoods and the expanding bio-economy. Seaweed-derived biostimulants have phytohormones, amino acids, polysaccharides and mineral nutrients that enhance plant growth and productivity. The agronomic potential of the red seaweed *Solieria chordalis* for improving growth, yield and essential oil production in French basil (*Ocimum basilicum L.*) under field conditions has received limited scientific attention. A field experiment was conducted during Rabi 2025 at the F12 block, ZARS, GKVK, Bengaluru, to evaluate different concentrations and methods of application of *S. chordalis* seaweed liquid extract. The experiment was laid out in a Randomized Complete Block Design comprising eight treatments and three replications. Application of *S. chordalis* significantly improved plant growth, leaf area, herbage yield and essential oil production over the control and recommended fertilizer dose alone. Among the treatments, RDF combined with 10% foliar application of seaweed liquid extract recorded the highest plant height (79.36 cm), leaf area (1847.11 cm²), herbage yield (9960 kg ha⁻¹) and essential oil yield (95.77 kg ha⁻¹). The enhanced performance is attributed to improved nutrient assimilation and stimulation of physiological processes by bioactive compounds present in the seaweed extract. The findings demonstrate that *S. chordalis* seaweed liquid extract is a promising natural biostimulant for sustainable French basil cultivation. Integrating seaweed-based biostimulants with recommended nutrient management to enhance crop productivity, essential oil yield and resource-use efficiency, thereby supporting resilient medicinal plant production and the growing herbal bio-economy.

Keywords: French basil, *Solieria chordalis*, essential oil, sustainable agriculture.

IDENTIFICATION OF A NOVEL IRIDOID O-GLYCOSIDE LEAD COMPOUND FROM *Ixora chinensis* AS A POTENTIAL EGFR TYROSINE KINASE DOMAIN MODULATOR FOR LUNG CANCER: AN INTEGRATED MOLECULAR DOCKING AND MOLECULAR DYNAMICS STUDY

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Abstract

Lung cancer remains the prevalent and lethal malignancies worldwide, posing a large global health burden due to its high incidence and mortality. Emphasizing the discovery of novel therapeutic agents with improved efficacy and reduced toxicity. Although several phytochemicals from the *Ixora* genus have been reported for various pharmacological activities, their potential against lung cancer remains largely unexplored. A total of 143 phytochemicals from the *Ixora* genus were retrieved from the COCONUT database and screened against a selected lung cancer target, EGFR, using molecular docking with PyRx 0.8. Protein-ligand interaction profiles were analyzed using Ligplots created with the VinaLigGen tool and the best-ranked compound was further subjected to Molecular Dynamics simulation to evaluate the stability and flexibility of the Protein-ligand complex. Among the screened phytochemicals, the iridoid O-glycoside, CNP0306005.1 which was isolated from *Ixora chinensis* emerged as the most promising potential lead molecule, exhibiting a binding affinity of -8.44 kcal/mol, demonstrating more favourable binding interactions than the reference drug doxorubicin, which was isolated from *Ixora coccinea*. The compound showed four hydrogen bond interactions with Thr766, Asp831, Thr830 and Glu738, together with extensive hydrophobic interactions involving Leu764, Lys721, Met769, Ala719, Leu820, Leu694 and Val702, indicating strong binding within the active site residues. Compared with doxorubicin, CNP0306005.1 exhibited a more favourable lead-like physicochemical profile, including a higher

natural-product likeness score, a lower topological polar surface area, fewer hydrogen-bond acceptors and donors, and a single rotatable bond, suggesting improved drug-likeness. Moreover, the MD simulation confirmed the structural stability and conformational flexibility of the CNP0306005.1-EGFR complex throughout the simulation, supporting the reliability of the docking results and its potential as a novel lead molecule for lung cancer therapy. The present study identifies CNP0306005.1 as a promising lead compound from the *Ixora* genus with greater binding affinity, better interaction profile and improved drug-like characteristics compared with doxorubicin. These findings from *In silico* research give significant support for further *in vitro* and *in vivo* investigations to evaluate its therapeutic potential against lung cancer.

Keywords: Rhynchosia beddomei, Herbal Cream, Antimicrobial Activity, Topical Formulation

ESTIMATION OF PHYSICO-CHEMICAL AND BIOACTIVE COMPOUND IN JAGGERY ENRICHED WITH KRISHNA TULSI (*Ocimum tenuiflorum*)

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Abstract

Sugarcane jaggery is a healthy sweetener that may be used to replace sugar and other artificial sweeteners in a variety of recipes. It is also known as 'medicinal sugar' because it is high in vitamins and minerals. It is utilized in ayurvedic medicine as a blood purifier and to cure infections. The objective of study was to estimate of physico-chemical and bioactive compounds in jaggery enriched with krishna tulsi (*Ocimum tenuiflorum*). In the current study, Jaggery was enriched in two forms using tulsi powder and aqueous extraction. VCF0517 sugarcane variety was selected for jaggery preparation and powder tulsi (PT) and aqueous extraction of tulsi (AT) were added at 20 per cent and subjected for physico-chemical and bioactive properties of jaggery enriched with Tulsi. The results revealed that jaggery enriched with powder tulsi at treatment 3 which consist 20 per cent having (0.72 %) titratable acidity followed by aqueous extraction of tulsi (T3) 0.89 per cent and control 0.96 per cent. Jaggery with tulsi powder had more per cent of ash (1.31%) when compared to aqueous extracted of tulsi (1.09 %) and control sample (1.14 %). Water activity (a_w) was found highest in aqueous based jaggery (0.70) followed by control (0.69) and powder based jaggery. The net rendement value (NRV) of enriched jaggery was found to be, powder tulsi based jaggery (62.63), aqueous extract of tulsi (64.27) and control jaggery (64.51) respectively. Total polyphenol content of enriched jaggery with tulsi powder was found to be highest 2079.60 µg GAE/100g respectively. Flavonoid content was highest in jaggery enriched with tulsi powder 1.58 mg QE/100g. Alkaloid content present in enriched jaggery with tulsi powder is 30 µg /100g and in both aqueous extract and control sample having 20 µg /100g. Minimum DPPH radical scavenging activity at 100 µg/ml was 60.18, 76.37 and 61.95 in control, PT3 and AT3. The maximum radical scavenging activity was observed in jaggery enriched with tulsi powder at dose dependent manner.

Keywords: *Ocimum tenuiflorum*, Net rendement value (NRV), Antioxidant activity and water activity

UNRAVELING THE EFFECT OF BIO-STIMULANTS ON COWHAGE (*Mucuna pruriens* L.)

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Abstract

Rising environmental contamination and slow deterioration of soil health is one of the major challenges to meet the increasing need for food supply using sustainable agricultural methods without lowering crop yield and producer revenue. Various farming systems have been suggested since last few decades to overcome above said challenge and among them, bio-stimulants being a novel and sustainable approach towards crop production. Various positive impacts on medicinal plants have been observed when different plant bio stimulants have been applied at varying concentrations through distinct mechanisms of action. Cowhage is important upcoming medicinal plant and its seeds contain L-DOPA (L-3, 4 dihydroxy phenylalanine), a non-protein amino acid that is commonly used as an anti-Parkinson and hypertensive drug. With this background, an experiment was conducted during Rabi, 2020 to unravel the effect of bio-stimulants on cowhage at ICAR-Krishi Vigyan Kendra, Hadonahalli, Doddaballapura Taluk, Bengaluru Rural District, Karnataka. Humic acid, amino acid, sea weed extract and microbial consortia were imposed as foliar and soil application in nine treatments with three replication. The results showed that foliar application of humic acid-based bio-stimulant along with RDF has significantly improved plant height (282.98 cm), number of leaves (87.16), leaf area (15497 cm²), leaf area index (4.30), days to 50 % flowering (95.23), pod weight (247.90 g/plant), seed yield (154.86 g/plant), number of nodules (19.85), chlorophyll (52.65), protein (30.17 %), L-DOPA (5.68 %) and biotic resistance over the control.

Keywords: Cowhage, bio-stimulants, seed yield, L-DOPA and biotic resistance

APPLICATION OF *Beauveria brongniartii* ON NEEM PLANTS (*Azadirachta indica*) FOR SUSTAINABLE BIOLOGICAL MANAGEMENT OF WHITE GRUB BEETLES (*Holotrichia serrata*)

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Abstract

Environmental sustainability is obtained by replacing application of chemical pesticides from effective biological control agents. Among the various entomopathogenic fungi, application of

Beauveria brongniartii has an effective biological control against white grubs (*Holotrichia serrata*). Naturally, white grubs congregate on neem (*Azadirachta indica*) foliage for feeding and mating during night time. Therefore, applying *Beauveria brongniartii* to neem tree represents highly targeted management strategy. The foliar spray of *Beauveria brongniartii* spores comes in direct exposure surface contact to adult beetles while feeding. This infects the adults and reduces its survivability and reproductive potential and decreases egg production. The infected beetles disseminate fungal spores by their movement and infect the immature grubs present in the soil. In the present study, the bioassay was performed in drums filled with sterilized soil. 15 adults were placed in each drum and neem leaves treated with different concentration levels of *Beauveria brongniartii* spores by water dilution (T 1 -1:50, T 2 -1:100, T 3 - 1:150, T 4 - 1:200, T 5 -1:250, T 6 -1:300 T 7 - control where the colony count maintained up to 6X10¹⁴ CFU, 3X10¹⁴ CFU, 1X10¹⁴ CFU, 6X10⁷ CFU, 3X10⁷ CFU, 1X10⁷ CFU and untreated in the treatments respectively) with three replications and placed in the different drums. The highest mortality is mainly observed in T 1 , T 2 and T 3 up to 58 to 65% mortality and significantly decreased up to 15% as the dilution increases. This result indicates that T 2 and T 3 are significantly on par with each other by showing 60 % and 58.33% mortality respectively. Therefore, the targeted white grub adults are minimized by applying entomopathogenic fungus *Beauveria brongniartii* over large field areas to make cost effective approach management. Other Integrated Pest Management (IPM) practices can significantly improve white grub suppression, reduce dependence on synthetic insecticides, and promote sustainable crop production while conserving ecological balance.

Keywords: *Beauveria brongniartii*, *Holotrichia serrata*, sterilized soil, Integrated Pest Management

ENP32

EXPLORING UNDERUTILIZED MEDICINAL PLANTS IN THE FOOD INDUSTRY: A REVIEW

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Abstract

The growing demand for natural, sustainable, and health-promoting foods has stimulated interest in underutilized medicinal plants as promising ingredients for the food industry. Despite their long-

standing use in traditional medicine, several medicinal plants, including Moringa (*Moringa oleifera*), Indian borage (*Plectranthus amboinicus*), Giloy (*Tinospora cordifolia*), Bael (*Aegle marmelos*), Butterfly pea (*Clitoria ternatea*), Gotu kola (*Centella asiatica*) and Roselle (*Hibiscus sabdariffa*), remain underexploited in commercial food systems. These plants are rich in bioactive compounds such as polyphenols, flavonoids, alkaloids, terpenoids and essential oils that exhibit antioxidant, antimicrobial, anti-inflammatory, antidiabetic, and immunomodulatory activities.

This review examines their potential in the development of functional foods, nutraceuticals, natural preservatives, and clean-label products. Their incorporation into bakery products, dairy products, beverages, snacks, edible coatings, and biodegradable food packaging can enhance nutritional quality, improve food safety, and extend shelf life while reducing reliance on synthetic additives. Furthermore, the cultivation and utilization of these underutilized medicinal plants contribute to biodiversity conservation, sustainable agriculture and rural livelihood development. However, their commercialization is constrained by limited scientific validation, variability in phytochemical composition, safety and toxicity concerns, inadequate standardization of processing techniques, regulatory challenges, and low consumer awareness. Emerging technologies such as green extraction methods, encapsulation, fermentation, and advanced food processing offer opportunities to improve the stability, bioavailability and functionality of plant-derived bioactive compounds. Future research should emphasize comprehensive phytochemical profiling, clinical validation, sensory evaluation, and regulatory harmonization to facilitate wider industrial adoption. Overall, underutilized medicinal plants represent a sustainable and innovative resource for developing value-added functional foods that promote human health, support clean-label innovation and strengthen sustainable food systems.

Keywords: Underutilized medicinal plants, *Moringa oleifera*, *Clitoria ternatea*, *Centella asiatica*, functional foods, nutraceuticals, phytochemicals, sustainability.

ENP33

IN VITRO AND IN SILICO EVALUATION OF *Mimosa pudica* L. LEAF EXTRACT FOR ITS PHARMACOLOGICAL POTENTIAL

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Abstract

Global interest in natural and plant based treatments is growing extensively and particularly in the fields of cancer therapy and antimicrobial research. Medicinal plants have a long history of being utilized to address different health issues and they have remained as a vital source of natural remedies. *Mimosa pudica* L., commonly referred to as the sensitive plant, belongs to the Fabaceae family and can be found extensively in tropical and subtropical regions, particularly in India. This plant has been

traditionally employed to manage wounds, reduce inflammation, treat diarrhea, dysentery, and control diabetes, to alleviate urinary disorders, and combat microbial infections. This is due to the presence of diverse range of bioactive compounds. This study is set out to investigate the biological activities and therapeutic potential of the leaf extract from *Mimosa pudica* L. The study involves obtaining the leaf extract by soxhlet extraction followed by assessing the presence of phytochemicals by qualitative tests such as phytochemical screening, thin layer chromatography (TLC), UV- visible spectroscopy. Quantitative and in-vitro studies were carried out by gas chromatography mass spectroscopy (GC-MS) analysis, antioxidant assays, and antimicrobial studies. Further, in-silico study such as ADMET prediction analysis was performed to identify potential lead like molecules. Future studies can be executed to develop novel drug molecules based on these phytocompounds.

Keywords: *Mimosa pudica* L., Medicinal plant, ADMET, Phytochemicals, Bioactive compounds.

ENP34

EVALUATION OF HIGH-YIELDING AND BIOTIC STRESS-TOLERANT TURMERIC (*Curcuma longa* L.) VARIETIES FOR THE EASTERN DRY ZONE OF KARNATAKA

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Abstract

Turmeric (*Curcuma longa* L.) is an economically important spice and medicinal crop valued for its culinary, pharmaceutical and nutraceutical properties. However, its productivity and quality are greatly influenced by varietal adaptability and tolerance to prevailing biotic stresses. The present study aimed to identify a high-yielding, superior-quality and stress- tolerant turmeric variety suitable for cultivation under the Eastern Dry Zone (Zone V) of Karnataka. A field experiment was conducted during 2022–2023 at ICAR–Krishi Vigyan Kendra (KVK), Chintamani, Chikkaballapura, Karnataka, using a randomized complete block design with seven treatment and four replications. The crop was grown following the recommended package of practices, including a spacing of 45 × 30 cm and fertilizer application of 150:125:250 kg N:P, O... :K, O ha⁻¹ supplemented with farmyard manure at 10 t ha⁻¹. The varieties were evaluated for yield, quality attributes, adaptability and tolerance to major pests and diseases. Among the evaluated varieties, IISR Pratibha consistently outperformed the local check, Salem Local. It recorded the highest fresh rhizome yield of 35.0 t ha⁻¹, representing a 35.21% increase over the local check. In station trials, the variety produced 32.28% and 31.28% higher fresh rhizome yields than Salem Local, confirming its superior yield potential, stability and adaptability under the agro-climatic conditions of the region. IISR Pratibha also exhibited desirable quality traits, with a curing percentage exceeding 21% and curcumin content greater than 5.2%. The variety was moderately resistant to leaf spot (4.81%) and leaf blotch (4.62%), moderately susceptible

to rhizome rot (8.25%), and highly tolerant to pseudostem borer (4.25%) and sucking pests (4.78%), recording significantly lower incidences than the local check. The study identified IISR Pratibha as a high-yielding, superior-quality and resilient turmeric variety with broad adaptability to the Eastern Dry Zone of Karnataka. Its adoption can substantially enhance turmeric productivity, improve farmers income and promote sustainable turmeric cultivation in the region.

Keywords: Curcumin, rhizome, productivity, turmeric, varietal evaluation.

ENP35

FRUIT WASTE TO HEALTHCARE AND SUSTAINABLE MATERIALS: DEVELOPMENT OF PECTIN-BASED BIOPLASTICS, TISSUE PAPER AND EVALUATION OF THE HEMOSTATIC POTENTIAL OF PECTIN FOR CIRCULAR BIOECONOMY, RURAL LIVELIHOODS AND ENVIRONMENTAL CONSERVATION

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Abstract

Medicinal and aromatic plants (MAPs) and their bioactive constituents offer immense opportunities for developing sustainable products that simultaneously promote human health, environmental conservation, and bio-economic growth. This study demonstrates the scientific validation and value addition of pectin extracted from *Citrus maxima* (pomelo) peel, an underutilized agro-industrial waste, by exploring its multifunctional applications in biodegradable bioplastics, eco-friendly tissue paper, and plant-based haemostatic biomaterials. Pectin was extracted through acid-assisted hot-water extraction, yielding 17.4–76.0%, and subsequently evaluated for diverse industrial and biomedical applications. For sustainable packaging, pectin was blended with sorbitol as a plasticizer and chitosan as a reinforcing agent to develop biodegradable bioplastic films exhibiting improved flexibility, mechanical strength, thermal stability, and antimicrobial potential. In tissue paper fabrication, pectin was incorporated into recycled paper pulp with glycerol, gelatin, and polyvinyl alcohol (PVA), resulting in enhanced water absorption, softness, and flexibility, thereby offering a biodegradable alternative to conventional virgin pulp-based tissues. The biomedical potential of pectin was further investigated through molecular docking with key coagulation proteins, Tissue Factor (TF) and Factor VII (FVII), revealing favourable binding energies (ΔG H⁻¹) “4.0 to “6.9 kcal/mol). In vitro clotting assays demonstrated dose-dependent haemostatic activity, reducing clotting time from 13 min 40 s (control) to 3 min 40 s, validating its potential as a sustainable plant-derived haemostatic biomaterial.

The findings establish pomelo peel-derived pectin as a versatile natural biopolymer capable of generating high-value products across healthcare, sustainable packaging, and eco-friendly paper industries. By converting agricultural waste into commercially relevant biomaterials, this research

supports circular bio-economy principles, value-chain development, resource conservation, and scientific mainstreaming of plant-derived biomaterials, aligning closely with the conference theme of exploring nature's pharmacy for health, livelihoods, bio-economy and conservation.

Keywords: Pomelo (*Citrus maxima*), Pectin, Medicinal and Aromatic Plants, Circular Bio-economy, Bioplastics, Tissue Paper, Haemostatic Biomaterials, Agro-Waste Valorization, Sustainability.

ENP36

PROXIMATE ANALYSIS, ANTIOXIDANT, AND HEPATOPROTECTIVE EFFECTS OF SELECTED UNDERUTILIZED WILD VEGETABLES FROM THE CENTRAL WESTERN GHATS OF INDIA

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Abstract

The Agumbe rainforests, located in the central Western Ghats of India, are among the richest biodiversity hotspots. Local tribal communities traditionally use a variety of wild vegetables from

these forests in their diets. This study investigates 21 such wild vegetables for their nutritional composition, antioxidant, and hepatoprotective properties. Traditional culinary applications were documented through field surveys. Proximate, mineral, and phytochemical compositions were evaluated using standard methods. Antioxidant components of the plants, such as Vitamin C, total phenolics, and total flavonoids, were estimated. Antioxidant activities were assessed using the total antioxidant capacity assay, ferric reducing antioxidant power assay, and scavenging of DPPH and ABTS free radicals. Proximate analysis revealed that these vegetables were rich sources of both macro- and micronutrients. Preliminary phytochemical test revealed the presence of alkaloids, saponins, flavonoids, phenolics, tannins, glycosides, oils, fats, and terpenes. The total phenolic and total flavonoid content ranged from 1.34 ± 0.02 - 2.17 ± 0.10 mg GAE/g and 0.37 ± 0.01 - 0.73 ± 0.03 mg QE/g on a dry weight basis, respectively. Among the screened species, *Hultholia mimosoides* exhibited significant free radical scavenging activity with IC₅₀ values of 27.77 ± 0.31 µg/ml (ABTS assay) and 89.45 ± 18.99 µg/ml (DPPH assay). Among the species, *Hultholia mimosoides* and *Canavalia virosa* showed over 80% cell viability against acetaminophen- induced stress in HepG2 liver cells at concentrations ranging from 4.68 to 300 µg/ml. This study highlights the nutraceutical potential of traditionally consumed wild vegetables from the Agumbe rainforests, providing scientific validation of their health-promoting effects, supporting their conservation and inclusion in sustainable food systems.

Keywords: Wild vegetables, Agumbe rain forest, Central Western Ghats, nutritional analysis, Hepatoprotective

EXPLORING NATURE'S PHARMACY: FROM GEOLOGICAL RESOURCES TO HEALTH CARE AND THERAPY

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Abstract

Minerals are the naturally occurring inorganic substance formed through geological processes aiding to the existence of life. Minerals have served as indispensable therapeutic resources since time immemorial and are continuously contributing to medical purposes. The properties like chemical composition, availability and stability of the minerals like gold, silver, copper, iron, zinc, sulphur, gypsum, mica, and various silicate minerals has helped the medical industry to utilize them in medicinal formulations across Ayurveda, Homeopathy, and modern healthcare systems. In Ayurveda, carefully processed mineral preparations (*Bhasmas*) exemplify the application of geological materials in medicine, providing stable and bioavailable formulations that promote vitality, enhance immunity, improve haematological health, regulate metabolic functions, strengthen the nervous system, and support the management of chronic ailments. Homoeopathy also incorporates a wide range of mineral-derived substances, including sulfur, silica, calcarea, graphite, gold, iron, and sodium salts, as source materials in its pharmacopoeia. In modern medicine, mineral-derived compounds of calcium, magnesium, iron, zinc, lithium, iodine, and bismuth are widely employed in pharmaceuticals, nutritional supplements, diagnostic agents, biomaterials, and implant technologies. Thus, a new branch of Geology is emerging, called medical geology - an interdisciplinary field that investigates the interactions between geological materials and human health, with particular emphasis on the beneficial role of naturally occurring minerals in disease prevention, treatment, and healthcare. Recent advances in mineralogy, nanotechnology and quantum technology, have further expanded the applications of minerals through the development of bioactive nanoparticles, targeted drug-delivery systems, antimicrobial coatings, regenerative biomaterials, and precision therapeutics. Integrating geological knowledge in pharmaceutical research can provide a scientific framework for identifying, characterising, and sustainably utilising medicinal minerals. The discipline highlights Earth's mineral resources not only as economic commodities but also as invaluable natural assets that continue to inspire innovative therapeutic materials, support healthcare innovations, and advance the future of sustainable and integrative medicine.

Keywords: Nature, Minerals, Ayurveda, Homoeopathy, Medicine.

SCIENTIFIC VALIDATION OF TWO ETHNOMEDICINAL SPECIES, SPHAERANTHUS INDICUS AND SPHAERANTHUS AMARANTHOIDES, THROUGH PHARMACOGNOSTIC AND BIOACTIVITY STUDIES

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Abstract

Munditika is one of the important drug in Ayurveda, used in the treatment of jaundice, fever, epilepsy, diabetes, painful swellings, gastric disorders and oedema. The accepted botanical source of Munditika is *Sphaeranthus indicus* Linn. One more species namely *Sphaeranthus amaranthoides* Burm.f. which is found in India, are used as substitutes for the drug Munditika. The aim and objectives of the present study are to evaluate the pharmacognostical, phytochemical and in vivo antidiabetic studies on the two botanical sources of Munditika which will provide and establish alternate sources for the Ayurveda drug, Munditika. The whole plant of *S. indicus*, and *S. amaranthoides* in flowering condition were collected from the surroundings of Tirunelveli, Thuthukudi district of Tamil Nadu. Pharmacognostical studies include taxonomical, macro and microscopical studies, macerate studies, histochemical tests for the root of two botanical sources of Munditika. Phytochemical studies include determination of physicochemical constants, fluorescence analysis, preliminary organic analysis and HPTLC studies. The pharmacological study includes acute toxicity, in vitro antioxidant, and antidiabetic studies of ethanol and aqueous extracts of the two species. The macro and microscopical characters, macerate, histochemical studies provide distinguishing characters for the identification of the plant material as well as the drug of all the two species of *Sphaeranthus* used as Munditika. The test extracts showed potential scavenging effects towards DPPH, nitric oxide, superoxide anion radicals and moderate effect on hydrogen peroxide free radicals. Antidiabetic study revealed that *S. amaranthoides* at 400 mg/kg dose showed a better antidiabetic activity when compared to *S. indicus*. Morphological and anatomical investigations will aid in the accurate identification and differentiation of the species, while antioxidant assays and antidiabetic studies will provide scientific evidence supporting their traditional therapeutic claims. The findings are expected to contribute to the authentication, quality assessment, and scientific validation of these ethnomedicinal plants, thereby promoting their rational utilization and mainstreaming in evidence-based herbal medicine.

Keywords: *Sphaeranthus indicus*, *Sphaeranthus amaranthoides*, Pharmacognostic Evaluation, Antidiabetic

PROPHYLACTIC AND THERAPEUTIC ANTI-ARTHRITIC EFFECTS OF THE HYDROALCOHOLIC LEAF EXTRACT OF *Kingiodendron pinnatum* IN COMPLETE FREUND'S ADJUVANT-INDUCED ARTHRITIS IN RATS

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Abstract

Medicinal plants have long been used in traditional medicine and remain important sources of therapeutic agents. Arthritis is a chronic autoimmune inflammatory disorder that primarily affects the synovial joints. This study evaluated the anti-arthritic activity of the crude hydroalcoholic leaf extract of *Kingiodendron pinnatum* (Family: Fabaceae), an endemic medicinal plant of the Western Ghats, India, in Complete Freund's Adjuvant (CFA)-induced arthritis in Wistar albino rats.

Arthritis was induced in Wistar albino rats (180–200 g) by sub plantar injection of 0.1 mL CFA. Animals were divided into eight groups (n = 8), including control, toxic control, prophylactic (day 0–21), and therapeutic (day 7–21) groups receiving dexamethasone (5 mg/kg, p.o.) or hydroalcoholic leaf extract of *K. pinnatum* (200 and 400 mg/kg, p.o.). Paw volume and diameter were measured at 4-day intervals up to day 21. Serum glutamate oxaloacetate transaminase, (SGOT), serum glutamate pyruvate transaminase (SGPT), and alkaline phosphatase (ALP), were estimated, and X-ray radiography evaluated for the assessment of disease progression.

Kingiodendron pinnatum hydroalcoholic leaf extract significantly reduced paw edema, paw diameter, and serum SGOT, SGPT, and ALP levels in CFA-induced arthritic rats. In the prophylactic study, 200 mg/kg showed significant effects ($p < 0.05$), while 400 mg/kg produced highly significant reductions ($p < 0.001$). In the therapeutic study, both doses (200 and 400 mg/kg) markedly improved all parameters ($p < 0.001$). Radiographic evaluation shows significant reduction in joint swelling and bone erosion following 21 days of treatment ($p < 0.001$), indicating dose-dependent protection against arthritic joint damage.

Keywords: *Kingiodendron pinnatum*, Complete Freund's Adjuvant(CFA), Arthritis, Dexamethasone.

INTEGRATING COMMERCIALLY IMPORTANT MEDICINAL AND AROMATIC PLANTS AS INTERCROPS IN COFFEE-BASED CROPPING SYSTEMS: OPPORTUNITIES FOR ENHANCED BIO-ECONOMY AND RURAL LIVELIHOODS

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Abstract

Coffee-based intercropping systems provide a favorable microclimate for cultivating shade-tolerant medicinal and aromatic plants (MAPs), offering opportunities to enhance farm profitability, diversified income and improve land-use efficiency. However, despite the widespread adoption of intercropping in coffee plantations, limited information is available on the comparative performance of commercially important MAPs under shaded coffee ecosystems and their influence on coffee productivity, particularly in the high-altitude regions of Karnataka. To address this research gap, the present study evaluated the productivity of six medicinal and aromatic plant species viz., patchouli (*Pogostemon cablin*), mandukaparni (*Centella asiatica*), brahmi (*Bacopa monnieri*), greater galangal (*Alpinia galanga*), bhringraj (*Eclipta prostrata*) and vetiver (*Chrysopogon zizanioides*) under monocropping and coffee based intercropping systems during 2025–26 at Hosagiri Estate, Sakleshapura, Hassan district, Karnataka. Significant variation was observed in the adaptability and productivity of the evaluated crops under intercropping conditions. Results revealed that patchouli, mandukaparni and brahmi recorded higher biomass under intercropping (1023.50, 534.25 and 706.50 g m⁻² year⁻¹, respectively), indicating superior shade tolerance of these species. In contrast, vetiver and greater galangal exhibited a substantial decline in yield under intercropping, reflecting its preference for open conditions. Coffee productivity remained unaffected or improved in most intercropping combinations, with the highest yield recorded in the coffee-patchouli system (20.74 q ha⁻¹), followed by coffee-vetiver (20.45 q ha⁻¹), coffee-mandukaparni (20.00 q ha⁻¹) and coffee-greater galangal (19.26 q ha⁻¹), compared with coffee monocropping system (18.35 q ha⁻¹). The cost-dynamics of this study revealed the higher benefit:cost ratio of 3.78 in the coffee-patchouli system, followed by coffee-greater galangal (3.38), coffee-mandukaparni (3.14) and coffee-brahmi (3.05), compared to coffee monocropping (2.36), while coffee bhringraj and coffee-vetiver system recorded least (2.23 & 2.34 respectively). The study demonstrates that integrating suitable shade-adapted medicinal and aromatic plants, particularly patchouli, mandukaparni, brahmi and greater galangal, into coffee plantations can enhance overall productivity, improve resource-use efficiency and strengthen the economic sustainability of coffee-based farming systems in the high-altitude regions of Karnataka.

Keywords: Intercropping, MAPs, coffee plantation, productivity, land use efficiency B:C ratio, bio-economy

SULFATED CELLULOSE NANOSPHERES FROM *Amaranthus tricolor*: A BIOCOMPATIBLE NANOCARRIER EXHIBITING POTENTIAL THERAPEUTIC PROPERTIES

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Abstract

Sulfate-functionalized cellulose nanospheres were synthesized from *Amaranthus tricolor* biomass through sulfuric acid hydrolysis. The synthesized nanospheres exhibited a spherical morphology with an average particle size of 23.11 ± 4.2 nm and a crystallinity index of 80.61%. Sulfate half-ester functionalization of the cellulose surface was confirmed by elemental analysis, energy-dispersive X-ray analysis, and Fourier transform infrared spectroscopy through the appearance of characteristic sulfate-associated vibrations. The synthesized cellulose nanospheres demonstrated broad-spectrum antibacterial activity against the tested pathogenic microorganisms. The nanospheres effectively inhibited biofilm formation and quorum sensing activity through reactive oxygen species generation and membrane damage. In addition, the nanospheres exhibited strong antioxidant activity with significant free radical scavenging potential. Biocompatibility analysis revealed excellent hemocompatibility with less than 1.4% hemolysis. The cellulose nanospheres also showed remarkable anticancer activity against pancreatic and liver cancer cells, while exhibiting negligible cytotoxicity toward normal fibroblast cells and minimal genotoxic effects in onion root tip assays. These multifunctional properties suggest that sulfate-functionalized cellulose nanospheres derived from *Amaranthus tricolor* possess strong potential as sustainable and biocompatible nanomaterials for biomedical and nanomedicine applications.

Keywords: *Amaranthus tricolor*, Sulfated Cellulose Nanospheres, Antibacterial Activity, Biocompatible Nanocarrier

TARGETING DNA GYRASE B: CHROMATOGRAPHIC AND COMPUTATIONAL DISCOVERY OF ANTIBACTERIAL METABOLITES FROM *Getonia floribunda* AGAINST MDR *Escherichia coli*

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Abstract

Antimicrobial resistance (AMR) is escalating into a major global health challenge, with multidrug-resistant (MDR) Enterobacteriaceae particularly *Escherichia coli* posing significant clinical threats.

This study explores the partial purification, phytochemical profiling, antibacterial efficacy, and *in silico* docking analysis of bioactive compounds extracted from a methanolic extract of *Getonia floribunda*, targeting MDR *E. coli*. Using column chromatography, three fractions were isolated hexane (HPF), chloroform (CPF), and ethyl acetate (EPF) and screened against ten clinical bacterial isolates. The EPF fraction exhibited the strongest antibacterial activity, producing inhibition zones of 22 mm against *Acinetobacter baumannii* and 20 mm against *E. coli*. Chemical characterization via GC-MS identified 27 compounds in CPF and 32 in EPF, including key bioactive constituents such as dimethyl sulfone, 2,4-di-tert-butylphenol, hexadecanoic acid-2-hydroxy-1-(hydroxymethyl)ethyl ester, octadecanoic acid-2,3-dihydroxypropyl ester, and isopropyl myristate. Drug-likeness and pharmacokinetic properties of these compounds were evaluated using SwissADME and ADMET Lab 3.0. Molecular docking against *E. coli* DNA gyrase subunit B (GyrB) revealed that 2,4-di-tert-butylphenol had the strongest binding affinity (“6.2 kcal/mol), followed by 2,6,11-trimethyldodecane (“5.9 kcal/mol). These findings position *G. floribunda* as a valuable natural reservoir of phytochemicals with strong potential to inhibit essential bacterial enzymes, offering a promising avenue for novel anti-MDR drug development. Further *in vivo* validation is warranted to confirm efficacy and support lead compound optimization for future therapeutic application.

Keywords: Antimicrobial resistance; *Getonia floribunda*; Multidrug-resistant *Escherichia coli*; GC-MS phytochemical profiling; Molecular docking.

ENP43

***Annona muricata* FRUIT EXTRACT SENSITIZES NICOTINE-INDUCED GEMCITABINE-RESISTANT PANCREATIC CANCER THROUGH DNA DAMAGE RESPONSE MODULATION AND HENT1/RRM1 SIGNALLING**

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Abstract

Annona muricata (Graviola), functional food rich in acetogenins, is known as cancer killer in traditional medicine. The fruit is widely consumed in tropical regions in the preparation of juices, desserts and ice-creams. Here we investigate chemosensitizing effects of *Annona muricata* fruit extracts in nicotine induced GEM resistant PC models. Pancreatic Cancer is lethal malignancy with 5-year survival rate less than 5%; Gemcitabine resistance is major cause of poor prognosis. Gemcitabine resistance was induced by nicotine treatment (1 μ M) for 15 days in PANC-1, MIA PaCa-2 Pancreatic Cancer cells and effects were assessed with Gemcitabine sensitivity assay, Comet assay, differential expression of resistance markers hENT1, RRM1 and dCK. Chemosensitizing effects of *Annona muricata* extracts at optimized concentrations were evaluated with Cell viability assays, Clonogenic assay, Apoptosis assay, ROS assay, Mitochondrial membrane depolarization assay, cell cycle analysis, differential expression of markers involved in chemoresistance and DNA damage response pathway. Short-term nicotine treatment escalated Gemcitabine resistance with 6.26 (p less than 0.0001) and 6.45 (p less than 0.0001) folds in PANC-1 and MIA PaCa-2 compared to parental cells. Comet assay revealed there was DNA damage in Gemcitabine alone treated group reversed in nicotine+gemcitabine

group. Protein expression studies confirmed upregulation of hENT1 and dCK with decreased RRM1 suggesting chemoresistance. *Annona muricata* extracts sensitized resistant cells by reducing cell viabilities with IC₅₀ value of 0.48±0.08 µg/ml in resistant MIA PaCa-2 and 3.28±0.04 µg/ml in resistant PANC-1. Extract treatment enhanced ROS, diminished MMP leading to increased apoptotic population. Cell cycle analysis disclosed surge in SubG1, S phase; concomitant decrease in G1-phase. Extracts upregulated γH2AX, p-CHK2, p53, p-ERK1/2, hENT1, Bax expression with subsequent down regulation of Bcl-2 and RRM1 evidencing combined therapy leading to sensitization. We provide the first evidence that *Annona muricata* extracts act as potential chemosensitizer to overcome gemcitabine resistance offering novel therapeutic strategy in Pancreatic Cancer.

Keywords: Annona muricata, Pancreatic Cancer, Gemcitabine Resistance, Chemosensitization

ENP44

IN VITRO AND MOLECULAR DOCKING STUDIES OF *Terminalia arjuna* BARK EXTRACT AGAINST QUORUM SENSING PROTEINS OF *Pseudomonas aeruginosa*: SINGLE SCAFFOLD TARGETING QUORUM-SENSING REGULATORS AND ENZYMES

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Abstract

The rising prevalence of antimicrobial resistance (AMR) in *Pseudomonas aeruginosa* underscores the need for alternative therapeutic approaches that target bacterial virulence rather than growth alone. This study aimed to evaluate the phytochemical composition, antibacterial activity, antioxidant potential, and quorum sensing inhibitory capacity of an ethanolic bark extract of *Terminalia arjuna* through combined in vitro and in silico approaches. The extract was subjected to preliminary phytochemical screening, antimicrobial susceptibility testing, minimum inhibitory concentration (MIC) determination, antioxidant assays, FTIR, and GC MS analysis, followed by molecular docking studies. Major phytoconstituents identified through GC-MS were further evaluated for drug-likeness and ADMET properties prior to docking against quorum sensing-associated proteins of *P. aeruginosa* using AutoDock Vina, with protein–ligand interactions visualized and 2D interaction profiles analyzed using LigPlot+. Phytochemical screening revealed the presence of diverse bioactive constituents, including flavonoids, phytosterols, and proteins. GC-MS analysis identified several phytocompounds exhibiting favorable pharmacokinetic properties. Molecular docking demonstrated strong binding affinities between selected ligands and the target quorum sensing proteins, primarily stabilized through hydrophobic and van der Waals interactions. Collectively, these findings indicate that *T. arjuna* bark

is a rich source of bioactive phytoconstituents capable of disrupting the quorum sensing pathway involved in biofilm formation and virulence in *P. aeruginosa*. These results support the potential of *T. arjuna* as a natural anti-virulence agent for combating multidrug-resistant bacterial infections, offering a promising alternative strategy in the fight against AMR.

Keywords: *Terminalia arjuna*, *Pseudomonas aeruginosa*, Quorum sensing.

ENP45

EXPLORING *Momordica cymbalaria*: A POTENTIAL UNDERUTILIZED SUPERFOOD

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Abstract

Momordica cymbalaria Hook F., commonly known as Karchikai or Little Wild Gourd, is a highly resilient, tuberous, climbing vegetable crop belonging to the Cucurbitaceae family. Though native to the semi-arid, dry deciduous forests of Central and Southern India, this wild vegetable crop remains a critically underutilized plant despite its rich history of use among indigenous communities. The plant exhibits extreme climate resilience due to its dormant perennial tuberous roots, which can survive adverse environmental conditions. Nutritionally, the fruit is remarkably dense, providing substantial dietary fiber, protein, and essential minerals such as potassium (2400 mg/100 g), calcium, and iron. It is also rich in ascorbic acid content (approximately 290 mg/100 g in fresh fruit), significantly surpassing many conventional fruits. Modern pharmacological research extensively validates its traditional medicinal uses, revealing potent antidiabetic, hypolipidemic, hepatoprotective, and antioxidant properties, making it relevant for managing lifestyle diseases like type 2 diabetes. However, despite its vast therapeutic and culinary potential, *M. cymbalaria* is quietly edging toward extinction due to rapid habitat destruction, overharvesting, and poor seed germination. Safeguarding this valuable botanical resource require immediate interventions, including tissue culture, micropropagation, and structured cultivation. By advancing post-harvest processing and raising public awareness, this sustainable, health-enriching wild gourd can successfully transition into a mainstream nutraceutical and functional food.

Keywords: *Momordica cymbalaria*, Underutilized crop, Superfood, Antidiabetic, Karchikai

***Garcinia talbotii* AND ITS BIOACTIVE CONSTITUENT OBLONGIFOLIN A RESTORE CHEMOSENSITIVITY IN PANCREATIC CANCER**

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Abstract

Garcinia talbotii, an evergreen tree endemic to the Western Ghats of India, produces wild edible fruits that are traditionally used in culinary preparations and folk medicine. This study evaluated the nutritional composition, phenolic and flavonoid content, and biological activities of *Garcinia talbotii* fruit. The fruit exhibited a high Vitamin C content (188.51 ± 20.38 mg/100 g) along with essential macro- and micronutrients. Antioxidant activity of *Garcinia talbotii* fruit extracts (GFE) was evaluated using various assays, demonstrating significant antioxidative potential. Furthermore, GFE was investigated for its protective effects on HEK-293 cells against H₂O₂-induced oxidative stress. The study assessed cell viability and intracellular reactive oxygen species (ROS) accumulation using the MTT assay and nitric oxide release assay, highlighting the extract's potential in mitigating oxidative damage in normal cells. Antiproliferative effects of GFE studied against pancreatic cancer cells PANC-1 and MIA PaCa-2 resulted in reduced cell proliferation and clonogenicity. GFE treatment on PC cells enhanced ROS, triggered mitochondrial membrane depolarization, apoptosis via DNA damage; expression of proteins in DNA Damage Response (DDR) pathway was studied by immunoblotting.

Oblongifolin A, a polyprenylated benzoylphloroglucinol, was isolated from the fruits of *Garcinia talbotii* fruit. The chemosensitizing effects of this novel bioactive constituent were evaluated in chemoresistant pancreatic cancer cells. Oblongifolin A (OA) demonstrated significant potential in overcoming chemoresistance by effectively inhibiting cellular proliferation and metastasis in resistant cancer cells. Additionally, OA enhanced the chemosensitivity of these cells, augmenting the efficacy of conventional chemotherapeutic agents such as gemcitabine. The synergistic interaction of OA with gemcitabine resulted in heightened cytotoxicity, underscoring its role as a promising adjunctive therapy in the treatment of chemoresistant pancreatic cancer. Notably, Gem+OA-induced mitochondrial apoptosis via ROS modulation in gemcitabine-resistant pancreatic cancer cells was observed for the first time, providing novel insights into the mechanisms of chemoresistance and its therapeutic reversal.

Keywords: *Garcinia talbotii*, Oblongifolin A, Pancreatic Cancer, Chemosensitization

ENP47

EFFICACY OF CITRONELLA OIL AS A REPELLENT AGAINST HOUSE RAT *Rattus rattus* L. UNDER STORAGE CONDITIONS

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Abstract

The house rat, *Rattus rattus* L., is responsible for causing major damage to grains in storage conditions. Rodenticides are used for preventing rodent menace however, secondary poisoning, bait shyness and resistance are of great concern which have made to search for new, safe, eco-friendly and effective mitigation methods for a long duration. In the present study, the efficacy of citronella oil as a repellent against *R. rattus* was evaluated. Citronella oil treated bait at 5% concentration was effective as a repellent against *R. rattus* in bi-choice feeding tests under laboratory conditions. The repellent effect was observed up to 14 days after treatment. The bait consumption of treated and untreated bait during the first day was non-significant under bi-choice feeding tests, indicating absence of a primary repellent effect of Citronella oil. Feeding bait mixed with 5% citronella oil continuously for 30 days in bi-choice feeding tests revealed the persistence of the repellent effect. These results indicated that 5% citronella oil can be used for field conditions to prevent the damage caused by house rats. Under simulated storage condition in experimental rattery formulation of 5% citronella oil containing wood dust as a carrier prevented rodent damage in terms of consumption of ragi grains, cuts on bags and grain spillage up to the experimental period of 15 days. The results indicate that 5% citronella oil formulation with wood dust as carrier has the potential to protect stored products from rodent damage which is effective and eco-friendly.

Keywords: House rat, Citronella oil, Repellent, Storage conditions

ENP48

CURCUMIN-EMBEDDED SILVER NANOPARTICLES FROM TURMERIC MITIGATE ATHEROSCLEROSIS IN MACROPHAGE CELL MODELS

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Abstract

Atherosclerosis is the most typical kind of cardiovascular disease (CVD), the main characteristics of atherosclerosis include inflammation of the main arteries and cholesterol accumulation, which can

ultimately result in myocardial infarction (MI) and stroke, two of its clinical consequences. Macrophages play a central role in disease progression by internalizing oxidized low-density lipoprotein and transforming into foam cells. Curcumin, a polyphenolic compound in *Curcuma longa*, possesses potent antioxidant, anti-inflammatory, and lipid-regulating properties. However, low bioavailability limits its therapeutic use, this can be addressed via nanoparticle-based administration.

Cur-AgNPs were synthesized and characterized using UV–Visible spectroscopy and DLS (Dynamic Light Scattering). Standard biochemical tests, like protein denaturation and proteinase inhibition were employed to evaluate antioxidant and anti-inflammatory properties. Cytotoxicity was evaluated by MTT assay in macrophages (RAW 264.7) to determine the IC₅₀ concentration. Anti-atherosclerotic efficacy was investigated employing Oil Red O staining for lipid buildup and the Griess assay for nitric oxide production.

Cur-AgNPs exhibited a characteristic surface plasmon resonance peak at 450 nm, confirming nanoparticle formation. Particle sizes between 85 nm to 95 nm with a zeta potential of -25.6 mV were found in DLS analysis, indicating high colloidal stability. The MTT assay demonstrated IC₅₀ of 165 µg/mL and 185 µg/mL of Cur-AgNPs and Tur-extract respectively. Cur-AgNPs demonstrated increased anti-atherosclerotic effect in palmitic acid-induced *in-vitro* cell models, where treatment reportedly decreases the intracellular lipid accumulation in the oil red O assay and altered nitric acid production in the Griess reagent test.

Cur-AgNPs showed improved antioxidant, anti-inflammatory, and anti-atherosclerosis properties by reducing lipid buildup and inflammatory reactions in macrophages. These results imply that Cur-AgNPs are a promising nanotherapeutic strategy for atherosclerosis prevention.

Keywords: Curcumin, Atherosclerosis, Macrophages, Silver nanoparticles, Cytotoxic effect.

ENP049

COMPREHENSIVE SCREENING AND CHARACTERIZATION OF PHYTOCONSTITUENTS FOR ANTI INFLAMMATORY PROPERTY FROM SIMAROUBA DC ETHANOLIC EXTRACT AND VALIDATION STUDIES

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Abstract:

Inflammation represents a major contributing factor to many chronic diseases. However, the long-term toxicity of anti-inflammatory drugs may impair their function. Despite their effectiveness, the prolonged use of these drugs comes with various side effects. Therefore, there is a growing demand for safer but effective anti-inflammatory drugs. Plants and plant based products have a rich history for their medicinal properties. Herbal medications have shown positive effects on inflammatory symptoms with minimal adverse reactions. *Simarouba DC* (SDc) a medicinal herb used extensively in indigenous medicine by various cultures, represents a rich source of various bioactive compounds with potential anti-inflammatory properties. An ethanolic extract of *Simarouba DC* was prepared using the Soxhlet Extraction method, and Qualitative and Quantitative analysis has performed with HR-LCMS. An in-silico study demonstrated that bioactive constituents and Pro-inflammatory targets binds with favorable binding affinity, HR-LCMS analyzes the active compounds in the extract. In Validation studies, SDc

exhibited the best scavenging capabilities in the antioxidant DPPH assay and their anti-inflammatory potential was checked using Protein Denaturation assay, Membrane Stabilization Assay, and Protease Inhibition Assay as anti-inflammatory activity. These findings demonstrate the potential of *Simarouba Dc* in exerting anti-inflammatory effects, as supported by Biochemical assays and in silico studies. Further mechanistic research is necessary to validate the therapeutic potential of all phytoconstituents in inflammatory treatment.

Keywords: Simarouba DC, Anti-inflammatory activities, In-silico Studies, Soxhlet extraction.

ENP050

INFLUENCE OF GLOMUS MOSSEAE AND GLOMUS FASCICULATUM ON PHYTOCHEMICAL PRODUCTION AND ANTIMICROBIAL ACTIVITY OF CYMBOPOGON CITRATUS

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Abstract

Cymbopogon citratus (DC.) Stapf, commonly known as lemongrass, is a perennial aromatic grass belonging to the family Poaceae. The plant samples used in this study were obtained from the Indian Institute of Horticultural Research (IIHR). Arbuscular mycorrhizal (AM) fungi served as the inoculum for the experiment. Pure culture of AM fungi was used for pot inoculation of the selected plant. Each treatment was performed in triplicate, and uninoculated control pots were maintained for comparative studies. Ten grams of inoculum of *Glomus mosseae* and *Glomus fasciculatum* (approximately 1,200 spores per pot) were added to the substrate mixture and placed at a depth of 15 cm immediately before planting the selected host plants. The plants were watered regularly, and observations were recorded after 30, 60, and 90 days. The plant materials were shade dried until all the water content evaporated and plants became well dried for grinding. Using methanol as a solvent by the Soxhlet extraction method, the extract was obtained and tested for the presence of phytochemicals by standard methods. It was found that quinones, saponins and tannins were not found in 30 and 60 days control plant. It was found that alkaloids, flavonoids, phenols, terpenoids, cardiac glycosides, and carbohydrates were present in treated plants. The extracts had varied effect on selected bacterial and fungal growth. Among the fungi chosen *C. albicans* was found to be comparably susceptible than *A. niger*. It is found that GM+GF extract was found to be comparably significant in terms of its ability to suppress the growth of the test organisms.

Keywords: *G. mosseae*, *G. fasciculatum*, *Citratus cymbopogon*, antimicrobial activity, phytochemicals.

PRACTITIONER AWARENESS AND CLINICAL USE OF TRADITIONAL MEDICINAL PLANTS IN THE MANAGEMENT OF PCOS AND MENSTRUAL HEALTH

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Abstract

Polycystic ovary syndrome (PCOS) is one of the most common endocrine disorders affecting women of reproductive age and is frequently associated with menstrual irregularities, infertility, and metabolic disturbances. Alongside conventional medical treatments, various traditional medicinal plants have been historically used to support reproductive health and hormonal balance.

The study objectives are, to identify medicinal plants, herbs, and oil seeds used in traditional treatments for PCOS and menstrual health, to assess the awareness and clinical use of these plants by healthcare practitioners in management of PCOS and menstrual health.

Of the present study, 17 varieties of traditionally used medicinal plants, herbs, and oil seeds for the treatment and management of PCOS and menstrual health were identified through scientific literature survey. Awareness of their nutraceutical benefits and extent of clinical use among healthcare professionals, including allopathic doctors, ayurvedic doctors, naturopathy practitioners, and dietitians was assessed through e-survey using structured questionnaires. The questionnaire included details on demographic data, clinical experience with reproductive disorders, awareness of commonly reported medicinal plants, herbs and oil seeds, patterns of use, and forms of administration. Responses were collected and analyzed descriptively.

Among samples turmeric, tulasi, flax seeds, aloe vera, amla, fenugreek seeds, sesame seeds, sunflower seeds, shatavari, and fennel seeds were commonly grown in Karnataka. The cross-sectional survey showed that 43% of practitioners recommend traditional or plant-based remedies for PCOS and menstrual health. Among the 17 plants assessed, aloe vera (75%), amla (88%), tulasi (74%), shatavari (74%), sunflower seeds (83%), sesame seeds (90%), pumpkin seeds (85%), fennel seeds (83%), flax seeds (87%), and turmeric (81%) were the most recognized. Additionally, 79% recommend medicinal plants for amenorrhea and 88% for PCOS, while 15% use them alongside allopathic medications.

The findings indicate that many healthcare practitioners are aware of and use traditional medicinal plants for managing PCOS and menstrual disorders. The practitioners mentioned that turmeric, tulsi, flax seeds, amla, fenugreek, sesame seeds, sunflower seeds, fennel seeds, and shatavari show potential in improving treatment outcomes, reducing side effects, and supporting effective management of PCOS and reproductive health. These results highlight the need to revive traditional knowledge, increase the cultivation and production of medicinal plants, and promote further scientific research to validate their efficacy and safety.

Keywords: Polycystic Ovary Syndrome (PCOS); traditional medicinal plants; herbal therapy; reproductive health; practitioners' awareness

PHYTOCHEMICAL EXTRACTION AND ANTI-CANCER POTENTIAL OF *Ziziphus nummularia* SEED EXTRACT ON MDAMB-231 CELL LINES

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Abstract

The inclination towards traditional/herbal medicine for the treatment of various life-threatening diseases has become a substantial part of the research field. Cancer being one of the leading causes of morbidity and a global challenge for the health care systems. In spite of significant research and advanced technologies in conventional cancer therapy, limitations such as drug resistance, high cost, and immense side effects have intensified the research towards a safer, herbal, affordable and more effective therapeutic alternatives.

Medicinal plants have predominated as a great alternative to conventional sources, it's adversely effective for treatment of diseases over the decades and their importance have been highlighted by many of the ayurvedic and homeopathic medicine as well. One among such medicinal plant is a shrub of species *Ziziphus nummularia* belonging to genus *Ziziphus* and *Rhamnaceae* family.

The study aimed to evaluate the anti-cancer potential of the *Ziziphus nummularia* seeds on the cancer cell line MDAMB-231. Among the chemicals compounds determined 1,3,5-tricaffeoylquinic acid represents one of the most pharmacologically significant metabolites.

The Overall, LC-MS profile of the aqueous extract indicates that the HAE extract is particularly rich in polyphenolic compounds, flavonoid glycosides, quinic acid derivatives and heterocyclic metabolites, all of which are strongly associated with antioxidant, anti-inflammatory, antimicrobial and anticancer properties.

The MMT assay is used for anticancer analysis of the *Ziziphus nummularia* seed extract. The IC-50 value at different test concentration shows positive anticancer potential of the seed. The *Ziziphus nummularia* seeds, having various phytochemical compounds can be further investigated for research, clinical trials and development of herbal therapeutics.

Keywords: *Ziziphus*, therapeutic, anticancer and pharmacological.

QUALITY ASSURANCE AND VALUE ADDITION IN MEDICINAL PLANTS: A REVIEW ON BLACK GINGER, BLACK TURMERIC AND BLUE GINGER

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Abstract

Medicinal and aromatic plants are fundamental to traditional healthcare, the development of nutraceutical, and the expanding herbal bio-economy. However, issues such as species misidentification, adulteration, and inadequate quality control systems continue to compromise product efficacy, safety and market value. This review consolidates recent advancement in authentication strategies and bioactive evaluation of black ginger (*Kaempferia parviflora*), black turmeric (*Curcuma caesia*), and blue ginger (*Dichorisandra thyrsiflora*), with emphasis on strengthening quality assurance and value addition.

Morphological characterization, encompassing attributes such as rhizome colour, odour, leaf architecture, and inflorescence traits, remains a preliminary tool for identification; however, its inherent limitations necessitate integration with advanced analytical techniques. Chromatographic fingerprinting methods such as high-performance liquid chromatography (HPLC), high-performance thin-layer chromatography (HPTLC), Fourier transform infrared spectroscopy (FTIR), and gas chromatography-based electronic nose systems provide reliable chemical profiling and species differentiation. The identification of distinct marker compounds, notably 5,7-dimethoxyflavone in *K. parviflora*, has significantly enhanced authentication precision.

Furthermore, research on blue ginger essential oil highlight its significant antioxidant potential, with compounds such as α -terpineol, eucalyptol, α -elemene, myrtenol, and camphor exhibiting potent radical scavenging activity. Structure–activity relationship analyses indicate that hydroxyl and oxygenated functional groups are pivotal to its antioxidant efficiency.

The integration of morphological, chemical, and bioactivity-based approaches establish a robust framework for quality assurance, prevention of adulteration, and value addition. Such strategies are vital for ensuring therapeutic reliability, supporting conservation efforts, and strengthening the economic sustainability of the medicinal plant sector.

Keywords: MAP, quality assurance, species authentication, chromatographic fingerprinting, GC electronic nose, antioxidant activity, radical scavenging; bioactive compounds, herbal standardization.

NATURE'S NUTRI-PHARMACY: AWARENESS AND SPATIAL DISTRIBUTION OF INDIGENOUS MEDICINAL PLANTS WITH ANTICANCER POTENTIAL FROM KODAGU DISTRICT

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Abstract

The Western Ghats of India, specifically the Kodagu district, are a reservoir of indigenous medicinal plants with significant bioactive and nutraceutical potential. However, rapid urbanization and a decline in traditional ecological knowledge threaten the conservation and utilization of these therapeutic resources.

To map geographical distribution of selected medicinal plants with anti-cancer potential in Kodagu region, to assess the knowledge and awareness of people on utilization of these medicinal plants.

A literature survey was conducted to identify 16 indigenous medicinal plants with anti-cancer efficacy. Their presence in specific locations of the Kodagu district was documented through field photographs and geo-spatial distribution. Traditional knowledge on their usage was gathered from folk medicine practitioners. A structured questionnaire was developed to assess public awareness and usage. The questionnaire included sections on demographic details, awareness of these indigenous plants and forms of administration. Responses were collected and analysed descriptively.

Geo-spatial analysis showed that all 16 species were distributed throughout Kodagu district, showing the accessibility to the plants. The exact location co-ordinates will help in guarding and enhancing the flora species growth and availability. Most of them were used by folk medicine practitioners. Survey revealed a majority of people were unable to identify key medicinal plant species, among identified most notably was *Garcinia gummi-gutta* (72.29%), *Justicia adhatoda* (69.15%), and *Artocarpus hirsutus* (62.86%). The preparation method or mode of consumption revealed that still the traditional preparations is followed, like Kashaya (10.1%), juices (9.6%), and playas (18.7) to culinary applications such as pickles (5.8%) and snacks (2.6%). Over 50% of respondents exhibited a lack of awareness regarding the optimal forms of utilization for these species.

This study identifies the location and geo-spatial distribution of selected indigenous medicinal plants Kodagu region. The results also reveal the knowledge deficit and underutilization of these medicinal plants with enormous therapeutic and nutritional benefits. There is a need for bridging the nutritional literacy and validating the anti-cancer and possibly other therapeutic efficacy of these medicinal plants. The sustainability of these medicinal plants production through geographical distribution mapping and systematic scientific validation wil enable to establish the potential biological activity and development of these medicinal plants as nutraceutical agents for disease preventive and health benefits.

Keywords: Nutraceutical, Medicinal plants, geo-spatial mapping, Western Ghats, sustainabilitiy, traditional plants

NUTRITIONAL COMPOSITION AND HEALTH BENEFITS OF SOLANUM TORVUM (TURKEY BERRY): A REVIEW OF ITS BIOACTIVE AND THERAPEUTIC POTENTIAL

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Abstract

Solanum torvum also known as the Turkey berry, is a perennial shrub belonging to the Solanaceae family that originated in tropical West Africa and has since spread to Asia, South America, and India. It is a nutrient-dense vegetable and a staple in ethnomedicine.

In India, it is commonly sun-dried and used as “sundakkai” in South Indian cooking. Its small green berries are rich in protein, dietary fiber, vitamins C and A, minerals iron and calcium, and bioactive compounds like flavonoids, saponins, steroids, phenolics, and torvosides.

It has several health benefits and can help treat fever, infections, diabetes, anemia, digestion, and even cancer prevention.

The primary objective of this study was to review the nutritional composition of Turkey berry, including their important vitamins, minerals, dietary components, and phytochemicals.

Relevant research publications on Turkey berries were gathered using scientific resources such as Google Scholar, PubMed, and ResearchGate. The selected literature was examined in order to compile information on the nutritional characteristics and bioactive components present in *Solanum torvum*. A thorough picture of Turkey berries' nutritional composition was created by evaluating and combining the findings of multiple studies.

The reviewed studies indicate that turkey berry is rich in essential nutrients, including iron, vitamins, and minerals, along with bioactive phytochemicals such as flavonoids, phenols, and alkaloids. These compounds contribute to its strong antioxidant activity and suggest that turkey berry may have potential therapeutic benefits in the management of conditions such as anemia and diabetes. Overall, the evidence highlights its value as a nutritionally and pharmacologically important plant with possible applications in improving health outcomes.

In summary, *Solanum torvum* is a highly nutritious plant containing essential vitamins, minerals, dietary fiber, and several bioactive compounds. These phytochemicals contribute to its antioxidant and therapeutic properties, supporting its traditional use in managing conditions such as anemia and diabetes. The findings highlight the potential of turkey berry as a functional food that can contribute to better nutritional and health outcomes.

Keywords: Turkey berry, Nutritional composition, Antioxidant activity, Functional food, Iron-rich food

PHYTO-SYNTHESIZED COPPER AND ZINC NANOPARTICLES USING *Syzygium cumini* LEAF EXTRACT AS NANO THERAPEUTICS AGAINST CARBAPENEM RESISTANCE *Acinetobacter baumannii*

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Abstract

Multidrug resistance (MDR) has emerged as a major global health challenge, limiting therapeutic options, increasing medical costs, and reducing the effectiveness of currently available antibiotics. Among MDR pathogens, *Acinetobacter baumannii* has become a serious concern due to its ability to survive in hospital environments, rapidly acquire resistance mechanisms, and spread easily, particularly in intensive care units (ICUs). In recent years, green synthesis of metal nanoparticles using plant extracts has gained attention as an eco-friendly and sustainable approach for developing novel antimicrobial agents. The present study aimed to synthesize copper and zinc nanoparticles using ethyl acetate leaf extract of *Syzygium cumini* and evaluate their antimicrobial potential against MDR pathogens. Fresh leaves of *Syzygium cumini* were collected, shade-dried, and powdered, followed by extraction with ethyl acetate. The obtained extract was used for the biosynthesis of copper and zinc nanoparticles through the reduction of their respective metal salts. The synthesized nanoparticles were characterized using appropriate physicochemical techniques and further evaluated for antimicrobial activity against MDR *Acinetobacter baumannii*. The results demonstrated that the biosynthesized nanoparticles exhibited significant antimicrobial activity, suggesting their potential as alternative therapeutic agents against MDR bacterial infections. In this study plant mediated synthesis of copper and zinc nanoparticles. Bioactive compounds were extracted using ethyl acetate through the cold maceration method. The obtained extract was used as a reducing and stabilizing agent for the synthesis of copper and zinc nanoparticles under controlled conditions. synthesis of copper and zinc nanoparticles was confirmed by visual colour change Uv-visualization and characterisation using SEM, FTIR, XRD and SEM EDX.

Antimicrobial activity of copper and zinc nanoparticles was evaluated for antimicrobial activity against carbapenem resistance *Acinetobacter baumannii* strains using standard agar diffusion and minimum inhibitory concentration (MIC) methods showing effective nanoparticle formation mediated by phytochemicals present in the Jamun extract, including phenolic compounds, flavonoids, and tannins. Both copper and zinc nanoparticles showed antibacterial activity, carbapenem resistance *Acinetobacter baumannii* with zone of inhibition----- 18 and 16mm. These biosynthesized nanoparticles could serve as promising candidates for the development of alternative antimicrobial agents to combat multidrug-resistant bacterial infections. Further characterization and toxicity studies are required to explore their biomedical applications.

BIOACTIVE POTENTIAL AND CYTOTOXICITY ASSESSMENT OF *Derris canarensis* BARK EXTRACTS ON HEK-293 CELLS

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Abstract:

Derris canarensis is a medicinal plant belonging to the Fabaceae family and is recognized as a promising source of bioactive phytochemicals with potential therapeutic applications. The present study aimed to evaluate the cytotoxic activity of aqueous and methanolic bark extracts of *Derris canarensis* using the MTT assay on HEK-293 cells. The extracts were tested at concentrations ranging from 10 to 500 µg/mL, and cell viability was determined following treatment. Both extracts exhibited a concentration-dependent reduction in cell viability, indicating cytotoxic potential. At lower concentrations, the aqueous and methanolic extracts maintained approximately 35–43% cell viability, whereas the standard drug cisplatin showed approximately 11–15% cell viability under comparable conditions. The methanolic extract demonstrated comparatively higher cytotoxic activity than the aqueous extract. These findings suggest that *Derris canarensis* bark contains bioactive constituents capable of exerting cytotoxic effects in vitro. Further phytochemical characterization, isolation of active compounds, and evaluation using human cancer cell lines are warranted to validate its anticancer potential and elucidate the underlying mechanisms of action.

Keywords: *Derris canarensis*, MTT assay, cytotoxicity, HEK-293, bark extract, phytochemicals.

PHYTOCHEMICAL ANALYSIS, ANTIMICROBIAL AND ANTI-INFLAMMATORY ACTIVITY OF *LEUCAS ASPERA* LEAF EXTRACTS

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Abstract

The study aims to screen phytochemical constituents, and evaluate the antimicrobial and anti-inflammatory capacities of different solvent extracts of *Leucas aspera* leaves.

Leucas aspera leaves were collected, shade dried, finely powdered, and subjected to phytochemical extraction using methanol, ethanol, water, and hydro-alcohol. From the extracts, phenol content was estimated by the Folin-Ciocalteu reagent method followed by antimicrobial activity by Kirby-Bauer

and Micro dilution assay with four different pathogenic bacteria. Anti-inflammatory activity was performed by various enzymatic assays.

Phytochemical screening of *Leucas aspera* extract confirmed the presence of alkaloids, flavonoids, phenols, and tannins. The hydroalcoholic (MIC:12.5 µg/ml; MBC: 25µg/ml) and ethanolic (MIC:6.25 µg/ml; MBC:12.5 µg/ml) extracts presented effective antimicrobial activity against *Escherichia coli*, *Staphylococcus aureus*, *Streptococcus mutants*, and *Propionibacterium acne*. Amongst in vitro anti-inflammatory assays, hydroalcoholic extracts showed effective albumin denaturation (183.8±31.6µg/ml), heat-induced haemolysis (213.4±22.3µg/ml) and considerable hypotonicity-induced haemolysis (277.8±29.9µg/ml). The results were expressed as mean ± standard deviation and statistical interpretation was based on two-sided tests at a p d” 0.05 significance level.

The study reveals that *Leucas aspera* holds a variety of valuable secondary metabolites, which embraces strong anti-microbial and anti-inflammatory activities, however further studies are necessary to assess its therapeutic use.

Keywords: Anti-Inflammatory, Anti-microbial, *Leucas aspera*, Medicinal plant, Phytochemical.

ENP59

HARNESSING THE NUTRACEUTICAL POTENTIAL OF INDIAN PENNYWORT (*Centella asiatica*) THROUGH FUNCTIONAL DARK CHOCOLATE DEVELOPMENT

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Centella asiatica (Indian pennywort), commonly known as Gotu kola, Mandukaparni, Vallarai and Ondelaga, is a medicinal herb widely recognized for its rich content of bioactive triterpenoids, flavonoids and antioxidant compounds, which contribute to its diverse pharmacological and therapeutic properties. which have been associated with wound healing, cognitive support and anti-inflammatory effects. Leveraging these properties, this study developed and evaluated a functional dark chocolate enriched with processed Indian pennywort leaf for enhanced nutritional and therapeutic value. Fresh *Centella asiatica* leaves were subjected to several processing methods; steam blanching produced the most desirable natural green colour, with colorimetric values $L^* = 54.09$, $a^* = -7.45$ and $b^* = 29.88$. The processed herb was incorporated into dark chocolate at six inclusion levels (0%, 2%, 4%, 6%, 8% and 10%) and assessed for Organoleptic acceptability, physicochemical characteristics, nutritional composition, antioxidant capacity and antimicrobial activity A 9-point hedonic sensory evaluation with 21 trained panellists identified the 8% herb incorporation as the optimal formulation, delivering the highest overall acceptability and sensory scores. Compared with the control (0% herb), the optimized 8% Indian pennywort dark chocolate (IPDC) exhibited notable textural changes, reduced hardness (22.08 N vs. 38.70 N), lower fracturability (4.86 N vs. 16.66 N) and decreased adhesiveness (-0.004 Ns vs. -0.008 Ns) indicating a softer, more palatable bite. Nutritionally, IPDC showed increased crude fiber (10.10 g/100 g vs. 8.27 g/100 g) and ash content (5.00 g/100 g vs. 4.03 g/100 g). Antioxidant

activity approximately doubled in the enriched formulation (3.25 mg AAE/g) compared with the control (1.62 mg AAE/g), attributable to Centella's triterpenoids. The IPDC also demonstrated antimicrobial efficacy, producing inhibition zones against *Bacillus subtilis* (16.00 mm), *Staphylococcus aureus* (13.67 mm) and *Escherichia coli* (11.00 mm). Incorporating 8% steam-blached *Centella asiatica* into dark chocolate produced a consumer-acceptable functional confection with enhanced nutritional, antioxidant and antimicrobial properties.

Keywords: Triterpenoids, 8% herb inclusion, optimal formulation, overall acceptability, sensory evaluation

ENP60

VALORISATION OF TENDER JACKFRUIT: A SUSTAINABLE APPROACH TO ENHANCING NUTRITIONAL AND HEALTH BENEFITS

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Abstract

Tender jackfruit represents a versatile yet underutilized bio resource in India, with substantial scope for value addition to improve health outcomes and rural livelihoods. Despite its rich nutrient profile, bioactive compounds, commercial processing and functional food applications utilization of tender jackfruit remain limited. In this context, the present study sought to valorize tender jackfruit through development of flour from two selected varieties (HV2 and TCV) and evaluate its nutritional, functional and health-promoting attributes. Tender jackfruit was subjected to nine pre-treatments with different concentrations of KMS and citric acid (0.1–0.5%). Among pre treatments, blanching with 0.5% KMS followed by drying at 60°C was most effective in reducing enzymatic browning. Nutrient analysis indicated that HV2 flour contains 5.86 g protein, 1.16 g fat, 11.43 g crude fibre and 84.39 g carbohydrates per 100 g, with TCV showing comparable macronutrient composition and marginally higher fibre content. Phytochemical profiling revealed that HV2 possessed markedly higher total polyphenols (679 mg GAE/100 g), antioxidant activity (301.4 mg AAE/100 g) and elevated levels of gallic, chlorogenic and ferulic acids, as well as lutein and α -carotene. Starch analysis further demonstrated higher total (38.49%) and resistant starch (8.62%) with a lower predicted glycemic index (52.53) in HV2. Enzymatic assays confirmed α -amylase (93.48%) and α -glucosidase (76.62%) inhibition, highlighting its potential for glycemic modulation. Based on its functional superiority, HV2 flour was incorporated (10–15%) into commonly consumed products such as *Chapathi*, Ragi dumpling, Pasta and Noodles, with favourable sensory acceptability, particularly at 15% incorporation in *Chapathi*, Pasta and Noodles. *In vivo* evaluation among prediabetic individuals demonstrated significantly reduced postprandial glucose AUC (1811) relative to control (2510), confirming improved glycemic regulation. The development of tender jackfruit flour therefore offers a shelf-stable, diabetes-friendly functional ingredient that simultaneously promotes health benefits and creates avenues for value addition, income generation and livelihood enhancement for jackfruit-growing rural communities.

Key words: Tender jackfruit, Valorisation, Functional flour, Nutrient composition and Glycemic response

DEVELOPMENT AND EVALUATION OF A SYNERGISTIC ESSENTIAL OIL FORMULATION FOR THE CONTROL OF *Musca domestica* IN POULTRY PRODUCTION SYSTEMS

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Abstract

The housefly, *Musca domestica* L. (Diptera: Muscidae), is a major insect pest in poultry production systems and serves as a mechanical vector of numerous pathogenic microorganisms affecting both animal and human health. The indiscriminate use of synthetic insecticides for housefly management has led to the development of insecticide resistance, environmental contamination, and adverse effects on beneficial organisms, emphasizing the need for sustainable and eco-friendly alternatives. The present study aimed to develop and evaluate synergistic essential oil formulations for the effective management of *M. domestica* under laboratory and field conditions. The combination of *S. aromaticum*, *R. officinalis*, and *P. nigrum* exhibited the highest insecticidal activity, with LC₅₀ values of 5.401% for larvae, 5.75 % for pupae, and 3.217 % for adults, indicating superior efficacy across all developmental stages. Gas Chromatography–Mass Spectrometry (GC–MS) analysis identified major bioactive constituents, including eugenol, α-caryophyllene, and piperine, which are known for their insecticidal, neurotoxic, and synergistic properties. Molecular docking studies further supported these findings by demonstrating strong binding interactions between selected phytochemicals and key insect target proteins, suggesting their potential mechanism of insecticidal action. The optimized formulation was further evaluated for cytotoxicity using the protox 3 bioinformatics tool and for non-target safety against earthworms (*Eisenia fetida*) and honeybees (*Apis cerana*). The formulation exhibited negligible toxicity towards non-target organisms compared with the synthetic insecticide control. Field evaluation in poultry farms confirmed a significant reduction in housefly populations following application of the optimized essential oil formulation. The results demonstrate that the synergistic combination of *S. aromaticum*, *R. officinalis*, and *P. nigrum* essential oils represents a promising, environmentally safe, and sustainable botanical insecticide for integrated housefly management in poultry production systems.

Keywords: essential oils, synergistic combination, houseflies, GC-MS analysis, insecticidal activity

USER-CENTERED DESIGN FOR DIGITAL TRACEABILITY SYSTEMS IN MEDICINAL AND AROMATIC PLANT SUPPLY CHAINS

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Abstract

Medicinal and Aromatic Plants (MAPs) constitute a significant component of traditional medicine systems and the global herbal economy. However, MAP supply chains frequently face challenges such as product adulteration, lack of transparency, and difficulties in verifying the origin of plant materials. Digital traceability systems have emerged as potential solutions to address these issues by enabling the tracking of products across multiple stages of the supply chain. Despite these technological developments, many traceability platforms focus primarily on technical infrastructure and data management while overlooking the usability needs of farmers and collectors who interact with these systems. This paper explores the role of user experience (UX) design in improving the accessibility and effectiveness of digital traceability tools for MAP supply chains. Using a literature review and conceptual analysis of existing digital traceability systems, the study identifies key gaps in current platforms, including complex data entry processes, lack of farmer-centered interfaces, and limited information transparency for producers. Based on these findings, the paper proposes a conceptual UX framework that emphasizes simplified data entry, icon-based interaction, audio guidance, and farmer-oriented information dashboards. The proposed framework demonstrates how integrating UX principles into digital traceability platforms can improve adoption, enhance supply chain transparency, and support sustainable medicinal plant trade.

Keywords: Medicinal and Aromatic Plants (MAPs); Digital Traceability; User Experience Design; Supply Chain Transparency; Farmer-Centered Design

AGRONOMIC PRACTICES INFLUENCING GROWTH, ESSENTIAL OIL YIELD AND QUALITY OF *Pelargonium graveolens* L'Hér.: EMPHASIS ON DRIP FERTIGATION

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Abstract

Pelargonium graveolens L'Hér. (rose-scented geranium) is an economically high demand aromatic-cum-medicinal crop extensively cultivated for its high-value essential oil, which is widely used in the

fragrance, flavour, pharmaceutical, cosmetic and aromatherapy industries. EO yield and quality are greatly influenced by agronomic practices, particularly nutrient and water management. Various approaches, including foliar application of sulphur (3.44 mmol L⁻¹) and phosphorus (2.2 mmol L⁻¹), optimization of nitrogen use efficiency through December planting (50 kg N ha⁻¹), row spacing and intercropping with cornmint, planting at 30 × 30 cm spacing with harvesting at 120 days, nano urea (0.5 mL L⁻¹) with 15 kg ha⁻¹ neem-coated urea and integrated nutrient management, have been evaluated, among these practices, nano urea combined with neem-coated urea produced the highest herbage yield (1.53 kg plant⁻¹); however, this increase was not accompanied by a proportional improvement in essential oil yield. In contrast, drip fertigation recorded a herbage yield of 1.36 kg plant⁻¹ while producing substantially higher essential oil yield, along with improved aroma profile and antioxidant activity under integrated nutrient management. Overall, drip fertigation integrated with balanced organic and chemical fertilization proved superior to other agronomic practices, offering a sustainable and eco-friendly for maximizing essential oil yield and quality in rose-scented geranium.

Keyword: Aromatic and Medicinal plant, Essential oil, Drip Fertigation and oil yield

ENP64

EMBELIN FROM *Embelia ribes* CAN MODULATE ATM SIGNALLING IN NICOTINE-TREATED PANCREATIC DUCTAL ADENOCARCINOMA

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Abstract

Pancreatic cancer is a lethal malignancy with a 5-year survival rate of less than 5%. Gemcitabine is currently used to treat pancreatic cancer, and chemoresistance is a major obstacle to overcoming pancreatic cancer. Nicotine is a known inducer of drug resistance in the pancreatic tumour micro-environment. The present study reports chemoresistance conferred by nicotine on gemcitabine and chemosensitization using Embelin, a benzoquinone from *Embelia ribes*. To develop nicotine-induced chemoresistance, PANC-1 and MIA PaCa-2 were treated with nicotine followed by gemcitabine. Gemcitabine sensitivity assay, migration assay, clonogenic assay, Mitochondrial Membrane Potential (MMP) assay, dual staining assay, comet assay, ROS, and cell cycle analysis. Immunoblotting was performed to prove the protein expression involved in chemoresistance and chemosensitization. Epithelial-to-mesenchymal transition was observed in nicotine-induced chemoresistant cells. Gemcitabine sensitivity assay revealed that relative resistance was increased to 6.26 (p<0.0001) and 6.45 (p<0.0001) folds in resistant PANC-1 and MIA PaCa-2 compared to the control. Resistance markers like hENT1 and dCK were downregulated with a subsequent increase in RRM1 expression in resistant cells. Embelin decreased the cell viability with an IC₅₀ value of 4.03 ± 0.08 iM in resistant PANC-1 and 2.11 ± 0.04 iM in resistant MIA PaCa-2. Cell cycle analysis showed cell cycle arrest at the S phase in resistant PANC-1 cells; in resistant MIA PaCa-2 cells, there was an escalation in the Sub G1 phase. Embelin upregulated Bax, ̑H2AX, p53, ERK1/2, and hENT1 expression with

concomitant downregulation of Bcl-2 and RRM1. Bioactive molecule embelin, in combination with gemcitabine, could provide new vistas to overcome chemoresistance in pancreatic cancer.

Keywords: Pancreatic cancer, Gemcitabine, Nicotine, Embelin, Chemoresistance, Chemo-sensitization.

ENP65

THE DISCLOSURE GAP: UNDISCLOSED COMPLEMENTARY AND ALTERNATIVE MEDICINE USE IN CHRONIC NON-COMMUNICABLE DISEASES IN INDIA — A STRUCTURED NARRATIVE REVIEW

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Abstract

National Health Policy aims for integrating AYUSH into mainstream healthcare. However concurrent complementary and alternative medicine (CAM) use among patients with chronic non-communicable diseases (NCDs) often remains undisclosed to treating physicians.

To synthesise the available evidence on the prevalence of CAM use, disclosure practices, determinants of non-disclosure, and the clinical and policy implications of undisclosed CAM use among adults with chronic NCDs in India.

A structured narrative review was conducted following the PRISMA 2020 reporting framework. PubMed, Scopus, Google Scholar, and relevant government and WHO publications were searched using predefined Boolean search strategies combining terms related to CAM/AYUSH, chronic NCDs, disclosure, and patient-provider communication. Eligible English-language studies published within the preceding ten years were synthesised thematically.

Forty studies met the eligibility criteria. CAM utilisation varied substantially across populations and study settings; however, concurrent use of AYUSH and conventional medicine consistently emerged as a common healthcare-seeking behaviour. Disclosure of CAM use to treating physicians remained consistently low and was associated with cultural beliefs, perceived safety of traditional therapies, fear of physician disapproval, and inadequate clinician enquiry. Undisclosed concurrent CAM use raised concerns regarding medication reconciliation, potential herb-drug interactions, pharmacovigilance, and continuity of care. A policy-practice paradox was identified whereby institutional integration of AYUSH has expanded, while routine clinical communication regarding concurrent CAM use has not kept pace.

Bridging the disclosure gap through routine clinician enquiry, public awareness, standardised documentation, strengthened pharmacovigilance, and patient-centred implementation research will be essential to achieving clinically safe, transparent, and evidence-informed integrative healthcare.

Keywords: Complementary and Alternative Medicine (CAM), Chronic Non-Communicable Diseases, Herb-Drug Interactions, Integrative Healthcare

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